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SANTA CRUZ COUNTY,

ARIZONA

THE OLDEST MINING REGION OF RECORD ON THE PACIFIC SLOPE OF THE UNITED STATES

By Allen T. Bird

It is not known generally that the area embraced now within the limits of Santa Cruz County, Arizona, was the seat of the earliest mining known on the Pacific Slope of the United States; but such is an historic fact. Without doubt the first and earliest mining in these regions was done by the Jesuits who founded a chain of missions in the Valley of the Santa Cruz River and farther south in Mexico. According to

"La Historia del Nayarit,"

an account of the "labors of the Society of Jesus in Sempitronial America," which work was written by Fra Ortega, one of that order, and published at Barcelona, Spain, about 1754, Father Eusebio Kino, whose name has been immortalized by his great work, whose memory is embalmed in history as "the Apostle to the Pima Indians," came from the City of Mexico in 1686, and locating in 1687 a mission at a point about thirty miles south of the present international boundary between the United States and Mexico he named the mission and the river beside whose banks it stood, one the Mission Dolores, and the other Rio Dolores. From that point as a base of operations the devoted missionary established missions at Cocospera, Remedios, Santa Barbara (the latter on the Santa Cruz River, close to the international boundary, but a few miles eastward from Nogales, the county seat of Santa Cruz, right at the line).

JESUIT MISSIONS

In the Santa Cruz Valley, below the Santa Barbara Mission, Fra Kino built four other missions, the first at San Felipe Guevavi, about nine miles northeast of Nogales; another at San Cayetano del Tumagacori, about nineteen miles northwest from the same town; a third at Santiago, the site of which point is not known accurately now; and the fourth at San Xavier del Bac, nine miles south of Tucson. San Xavier has been restored by the federal government, and it is one of the show places in Arizona, thousands of interested tourists visiting it annually. It is a church of great size and beauty, its interior magnificent-

ly ornamented; and it is said that the silver plate upon the altar was worth at least $40,000.

The old church at Tumacacori (as the place is known now) is a ruin, falling fast; the Guevavi mission is a shapeless mound, while the site of the Santiago Mission is unknown.

Father Kino extended his explorations beyond the Gila River, and established a chain of missions in the Valley of the San Pedro River, but for the purposes of this bulletin nothing further need be written of them.

In the vicinity of each mission was a *presidio,* or military post, with a garrison sufficiently strong for protection of the surrounding region from the marauding Apaches, who occupied regions beyond the San Pedro and the Gila, whence they were wont to make excursions of rapine and ravage into the country of the Pimas and the Papagoes, peaceable Indians occupying these regions, who readily embraced Christianity, coming easily under the domination of the gentle priests. Those Indians were tillers of the soil and laborers. From among them were drawn the workers in the mines and on the ranches that the friars and laymen among the Spaniards discovered and exploited. Tubac, on the Santa Cruz, twenty-two miles from Nogales, was the *presidio* near Tumacacori, and recently there have been unearthed there a lot of old, rusty twelve-pound cannon balls that were no doubt for use in some of the artillery of the garrison. Tucson, which had been the site of an Indian village, was the *presidio* for protection of the country surrounding.

According to the history of that time, and the records of the mission, now preserved in Spain, the friars at Tumacacori discovered and wrought

RICH SILVER MINES

in the Santa Rita Mountains, to the northeast, and in the Atascosa Mountains, on the southwest. The Salero mines and other properties in the Santa Ritas are known to have been operated by the friars, and in places vestiges of their workings are found yet today. In recent years a party from California having a plat or map with a written description of the location, said to have come from the archives of the old mission, has been searching in the Atascosa Mountains for an abandoned mine that the record they have tells of having been exploited by the friars. Those operations are established to have been inaugurated very shortly after completion of the Mission church and cloister at Tumacacori in 1688. So there is presented the record of the

FIRST MINING

done on the Pacific Slope of the United States.

But the Jesuit priests and missionaries were not the only miners

among the successors of the conquistadores. In all parts of its American possessions the Spanish crown encouraged mining, offering every facility and giving military protection. Here, as elsewhere, hundreds of adventurous Spaniards prospected the hills and mountains, exploiting valuable mines paying readily to the treasury of the sovereign one-fifth and to the coffers of the church another fifth of their gross product. As their labor was very cheap, giving the Indians a bare subsistence, with which the latter were content, and their processes were crude and primitive, yet inexpensive, those heavy exactions were not really burdensome. Modern mining with high-priced labor and expensive machinery could not stand a tax of 40 per cent upon production.

Some historians have endeavored to minimize the labors of the Spanish during their occupation of this part of North America, and affect to have found no record of extensive cultivation of the lands, exploitation of the mines, or abundant population in those decades. But the record is against them. Ortega, in the *"Historia de Nayarit,"* recountes the baptism of thousands of Indians at various missions, and there are extant in the Spanish and Mexican archives many maps and accounts of the settlements on the Santa Cruz and San Pedro. In an address before the American Geographical and Statistical Society, in New York, in 1859, Sylvester Mowry, whose name is linked inseparably with the early history of American occupation, stated that he had in his possession a copy of an early Spanish map of the country, and that within the area comprised by the Gadsden Purchase, embracing the region south of the Gila River to the present international boundary, there were no less than

FORTY TOWNS AND VILLAGES,

many of them of considerable size. The original map, with accompanying notes, was made in 1757, sixty-nine years after the advent of Father Kino, and in his address Lieutenant Mowry stated that at that time it was in the archives of the Mexican government at their federal capital, his copy having been made from the original by Captain C. P. Stone, U. S. A. To quote Mowry:

"The Santa Cruz and its tributary valleys teemed with an agricultural and mining population. . . . . The notes referred to contain the names of more than one hundred gold and silver mines worked by the Spaniards. The survey by the Jesuit priest (Father Kino) about 1687 was repeated in 1710 with renewed accessions of population. From that time to 1757 conquest and settlement of the country were prosecuted with vigor by both the Jesuits' Society and the Spanish government."

Under Spanish domination the region described continued to pros-

per until the Mexican Revolution of 1810-20. For service against that finally successful revolt the Spanish government withdrew to the interior the troops that were the protection of Pimeria Alta, as the region was named, and they were not replaced by the revolutionary government which arose in succession. Then, in 1820, there came the

GREAT APACHE UPRISING

And the entire region with half of Sonora were devastated and harried with little cessation for more than a half century. Settlements were destroyed, mines abandoned, missions deserted, and the population nearly wiped out from existence. All the settlements within what became the Gadsden purchase, except Tucson and Tumacacori, disappeared, and in Sonora cities that numbered their population by thousands became mere villages. Arispe, one time the capital of all the Pacific Slope possessions of the Spanish crown, which had a population exceeding thirty thousand souls, fell in numbers to less than ten per cent of that enumeration.

With acquisition under the Gadsden Treaty in 1856, and occupation of the country by American troops, there came again the military protection necessary for peace and uninterrupted operation. With that assured attention was turned in this direction by American mining men, and several enterprises were inaugurated, meeting with more or less success.

