

NEW MEXICO SCHOOL OF MINES  
STATE BUREAU OF MINES AND MINERAL RESOURCES  
C. E. NEEDHAM, President and Director

Circular No. 5

GOLD MINING AND GOLD DEPOSITS IN NEW MEXICO

By

E.H. Wells and T. P. Wootton, April, 1932

Revised by T. P. Wootton, April, 1940

Socorro, N. M.

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## INTRODUCTION

One of the outstanding effects of the current business depression has been the improvement in the status of gold as compared with the other metals. Gold deposits are attracting more interest than for many years. Proved districts are being re-examined, and an active search is being made for new deposits. The State Bureau of Mines and Mineral Resources of the New Mexico School of Mines has received many requests recently for information regarding the gold resources of New Mexico, and this circular has been prepared in response to this demand.

Most of the geology and mining history prior to 1909 which is given in these notes has been taken from "The Ore Deposits of New Mexico," Professional Paper 68 of the United States Geological Survey, by Waldemar Lindgren, L. C. Graton and C. H. Gordon. Subsequent information has been obtained from various sources. A fairly complete bibliography is appended, and the reports listed contain considerable valuable data on gold in New Mexico. The "Geologic Map of New Mexico" by N. H. Darton, issued by the United States Geological Survey, has much information for the prospector with geologic training.

The information on the deposits given in this circular necessarily is hardly more than a summary. Additional information on this subject is contained in the following bulletins of the Bureau: "The Metal Resources of New Mexico and their Economic Features," by S. G. Lasky and T. P. Wootton; "The Ore Deposits of Socorro County, New Mexico," by S. G. Lasky; "The Ore Deposits of Sierra County, New Mexico," by G. T. Harley; and "The Geology of the Organ Mountains," by K. C. Dunham,

## THE PRESENT STATUS OF GOLD

From January 18, 1837, through 1932, the price of gold was \$20.67 plus per ounce and in 1933 the legal coinage value was continued at that price. The average weighted price per fine ounce in 1933, as computed by the U. S. Bureau of Mines, was \$25.56 and in 1934 was \$34.95. Under the Gold Reserve Act of 1934 the value of gold was fixed by Presidential Proclamation on January 31, 1934, at \$35.00 per fine troy ounce and has remained at that figure. As a result, some lode and placer deposits of gold which were valueless a few years ago can now be worked at a profit,

## PRELIMINARY INVESTIGATIONS

Although the outlook for gold mining is much improved, those who are interested in working or financing gold properties should not be unduly optimistic. Many gold deposits in New Mexico and elsewhere

are still too low grade to be worked successfully, It is possible to obtain picked samples from many worthless deposits which give assay returns far greater than the average of the material that can be mined. A vein a quarter of an inch wide may actually contain \$1,000 to the ton in gold, but when diluted with the adjacent country rock that must be mined with it, the resulting ore would have a gross value of less than \$8 a ton. Mining, transportation and treatment expenses for ore of this grade in many places would exceed the metal value, and mining could be carried on only at a loss. Gold gravels which would pay handsomely if at the surface may be fatally handicapped by barren over-burden that must be removed before they can be reached. Placer ground that would be workable with abundant water near at hand may be valueless because of the scarcity of water or the cost of bringing it to the deposits.

New Mexico has suffered greatly from the promotion of ill-advised mining projects. Unquestionably, many statements regarding mineral deposits in the State have been made by promoters and others which would not be substantiated by efficient investigations of the deposits. Before any gold mining program requiring a large or even moderate expenditure in advance of actual production is adopted, the deposit should be carefully examined by a reliable mining engineer or mining geologist and a favorable report received from him. Particularly in the case of placer deposits the examination should include thorough, systematic and accurate sampling. The examination may cost hundreds or even thousands of dollars, but if it proves the property to be non-commercial, many times its cost in useless expenditures will be saved. If favorable, it should contain information of much value to the owners regarding the character and grade of the deposit and proper methods of mining and treatment. A favorable report does not necessarily assure profitable mining, but it should indicate a reasonable probability of successful operation.

#### MINING AND TREATMENT OF PLACER MATERIAL

Shallow placer material is mined in open cuts with picks and shovels, plows and horse scrapers, power scrapers, drag-line excavators, and power shovels; and worthless overburden, if not too thick is removed by one of these methods. The gravel is transported to the gold-saving plant mechanically or by running water. Deep pay streaks can be worked by drift mining without disturbing the overlying material but at relatively increased cost.

The simplest apparatus for recovering gold from placers is the miner's pan, and it is indispensable in prospecting. Its capacity is small - about one cubic yard per day - but in the hands of a skillful operator it is quite efficient. A surprising amount of gold has been obtained by its use.

The rocker is used in prospecting and in working small placer deposits. The gravel is passed through the machine with a rocking motion, and the gold collects against riffles or on an apron. The rocker is easily and cheaply constructed and obtains good gold recoveries with a moderate amount of water. It gives best results when operated by two men, who can handle from three to five cubic yards of gravel per day with it.

The sluicing method of recovering gold is practiced where the deposit is of at least moderate size and water is abundant. The sluice (also called riffle box) is a slightly inclined trough with cross-pieces or other obstructions in the bottom, called riffles. The gravel is deposited in the head box at the upper end and washed through the sluice with water. The gold collects in front of the riffles. Mercury is sometimes used to aid in collecting the gold.

Placer gold that is granular and not too fine can be recovered effectively by running the closely-sized sand over a standard concentrating table,

Several wet machines have been placed on the market recently which recover the gold from placers with a reduced amount of water. Dry placer machines, in the operation of which no water is required, do not save as much gold as wet machines, and they have not been satisfactory with many gravels. If these machines are sufficiently improved they may be used successfully at certain deposits where the water problem is serious.

Hydraulic mining consists of excavating the gravel deposit by directing a stream of water under considerable pressure against it, washing the material to a sluice through which it passes and in which the gold is caught, and disposing of the tailings. The most important requirements for this type of mining are an ample supply of cheap water under high pressure, sufficient grade on bed-rock for the sluices, and adequate dump room for the tailings. The disposal of the tailings may entail difficulties in agricultural areas. Under favorable conditions hydraulic mining is much less expensive than hand methods or ordinary sluicing.

The gold dredge is a scow supplied with a mechanical excavator and elevator - usually a digging ladder and an endless system of buckets - screening and washing plant, and gold-saving equipment. This method is suitable to extensive