That peaceful condition, however, continued but a few short years. At the outbreak of the Civil War, in 1861, the troops were wtihdrawn, the country was given over again to the Apache, mines, camps and settlements were attacked, their owners and help were murdered, and those who escaped destruction departed the country.

As soon as possible the Washington government restored military protection, and with the close of the Civil War, in 1865, attention was turned to making the country safe. A reservation was provided and the

APACHES WERE DRIVEN

upon it by force of arms. But occasionally a predatory band made a marauding excursion from the reservation, ravaging the country and seeking safety in the fastnesses of the Sierra Madre, in Mexico.

In 1880 the largest and most dangerous of the marauding bands was followed into Mexico and captured by American soldiers led by Captain Lawton. They were deported to Florida (as far away from the scenes of their devilment as was possible), and none of them were ever permitted to return to Arizona.

That effective policy brought the long desired peace, and there began for Arizona a new era of development and prosperity which continues yet without abatement.

In the operations following

AMERICAN ACQUISITION

in 1856, Tubac, on the Santa Cruz River, without doubt one of the oldest settlements in North America, assumed renewed importance and became quite a center of population. A number of companies operating mines in the mountains on either side made the place their headquarters.

Among those operating at that time was Charles D. Poston, who became afterward the first Delegate in Congress, after Arizona was created a Territory, in 1864 (cut off from New Mexico), who was managing a property in the Atascosa Mountains, now known as the Cerro Colorado Mine, which is in Pima County.

The Salaro Mines, worked in 1688 by the friars at the Tumacacori Mission, were taken up by a Cincinnati corporation, at its head John W. Wrightson, who had been business manager of the Cincinnati Enquirer. In 1861 Wrightson was killed by Apaches, as were Grosvenor and Hopkins, his superintendent and geologist, respectively, and operations were abandoned. The properties are in the Santa Rita Mountains, and have been worked until of late years. They are valuable yet, but the owners have died, and their estates have given no attention.

Contemporaneous with Poston and Wrightson was Sylvester W. Mowry, an army officer, who took up a group of mines in the Patagonia Mountains and established the Mowry Mining Camp. Lieutenant Mowry erected a reduction plant and produced a great deal of lead-silver bullion, which he transported by wagon to Guaymas, the seaport of the adjacent State of Sonora, in Mexico, and shipped by water to Swansea, Wales. During the Civil War Mowry was accused of treason to the United States and his property was confiscated. In later years the property passed to others, and it has been workd with good returns. It has been idle now a number of years, the later owners having become involved in litigation.

The mines at Duquesne and Washington Camp were worked also at about the same time as the Mowry, preceding the Civil War; and it is believed that some of the ledges in that vicinity were exploited by Mexicans previous to the time of the Gadsden Purchase.

Upon the west side of the Atascosa Mountains, in the extreme end of the county, adjacent to the Mexican border, lies the Oro Blanco region. Tradition has it that good gold placers were worked there in *antigua* days, but there is nothing authentic.

In the Greaterville region, on the northeast slope of the Santa Rita Mountains, there are also gold placers and quartz ledges bearing gold,

but mostly that mineral country lies across the line in Pima County.

GEOGRAPHY

Santa Cruz County is that political subdivision of the State of Arizont which abuts upon the international boundary about the center of the southern tier of counties. Its greatest length, east and west, is about fifty miles, and its greatest width is about thirty. Its chief drainage chanel is the Santa Cruz River, rising in the San Rafael Valley, between the Patagonia and Huachuca Mountains, in the southestern section. That river flows southward some miles into Mexico, makes a great bend around the base of the San Antonio Mountains, entering Arizona about five miles east of Nogales, continuing across the county in a northwesterly direction, skirting the western bases of the Patagonia, San Cayetano and Santa Rita Mountains with the Atascosa Mountains lying to the westward. The Santa Cruz River Valley is from two to four miles in width.

The chief confluents are the Sonoita River, Nogales Wash and Sopori Creek. The first named rises in the region eastward from the Santa Rita Mountains, in the summit of a low ridge connecting the Huachuca Mountains and the Santa Ritas, flowing in a general southwesterly direction, cutting through the depression between the Patagonia and Santa Rita Mountains, skirting the southern base of San Cayetano Mountain and joining the Santa Cruz near Calabasas, about nine miles north from the Mexican line.

Sopori Creek is in the northwest part of the county, flowing due east near the line between Santa Cruz and Pima Counties. The Oro Blanco region drains into the Altar River Valley of Sonoita. In the northeastern part of the county the Rain Valley drains eastward into the San Pedro River through Babacomari Creek, and northward to the Pantano Wash through Cienega Creek.

RAILWAY SYSTEM

consists of two branches of the Southern Pacific, the Benson-Nogales line, eighty-eight miles in length, entering the county near Elgin, about the northeast corner, crossing Rain Valley, passing between the Santa Rita and Patagonia Mountains, following the course of Sonoita River to Calabasas, where it crosses the Santa Cruz River, thence up Nogales Wash to the town of the same name; and the Tucson-Nogales line, fifty-eight miles long, to Calabasas, from which point both lines use the same track jointly.

A good system of wagon roads throughout the county is in course of construction, a road bond issue of $150,000 having been voted by the people in 1915, and the bonds sold at a premium. The

MOUNTAIN SYSTEM

embraces the Patagonia, Santa Rita and Atascosa Mountains, with the Canelo Hills and Grosvenor Hills. The Canelo Hills are a spur from the Huachuca Mountains, in the western foothills of which runs the east line of the county, and they separate the Rain and San Rafael Valleys. They connect the Huachucas with the Santa Ritas. The Grosvenor Hills are in an offshoot from the Santa Ritas extending toward the San Cayetano Mountains. The Patagonia and Santa Rita Mountains are practically a continuous chin, cut by the Sonoita Canyon, entending clear across the county in a northwesterly direction, and extending into Pima County nearly twenty miles. The Atascosa Mountains cross the county in a northwesterly direction westward from the Santa Cruz River. The mountains vary in height from 5,000 to 9,000 feet, Old Baldy, the highest peak in the Santa Ritas, reaching an altitude of 9,432 feet. The valleys are elevated, the lowest point being at Amado, near the Pima County line, which is about 3,000 feet above sea level. The

MINING DISTRICTS

are the Nogales and Patagonia Districts, abutting upon the international boundary, the latter covering the south end of the Patagonia Mountains; Palmetto District, on the west slope of those mountains, extending to the Rio Sonoita; Harshaw District, embracing the north end of the Patagonias; Red Rock District, extending from the Harshaw northeasterly to the Canelo Hills; Wrightson District, on the east side of the Santa Rita Mountains, extending to the Sonoita River, which flows there in a southerly direction; Tyndall District, on the west side of the same mountains, extending from the Sonoita northward into Pima County, including the Grosvenor Hills in its southern area; parts of Old Baldy and Greaterville Districts, which are in Pima County; San Cayetano District, covering the mountains of the same name; Pajarito District, at the south end of the Atascosa Mountains, Sopori District at the north end, and Oro Blanco District, on the western slope of the same range.

GEOLOGY

Within the area of the county there are presented in great variety both igneous and sedimentary rocks. In age they are said by geologists to range from pre-Cambrian to Recent, igneous rocks predominant areally. The sedimentary rocks have been folded extensively, upturned, faulted, fissured, metamorphosed, intruded by igneous masses and dykes of granular rocks, becoming important ore-bearing foundations. The most abundant of the intrusive rocks are granite, quartz monzonite, granite porphyry and rhyolite, although there are found

many more varieties, such as aplite, quartz latite, syenite, etc. These intrusive rocks occur in the mining districts, and with many of them are associated fissure vein that seem related with them in origin. Such fissure veins are numerous and widely distributed, being particularly plentiful along the west slope of the Santa Rita Mountains and in the Patagonia Mountains. They range from one to twenty feet in width, averaging about six feet. The

FISSURE VEINS

Cited, and metamorphic-contact or replacement deposits are the magma or gangue containing gold, silver, lead, copper, zinc, tungsten, molybdenum and other metals that are the cause and foundation of a mining industry which within this area has produced a great deal of wealth, and is destined to make Santa Cruz County one of the most important metal producing regions in Arizona.

To a great extent early development of the vein system presented a production of lead and silver, with slight percentages and traces of copper, which increased gradually as depth was attained; and in nearly all the mineral ledges or deposits in which development has reached any depth they have become

DISTINCTIVELY COPPER BEARING

In fact, microscopic examination of lead-silver ores from the surface deposits has demonstrated that originally they carried much more copper, and that they have been altered by percolation of surface waters seeking the depths dissolving and carrying the copper with them to the water level (metasomotism). The lead-silver mines at Duquesne, Washington Camp, Mowry, World's Fair, etc., in the Patagonia Mountains; and at Alto, Mansfield and other camps in the Santa Ritas, all give evidence of the metasomatic action noted. Where the veins and ledges predominate in copper from their very croppings it is plain that the metasomatism noted elsewhere has not occurred. Even in gold bearing sections, such as Oro Blanco, there are presented instances of metasomatic action—notably the Austerlitz Mine, which has produced gold and silver abundantly, but in the deeper workings has commenced producing copper.

In recent years there has been presented in the Patagonia Mountains a gratifying development of

COPPER BEARING PORPHYRY

Great masses of porphyritic rocks carrying finely comminuted particles of copper (chalcocite and chalcopyrite) disseminated evenly through the magma, giving low per centages of the metal, yet wrought easily and profitably when handled upon a great scale, as at Bingham, Utah, and Ray, Arizona, dependable for production of vast quantities of

the red metal, returning large dividends upon a heavy capitalization.

One of the great copper deposits mentioned is the noted "Red Hill," at the north end of the Patagonia Mountains, overlooking the town of Patagonia; the other is about a dozen miles south, upon the axis of the same range, not far from Duquesne and Mowry, but upon the west side of the summit. The first is a great mass—a mountain—of low-grade rhyolitic porphyry, carrying 1 per cent to 3 per cent copper, a proposition for working with steam shovels, railway trains, great concentrating mills and colossal smelting furnaces. The other, under development by the Red Mountain Copper Company, is overlaid by a thick shell of non-mineral rock of the same general texture and quality, which prevents the steam shovel, but the ore body may be handled by the

CAVING PROCESS

Eventually both of these "Red Hills" will become foundations of great copper producing industries.

Many of the ores produced from the veins, ledges and deposits of Santa Cruz County have proved rebellious and difficult for recovery of all the metalifferous values therein. Notably this has been true of ores carrying zinc along with the lead and copper. Where the zinc content was high and it went into the tailings the loss in values was the profit that was necessary if operation was to continue. In some instances the zinc lost in that way ran as high as 20 per cent of the weight of the rock. That problem seems to have been solved by the recently discovered and perfected process of concentration by

OIL FLOTATION,

as one such plant is in successful operation by the Duquesne Mining & Reduction Company, at Duquesne, about three miles north from the Mexican border in the Patagonia Mountains. The ores from other localities have been tested by this process, with results highly gratifying, and its adoption in all parts of the county is but a matter of a short time. So successful has been the process at Duquesne that the capacity of the plant is to be doubled at once.

This same company is inaugurating a new departure in the substitution of steam by electricity for driving its machinery, the "juice" to drive the motors being supplied from a central electric plant at Nogales, and conveyed by an electrical

TRANSMISSION LINE

a distance of nearly twenty miles. For driving their machinery several smaller properties on the line are arranging to purchase power; and the plans of the International Gas Company, operating the electric power plant at Nogales, contemplate ramifying their transmission lines to all

parts of the county and delivery of power wherever desired. The present plant, completed in November, 1915, consists of two great Diesel type internal combustion oil burning engines, each driving a colossal alternating current dynamo, each unit capable of developing 550 horsepower. As the transmission lines are ramified among the various camps other similar units will be installed. The advantage of this cheap and readily available power will be a great factor in mine operation and ore reduction, while the impetus it will give the industry in Santa Cruz County can hardly be measured in contemplation or anticipation. Instead of installing ponderous engines to drive mills, hoists, etc., and boilers to generate steam for power, maintaining heavy investments in machinery, fuel, labor cost, etc., a company can drive all its machinery at small cost with a few inexpensive motors and a short wire connecting with the main transmission line. The

NOGALES MINING DISTRICT

includes the region north of the international line and east from the Nogales Wash, to Calabasas and the Sonoita River on the north, the eastern boundary being a line extending in that direction from a point where the Santa Cruz River emerges from Mexico. It is about ten miles long and seven in width. It is an elevated region, a spur extending northward from the high divide between the Gila River basin and the coast of the Gulf of California. The highest point is Mount Benedict, some three miles north from Nogales, rising to an altitude of 4,500 feet; but the greater part of the area has an elevation less than 4,000 feet above sea level.

The mineralized area in the district is upon the slopes of Mount Benedict, and chiefly they are gold bearing, although silver, lead and tungsten have been found. The formation is quartz monzonite with intrusions of diorite, aplite, granite-porphyry, etc., with which most of the mineral deposits are associated. Near the Santa Cruz River there are placer beds from which some gold has been recovered.

In the workings near the surface of some of the ledges the ore is said to have been very rich, but it was in small quantities. One shipment from the Dura Mine, sent to the Selby smelter, in California, is said to have yielded thirty-five ounces gold per ton; three carloads shipped in 1903 averaged $600 gold to the car. In 1895 a prospector named Lichliter shipped eighty tons which averaged $50 gold per ton.

At a little depth the veins seem to pinch out, but the geological indications are that if followed down they will widen again, and become productive once more. So far as competent observers have given attention the ore occurrences are in lenticular form, and the surface open-

ings were the lower sections of a series of lenses that had been cut down with erosion of the surrounding region.

The principal properties are the Dura, Uncle Sam, Lion, Columbia, Float Gold and Reagan Mines. Near Guevavi, the site of one of the old Jesuit Missions, described hereinbefore, the Float Gold Amalgamating Company has a small stamp mill that was operated with considerable success in 1913. In the Reagan property there has been developed wolfram and scheelite (a shipment of which ores yielded about 50 per cent tungsten acid. The

PATAGONIA DISTRICT

is adjacent to the Nogales District on the east, and crosses the southern part of the Patagonia Mountains. The east and west width is about twelve miles and it extends northward from the Mexican border about eight miles. In elevation the mountains average about 5,500 feet, and the highest peaks reach 7,000 feet. They are precipitous, rugged and sparcely timbered with scrub oaks and juniper trees. As classified by geologists, the rock formations include Mesozoic limestone, quartzite, shale, etc., with intrusions of quartz monzonite (classified generally as syenite or granite), granite porphyry, diorite, etc., sedimentary Mesozoic rocks consisting of shales and arenaceous limestones; Tertiary rhyolite; and gravels and wash. As a rule mineralization accurs in or is associated with the intrusive rocks; but at Duquesne and Washington Camp they are a result chiefly of contact-metamorphic action.

The mineral deposits occur in a broad belt about six miles in width extending across the district in a northwesterly direction, following the trend of the mountain chain.

The district includes about forty promising groups of mines and mining camps, while the number of good claims and prospects runs up into the hundreds. Some of them are good producers now, and many have great records of production in former years. Among them may be mentioned the mines at Duquesne and Washington Camp, the Four Metals properties of the Red Mountain Copper Company, the Mowry Mines, Gross Group, Morning Glory, Old Soldier, Good View Mines (formerly Buena Vista), Santo Nino, Proto Group, Gladstone Mines, National Havelena, Creston, Skibo Development Company's properties, Golden Rose, Providencia, and many more. The

GREATEST DEVELOPMENT

is presented at the Washington-Duquesne Camp, where the Duquesne Mining & Reduction Company, of Pittsburg, Pennsylvania, is operating upon an extensive scale, and has penetrated to the greatest depth of any work in the district, with the greatest record of production. The camp lies about three miles from the international line, sixteen

miles from Nogales, and twenty miles south from Patagonia, on the east side of the main range of the Patagonia Mountains, the mines at altitudes varying from 5,000 to 6,000 feet.

Although less than a mile apart, Duquesne and Washington Camp were separate entities, the mines under various ownerships; but acquisition gradually of all the properties by one company has united the two into a single camp. The reduction plant is at Washington, and while the mines are all around both places the most important development and deepest workings are at Duquesne, an aerial tramway connecting the shaft with the mill.

Some of the claims were exploited before American acquisition, ruins of adobe smelters in the vicinity being witness to the fact; and others were known as producers more than forty years ago. In those days lead and silver were sought, and the ores extracted from near the surface were very rich in both metals. With depth and replacement by basic ores (sulphides carrying zinc and copper), profits disappeared and operations were suspended.

In the last decade of the Nineteenth Century the copper possibilities attracted attention, and the Westinghouse interest, as the enterprise is known, began acquisition of properties and development of ore deposits, gradually extending its holdings until there are embraced now under one ownership more than 1600 acres of good mining ground, embracing eighty claims, of which about forty are patented.

The main shaft, on the Bonanza property at Duquesne, is three-compartment, 635 feet deep, with extensive underground workings, exposing large and valuable ore bodies, from which there has been extracted many thousand tons of high-grade ores that paid to ship.

Acquisition of the Pride of the West properties and reduction plant at Washington Camp, in 1906, gave the Duquesne Company another highly developed property, with large facilities for treatment of ores. The Holland and the Belmont Mines, which were taken over about the same time, and the Empire, which came later, all gave the enterprise well developed claims, with large ore bodies demonstrated. Other properties not mentioned here added greatly to the known ore reserves.

THE PROBLEM

all along has been to find and apply a process that would reduce the ores economically and save all the values. Toward that end thousands of dollars have been expended in experimentation. As stated in another place, oil flotation has solved the problem, and the enterprise is about to enter upon a long period of unremitting profitable production.

The machinery equipment consists entirely of the best types of mechanical appliances, while plans adopted contemplate great and exten-

sive additions. In the course of a few years the industry will attain great growth and become highly productive.

The formation is one of great interest, the country rock being a great belt of limestone and quartzite surrounded by igneous upthrusts, the ore deposits occurring in the metamorphic contact rocks. They carry lead, zinc, sopper, silver and some gold.

In the vicinity are the Brooks-Fassig group of mines, the Line Boy group, the property of the Armada Copper Company, and the Santo Nino group, the latter the property of the Havalena Mining Company, in which there has been made a wonderful development of molybdenum ores. The

MOWRY MINES

are located on the east side of the Patagonia Mountains, about four miles north from Washington Camp. They are distinctively lead and silver producers, and have been worked to a depth of 500 feet. There are about 12,000 feet of underground workings, and a large and effective machinery equipment consisting of a smelting furnace, hoists, etc. Unfortunately a concentrating mill that was a part of the plant was destroyed by fire several years ago. Litigation and internal difficulties in the Santa Cruz Mines, Smelter & Transportation Company, which owned and operated the mines (also the Alto Mines in the Santa Rita Mountains) have caused suspension of operations through several years.

Tradition says that the Mowry was worked by the Jesuits during *antigua* times, but there is no record of the operation. The authentic account of early operation antedates the Civil War by two years, when Lieutenant Sylvester Mowry, U. S. A., commenced operation of the property and continued working about four years, erecting a reduction plant and shipping lead-silver bullion and high-grade ores to the value of about $1,500,000. This has been mentioned on a preceding page.

The formation is a fault contact between limestone and quartz monzonite, and the ore bodies are to a great extent replacement in the limestone. The ores are highly argentiferous lead combinations, and they have run high in values.

In the vicinity of Mowry are the Skibo, Cunningham, Endless Chain, Bullwhacker, Olive and other good properties. The Olive was a shipper of high-grade ores in the early '70's. The

FOUR METALS MINES

about three miles southwest of Mowry, on the west side of the main crest of the Patagonia Mountains, is one of the properties mentioned earlier in this account as a remarkable presentation of a large, low-

grade copper deposit, that will pay handsomely if worked on an extensive scale, with a great reduction plant, automotic in operation, handling ore in masses. It has been explored by a series of tunnels, three in number, with their various drifts, crosscuts, winzes, etc., aggregating more than a mile of work, proving to a depth of 600 feet below the croppings an extensive ore body that has been penetrated several hundred feet in all directions without reaching the utmost limits. There is in the gulch below a fourth tunnel site which will be developed shortly, giving a couple hundred feet more of "backs." Below that development will have to be by winzes, and there is no doubt that with the water level reached the character of the ores will change to copper sulphides, and very likely it will be found higher in grade. In fact, present development shows more copper in the ore in the lowest tunnel than in that in either of the others, and between those two the same rule prevails. The copper bearing rock is a rhyolitic porphyry, ground and crushed, with highly comminuted particles of chalcocite, chalcopyrite and pyrite disseminated throughout the mass. It is very friable, easily pulverized and concentrated, the concentrates going about one ton from sixteen tons of ore. As the rock in the lowest tunnel goes about 3 per cent copper, it shows that concentration will give a high-grade product. The Red Mountain Copper Company, owning and operating the property, is working conservatively, exploring the ore body and demonstrating daily its greater size and capacity for production, until such time as the need for a great reduction plant is proved, when one will be provided. The

BUENA VISTA MINES,

owned and operated by the Good View Mining Company, lie a couple of miles west from the Four Metals property, and they have entered recently the list of producers, a small concentrating plant having been installed to reduce the ores to concentrates. The mine is opened by tunnels, on a ledge about four feet in width with a pay streak of high-grade chalcopyrite eighteen to twenty-four inches in width, that is very rich in copper. A deal of the ore has been shipped, with good results. The concentrator will effect a saving in transportation.

In this same vicinity are the Providencia, G. L. & C. group, Shannon group, Proto Mines, Gladstone, Old Soldier, Creston, National and many more good claims and promising prospects. Capital and development are all that are needed to place them in the list of permanent and profitable producers. Upon the east side of the Patagonia Mountains the

HARSHAW DISTRICT

joins on the north that part of the Patagonia District which extends

across the range. The district extends northward to the Sonoita River, at Patagonia, its western boundary following closely the crest of the mountains, the formation of the two districts presenting the same general characteristics. It includes some of the most noted and notable mines in Southern Arizona, including the Hardshell, Hermosa, World's Fair, Trench, Wieland Group, Blue Nose, Jefferson, Sunnyside, Buffalo Group, Chief Group, Great Silver Mine, and many more. At the present time active operations are conducted in a number of those named.

The Hermosa Mine was operated in the early '80's by a New York Company which built a 20-stamp mill, that produced a deal of silver bullion. At that time the record of production was more than a million dollars within eighteen months, and later it produced another half million. It is believed to contain yet a great deal of valuable mineral, well worth exploitation.

The Hardshell, which is adjacent to the Hermosa, has also a great record of production. Upon the property there is a concentrating mill. After a period of idleness extending over a number of years, the property has been taken over recently by experienced mining men, who will renew the history of the mine. Probably the

WORLD'S FAIR MINE

is one of the most noted and valuable properties in the district, with a long record of production. The property lies about two miles west from Harshaw. The location was made in 1879, and at that time considerable high-grade ore was shipped.

In 1884 the property passed by purchase to Frank and Josephine Powers, the consideration said to have been $100. It is reported that within a few months the purchasers had extracted and shipped several 25-ton carloads of rich rock that yielded from $8,000 to $25,000 per carload. Shipments were made, however, only when money was needed, and from ores taken out in development. In 1903 it was estimated that such development had exposed, ready for stoping and shipment $600,000 worth of high-grade lead-silver ores. The owners have been content to let the values remain in the ground, as a safer place than bank vaults; and the property has never been exploited to swell a plethoric bank account; yet, according to statistical information, in 1907 the production was $74,210 in ores yielding lead, copper, gold and silver. During 1910 the production was $42,730.82. There has been production every year, and since its discovery in 1879 the World's Fair is said to have produced more than one million dollars. It is in operation yet, and daily there are extracted many tons of high-grade ores, rich in lead, silver, gold and copper.

The World's Fair is developed to a depth of 600 feet, and it is the deepest mine in the district. The underground workings measure about 15,000 feet of tunnels, drifts, shafts, stopes and winzes. The main entrance is a crosscut tunnel at an altitude of 4,680 feet. In this tunnel is a winze 600 feet deep, with 1,000 feet of drifting each way, the development following the vein, with levels 100 feet apart.

There is a good equipment of machinery, including a 10-stamp mill. However, there has been little use for that, the rich ores bearing shipment to points where cost of reduction is much lower.

The country rock is diorite intruded with rhyolite, and the ore deposits seem associated with the lines of contact between the two kinds of rock. The average width of the vein is about six feet, and it is filled with high-grade rock.

In the upper workings the ores were generally lead-silver; but below the water level the usual law of the region prevails, copper coming into the combination with some antimonial silver and high values in gold. The average values are said to run 20 per cent copper, 500 ounces silver, and $15 per ton in gold.

There have been made a number of offers to purchase, and there have been some negotiations, but without result. The sales price set by the owners is one million dollars, 10 per cent in hand without inspection of the property.y

North from the World's Fair Camp, about a mile, there lies the other "Red Hill," or

PORPHYRY-COPPER DEPOSIT

mentioned elsewhere, that promises the foundation for a great producer of the red metal. Beside the great mass of porphyritic rhyolite in the mountain, there are many mineralized veins and dykes, from some of which good shipping ores are taken. In the Aztec Group, on the north side of the hill, not far south from Patagonia, there occurs such a vein; and on the east side of the hill there are others, in the Hardtmayer claims and in the properties of Wagner & Fessler.

Northeast from the World's Fair, about a mile, is The Basin, a region that holds in a great hollow a cluster of good mines, including the Wieland Group, Buffalo Group, Red Men, Great Silver Mine, and several others, in various stages of development, some of them shipping ores at the present time. The

PALMETTO DISTRICT

lies on the west side of the Patagonia Mountains, between the Harshaw and Nogales Districts, extending northward from the Patagonia District to the Sonoita River. From east to west its width is about four miles, and the length is six. The topography is rough, and on the

east side of the district the contour rises abruptly from an altitude of about 4,500 feet to one exceeding 6,000 feet, the summit of the highest being about 6,400 feet above sea level.

The country rocks embrace diorite, quartz monzonite, rhyolite and granite-porphyry, the second in the list predominating. The mineral deposits lie in the eastern part of the district, and they are associated closely with those found in the Harshaw District adjacent on the east, many of the properties in the two districts being in juxtaposition, notably the World's Fair and Chief in the Harshaw District, and the Flux and R. R. R. in the Palermo District.

The ores comprise lead, silver and copper. The lead-silver ores occur in the quartz monzonite, and the copper is found in the granite-porphyry and sedimentary rocks. In some cases the lead-silver ores carry a little gold, silver and molybdenum.

The principal mines in the district are the Flux, Domino, R. R. R., Jarilla, New Hope, Palmetto, Sonoita, Arizona-European, Grey Brothers, Dos Amigos, and others. The most noted and most important, in point of development, are the

R. R. R. MINES

which attracted great attention some three years ago on account of magnitude, richness and great value of the copper deposits encountered; and the development thereof gave to mining in the surrounding region an impetus which marked a new era in the affairs of Santa Cruz County, but which was checked by a protracted litigation between the original owners of the property, litigation that is still in the appellate court, and has caused a suspension of operations with cancellation of a bond and lease under which the property was in operation.

In the holdings of the R. R. R. Group there are included fifty or more good claims. They lie on the west side of the main range of the Patagonia Mountains, about four miles south from the town of Patagonia, just below the crest of the ridge, at altitudes ranging from 5,500 to 4,000 feet.

The ground rises abruptly, giving excellent opportunity for development by tunnels, which is the system employed, there being four, from 200 to 600 feet in length, with a shaft 375 feet deep. The entire development embraces several thousand feet of tunnels, shaft, crosscuts, winzes, etc., and as developed the ore body gives 700 feet of backs. A wagon road from the entrance of the lowest tunnel to the railway station at Bloxton, 3½ miles away, which is the shipping point, gives excellent facility for hauling the ore to a railway.

Between May, 1911, and October, 1914, ore shipments are said to have reached a total exceeding one million of dollars in value, the

shipments continuing at the rate of 100 tons of good ore daily. The rock is said to have averaged 9 per cent copper. The ores are chalcocite, chalcopyrite and pyrite, with occurences of galena and cerussite.

The country rock is mainly a granite-porphyry, and the ore deposits occur in a shear zone traversing those rocks.

At this writing the litigation pending in the Supreme Court of Arizona has been argued, a decision is due at any time, and when it is given it is to be hoped that the litigous owners will be able to make a composition by which operations can be resumed.

In the immediate vicinity of the R. R. R. the Flux Mine is in operation, a concentrating mill reducing the ores, and the concentrates are shipped. The mine and mill are connected by an aerial tramway. The property, owned and operated by the Sterling Development Company, has a record of production antedating the Civil War.

The Jarillas Mine, near the south end of the district, the property of Messrs. E. E. Bethell, of Patagonia; Bracey Curtis and Doctor A. L. Gustetter, of Nogales, is in active operation and presents considerable development. The ore is high grade, carrying lead, silver and gold. Shipments made some years ago yielded $5,000, giving returns of 40 per cent lead, 175 ounces silver and 1 ounce gold per ton.

Of course, it is understood that the properties mentioned in these descriptions of the various districts are but a few of those worth giving attention. To give a very short description of all would extend this bulletin to a large volume. The

RED ROCK DISTRICT

lies adjacent to the Harshaw District on the northeast, and eastward from the Sonoita River, extending to the summits of the Canelo Hills. The mineral bearing areas are limited, and the formations are not conductive to mineral occurrence. The principal properties are La Plata, New York, Meadow Valley, Copper Mountain and Sheehy Group. Ores have been shipped from the New York, La Plata and Meadow Valley properties. In the Sheehy Group there has been done considerable work upon a low-grade copper proposition of large extent, which, with development, may prove important. There are numerous small prospects showing very little work. The

WRIGHTSON DISTRICT

Covers the east and southeast slopes of the Santa Rita Mountains, the southern and eastern boundaries of the district being defined by the Rio Sonoita. The north line intersects Old Baldy, a turn of that line in a southeastern direction joins the east line at the river, a prolongation thereof crossing the stream, continuing as the northeast line of the Red Rock District. The greatest length of the district, from Old

Baldy to the Sonoita, near Patagonia, is twelve miles; the greatest width is eight miles on an east and west line.

The topography is rough and altitudes vary from 3,500 to 6,500 feet, rising to 8,000 and 9,000 on the great summits in the north, with heavy erosion, deep canyons and lofty ridges. Generally the mining claims follow the ridges, opened by tunnels from the gulches and canyons, although that rule of development is not universal. Chiefly the formation is andesite, a belt of the rocks 2½ miles wide extending north and south across the west central portion, flanked on the northwest in great part by the underlying rhyolite, and partly by a narrow bowl of quartz diorite and monzonite. On the south the country rock is granite porphyry. The eastern part is covered with quaternary gravels with intrusions of older rocks.

The ore deposits carry lead and silver principally, with some copper, there appearing the same tendency manifested elsewhere to increase in copper as depth is attained. They occur in quartz bearing fissure veins or consist of replacements in the igneous and metamorphic rocks. In the Temporal Gulch region there is a small belt of gold-bearing quartz veins, the Gringo Mine presenting the most notable example.

The district embraces a half dozen or more camps, with a score or more of small mines and prospects, and several hundred likely claims to be given attention. There may be enumerated the Gringo, Happy Jack, Anaconda, Mansfield Group, Ivanhoe, American Boy, Victor, Castle Butte, Viceroy, Hosey, Castle Butte, Burro, etc. The

GRINGO MINE,

a gold producer, is in the southern part of the district, about three miles northwest from Patagonia, at an elevation of about 4,200 feet. The discovery was made in 1893, but no work of any consequence was done until 1906. For a time a five-stamp mill was in operation. Later an additional battery was installed, and increase to twenty stamps is contemplated. The property embraces a group of nine claims extending 4,500 feet on the veins, of which there are two running through the ground—the Gringo and the Independent. The principal development is in the Gringo vein, which is five to twenty feet in width, nearly vertical in position. The vein filling is quartz. The ore body goes as wide as fifteen feet, all good milling ore. The gold is fine and well disseminated, although the higher values are next to the footwall. The rock runs about $10 to the ton in gold, carrying also a little silver, lead and copper.

The Independent vein, about 600 feet from the Gringo, and approximately parallel, is in general fifteen to twenty feet in width, and at the junctions of several spurs it widens to about forty feet. The spurs

make as good a surface showing as the main vein. The Independent ore averages about $9 per ton. The plates recover about $5 per ton, while a greater part of the remaining values are saved by concentration. The ore bodies are very large and will supply production through a long period of time.

Development is by a shaft 180 feet deep in a deep depression in the ground. Two levels extending several hundred feet east and west make depth rapidly and as extended give increasing backs. Other shafts on higher ground are sinking, but no deeper than a line level with the collar of the main shaft. The country rock is andesite, but by the veins, the filling in which is quartz principally. The

MANSFIELD MINES,

property of the Ruby Copper Company, successor to the Mansfield Mining & Smelting Company, are in Mansfield Gulch, a tributary of Temporal Gulch, about six miles north from Patagonia. The holdings embrace about forty claims. The principal development is on the Black Cap, Ruby and Sweet claims, aggregating more than 4,000 feet of work. At present operations are confined to the Ruby, where is the Lee shaft 425 feet deep, with drifting nearly 300 feet on the ledge in good ore. It is at the extreme west end of the group, near the head of the gulch. The Sweet Mine, which is at the lower part of the gulch, near Temporal, in which gulch lies the camp, has a 360-foot shaft, with levels 100 feet apart. The showing of ore is good. The Black Cap is opened by a shaft 140 feet deep, connected at the bottom with a 200-foot tunnel. Good shipping ore has been marketed from this property. Near the camp there is a small smelting furnace in which ores from the Sweet Mine were smelted. Work is progressing steadily and development accomplished gives promise of a great and profitable enterprise.

The country rock consists of quartz monzonite and rhyolite in chief, with andesite. Some of the ledges seem in contacts between the rhyolite an quartz monzonite. The

AUGUSTA MINE

is one of the so-called Hosey or Presidential Group, in the immediate vicinity of the Black Cap and Ruby. The group embraces seven claims, the principal work being on the Augusta. Upon two levels, 100 and 200 feet below the collar of the shaft, which is 215 feet deep, there are more than 1,000 feet of development.

Running through the property are three veins, the chief development being on the south vein, which is from eight to fifteen feet in width. A four-foot ore chute averages 12½% copper, carrying a

little gold and silver. Through several months' time, under a former management, ore shipments averaged twenty tons a day.

Recently the property has been taken over by Mr. W. B. Ramsdell, an operator in mines of extensive experience, who is represented by Mr. Colin Timmons, a veteran mining engineer with wide experience in Colorado, Arizona and Mexico.

The new management has started a new working shaft on the same ledge at a point 300 feet east of the present shaft. The grading done for the new working shows a great ledge more than 100 feet wide, and as the ground rises rapidly above the shaft site, depth will be attained very fast. Every indication points to a great ore body below.

Upon another ledge, about 150 feet north of the old shaft, work of sinking upon another ledge is in course of prosecution, and it is at a depth of about 100 feet. The pay streak is thirty inches wide and it is yielding grey copper high in values. The work was commenced to perform the assessment work for the year 1915. The ore taken out from the first was so good that it was shipped at a handsome profit, and there has been no reason to stop. The

HAPPY JACK MINES

embrace a group of nine claims, not far south from the Black Cap property of the Mansfield group. The Happy Jack Mining & Reduction Company, of which Mr. W. H. Barnett, of Patagonia, is general manager, operates the property. Upon the dump there are several hundred tons of good concentrating ore, and there have been shipped a number of carloads of high-grade rack that averaged about 42% lead with 2½% copper, twenty ounces silver and $2 gold per ton. The ground is cut by several veins, the principal one, on which was done the development, being in the middle. The aggregate work exceeds 4,000 feet. The main or lower tunnel is 900 feet long, 400 feet below the croppings. The other tunnel is 200 feet higher. At 600 feet the two are connected by an upraise. The

AMERICAN BOY MINE

is in the same vicinity and northwest from the Black Cap. The owners, Jens Peterson and George Clarke, have worked the mine in a small way about ten years, making occasional shipments of high-grade ores. Development has been by tunneling. The

TYNDALL DISTRICT

lies upon the west side of the Santa Rita Mountains, and extends from the Rio Sonoita northward a distance of eighteen miles, a very small section of the area being in Pima County. The width of the district is about six miles. The region is rough and rugged, the three

highest peaks of the Santa Ritas (Mount Hopkins, Old Baldy and Josephine Peak) being at the north and east edges of the district, and the surface of the entire district is cut deeply by the canyons and gulches draining their slopes. Elevations vary from 3,500 to 9,000 feet. Geologically the district embraces a wide variety of formations, and the ore occurences are extensive.

Tyndall District was the seat of some of the earliest mining of which there is any record on the Pacific Slope of the United States, cited in the opening pages of this bulletin; the Jesuit missionaries at Tumacacori having discovered and wrought the Salero, Alto, Montosa, Wandering Jew, and other properties as far back as 1688. American operation began with acquisition of the Gadsden Purchase in 1856.

The district embraces forty or more mines or groups of mines, many of them presenting extensive development and operations proceeding actively in quite a number.

They include the Alto, Apache, Arizona-Pittsburg, Aztec, Blacksmith, Bland, Bradford, Burro, Camp Bird, Connecticut, Conquest Group, Devil's Cash Box, Elephant Head, Eureka, Hermit's Home, Ivanhoe, John Allen, Joplin, Jumbo, Mary & Poltski, Montezuma, Montosa, M. & S., Rhode Island, Rosario, Royal Blue, Salero, Santa Rita, Sheehy Group, Tia Juana, Toluachi Group, Treasure Vault, Trenton, Wandering Jew, Vulcan, etc. The

ALTO MINES

present an extensive development and have been very richly productive. The ground included was among the early discoveries of the Jesuits, who are said to have continued operations in their primitive and desultory way rather steadily for about 150 years. Their facilities for development, ore extraction and reduction were crude and ineffective. Drill steel and blasting powder were unknown. With rough iron bars they drilled to depths of several feet into the rocks large round holes several inches in diameter, which were filled with lime, plugged securely and water poured in. The swelling lime rent the rocks, and when thrown out of place they were broken further with hammers. That process necessarily must have been slow and painful. Ores were packed to the surface on the backs of men, carrying rude rawhide buckets, climbing out of shafts on rude ladders, poles with notches cut into them.

Ores were smelted in rude reverberatory furnaces that were made from adobe, and after reduction the lead and silver were separated by a rude cupelation in the same furnace. In other regions where the ores carried gold and silver only the rock was milled with mercury in *ar-*

rastras, and the amalgam retorted crudely. Processes so crude were slow and laborious. They were possible only with a laboring population but little better than slaves, with wants limited and contented with a bare subsistence.

The property is located in the Salero region, about eight miles east from the Santa Cruz River, at Tumacacori, where are to be seen the ruins of the mission that was the home of the mining monks. About 1875 Mark Lulley, now of Nogales, located a part of the ground under the name of the Goldtree Mine. He sold it and there was taken out a great deal of high-grade lead-silver ore in the upper workings. A dozen years ago the property was made over to the Alto Mining Company, under which there was done a great deal of work, and that company was succeeded by the Santa Cruz Smelter, Mines & Transportation Company. Now the ownership is a subject of a complex litigation.

There are about 10,000 feet of work, several tunnels, with crosscuts, shafts, drifts, winzes, etc. The ores in the lower workings are copper bearing.

The geology of the Alto hill is complicated, and a description would require too much space to serve the purposes of this bulletin. The

SALERO MINES

About three miles south from the Alto are *antiguas* also, wrought by the Jesuits long, long ago; and it was one of the first to which attention was turned after American occupation sixty years ago, there clustering about it traditions of some of the tragedies of Apache hate and ferocity. Until recent years it was in operation, a steady producer of high-grade lead and silver ores, but the death of the chief owners, following each other closely some years ago, caused suspension of operations, and the property stands idle. The

WANDERING JEW

group of mines is north from the Alto, on the next ridge. In the principal ledge there is considerable development, with a fine showing of lead-silver ores, manifesting the usual tendency to run into copper, the copper content increasing steadily as depth is attained. The Jew is in the same ledge as the Lee shaft in the Ruby Mine, on the east side of the main ridge, from which the Jew ridge is a spur, the ledge being traced readily across the mountain down the other side. The collar of the Lee shaft is lower in altitude than the deepest work in the Wandering Jew, and at a depth of 400 feet the Ruby is distinctively a copper producer. In the Wandering Jew the ore chutes are strong and

well defined. With more depth they are apt to yield a good copper output.

The owners of the Wandering Jew are Mark and Louis Lulley of Nogales, with R. R. Richardson of Patagonia. The property is under bond and lease to Holt Brothers, experinced operators, who have scored several successes in Mexico. They are shipping ore. The

TOLUACHI GROUP

north from the Wandering Jew, owned by Mr. Josiah Bond, includes the Jersey Girl, Silver Sally and Merry Widow. The principal work is on the Silver Sally, which has a shaft nearly 300 feet deep with a level at 220 feet. The ledge is about fifteen feet in width and has yielded ore that has averaged fifty ounces silver per ton.

The Merry Widow has a shaft 100 feet in depth, operating a vein from which ore shipments yielded 8% lead and 72 ounces silver per ton. The

BLAND MINE

is in the immediate vicinity of the Alto, lying southeast. Tunnels are the principal development, the lowest being 540 feet below the croppings, the aggregate work being 1,500 feet. Near the surface the ores were high-grade lead-silver, carrying copper; but with depth the lead diminished. In the early history of operation two carloads of ore shipped to El Paso and treated yielded 64% lead, 24% copper and 35 ounces silver per ton. Assays taken later from lower levels are reported to have run 8% to 12% copper, 6 to 15 ounces silver and $3 to $12 gold. Upon the two dumps there are measured 300 and 500 tons of ore, respectively, which show good values in copper, gold and silver.

The Bradford, Rosario, Montezuma, and other good properties are at the south end of the district, near the Rio Sonoita.

In the northern end of Tyndall District are the Devil's Cash Box, Sheehy Group, Conquest Group, Elephant Head and other properties.

Old Baldy and Greaterville Districts, on the north side of the Santa Rita Mountains, lie for the most part in Pima County, but the southern tips of each being in Santa Cruz. In Old Baldy District are the Curry properties, worked by the Six Metals Mining Company, running a concentrator and shipping copper concentrates.

The Greaterville District is chiefly gold bearing, with good quartz ledges and extensive placer deposits. Some of the placers are on the Santa Cruz side of the line.

Southwest from the Greaterville settlement, but within the County of Santa Cruz, lies an extensive deposit of onyx, owned by the Onyx

King Mining Company. The stone is very pure, beautifully colored and susceptible of a high polish.

San Cayetano District covers San Cayetano Mountain, between the Santa Rita Mountains and the Santa Cruz River. It embraces the Tubantia Mine, the Wise Prospect and some undeveloped ledges. From the Tubantia there has been shipped some ore.

In the region west of the Santa Cruz River the Atascosa Mountains are divided into three districts—the Sopori, covering the north end of the main range, the Pajarito District, on the south end, abutting on the Mexican line, and the Oro Blanco District, in outlying spurs on the west. In the Sopori District there is some prospecting, and in the Pajarito are the Raines Group, Clarke Group and Maloney Group of mines. In none of them is there anything doing. In the extreme west end of the county the

ORO BLANCO DISTRICT

has attracted attention through many years, and to a great extent its history is traditional. Vestiges of many *arrastras* show that it was worked for gold by Mexicans. It is about eighteen miles northwest from Nogales, and the famous Planchas de Plata Mines lie about ten miles south, in Mexico. The district extends about ten miles north from the international line, and its greatest width is about four miles.

Geologically the Oro Blanco country is classed as "late cretaceous," yet there are intrusions of igneous rocks, including andesite, ryolite, dacite and quartz-porphyry. The mineral belt extends in a northwesterly direction. The chief production has been gold, and as there runs silver with it, giving the metal a lighter appearance than usual, it is known as "white gold" (oro blanco), from which the region takes its name.

Doubtless the first work was in placer ground, and there remain yet some good placers. During rainy seasons the natives find in the gulches and arroyos small nuggets and bits of gold. The presence of the ruined *arrastras* mentioned shows that the quartz ledges were worked at some time, whether by the Spaniards in the *antigua* days, or later by Mexicans, is a matter of conjecture.

The earliest record of American mining dates from 1865, when a man named Clinton Thompson was there working on what is now the Austerlitz Mine.

The quartz ledges are all strong and well defined, and in some parts of the region they are close and frequent. Gold and silver predominate, but copper is becoming manifest. In remote geologic time some great seismic disturbance rent, shattered and pulverized the rocks in all directions, and the interstices offered precipitation surfaces for the

vaporous solutions rising from the depths, which, coooling, precipitated and converted into the metallic ores that are found.

Near the international line there is a deposit of granite. In the southeastern part of the district there have been found extensive beds of potassium and potash. Oil-bearing shale is in evidence also. It is found near the camp of the Progressive Mining Company, springs of water showing oil float upon their surfaces. Whether the shale is an anticline or syncline has not been investigated. But if it is ever found to be a syncline, boring to the bend of the uptilted strata would produce oil, in paying quantities probably. The

PRINCIPAL MINES

are the Austerlitz, Switzerland, Ragnaros, Oro, Old Glory, Oro Blanco, Tres Amigos, Triangle, Warsaw, Franco-American, Grubstake, Yellow Jacket, Montana, Portland, etc. In some of them are extensive development with exposure of large and valuable ore bodies. In the early history of recent operations, thirty years ago or more, there were erected several quartz mills, but the processes seemed poorly adapted to the character of the ores, and they fell short in saving the values. All can be made to pay handsomely by installation of more modern and efficient extraction processes. The Oro Blanco Mine is said to have blocked out and ready for stoping many thousand tons of gold-bearing rock that can be made to pay well. Its owner is a banker in Scranton, Pennsylvania. The Old Glory shows above ground on one side a great gold-bearing ledge that is exposed to a height of 100 feet and a length of several hundred. From the ledge, which is about forty feet in width, gold-bearing rock has been quarried and sent down to the mill below. The mine has also considerable underground development. The

AUSTERLITZ MINE

has been a good producer, and it gives evidence of the making of a great mine. In 1912 Woodworth & Lane, who were working under bond and lease, shipped to El Paso and Pioneer smelters 1,414.5 dry tons of ore, and 180.4 dry tons of concentrates, for which they were paid $57,223.44.

The Austerlitz and adjacent claims show on the surface an oxidized ore zone the ores from which average well in gold and silver, and often run to high grade. At greater depth there is penetrated a sulphide zone, the rock in which is extensive, massive and frequently high-grade, running well in silver, gold and copper. The deep-seated rocks are andesite, with an overflow of rhyolite. It is predicted that were the rhyolite cut through there would be found a great body of sulphide copper ores, rich in gold and silver.

The Austerlitz is owned by Doctor A. H. Noon, of Nogales, but at this writing it has been taken over under bond and lease by Mr. Camphaus, an English mining operator.

In the extreme northwest corner of the Oro Blanco District is the Yellow Jacket mine, a gold producing property with a 10-stamp mill. It has lain idle twenty-one years, but recently work has been resumed by Mr. W. N. Gourley, of Philadelphia, whose deceased father's estate holds the title.

The foregoing pages serve to give some idea of the mines and mineral resources of Santa Cruz County. They are great and inexhaustible. To appreciate them investigation is necessary, which is invited.

ALLEN T. BIRD.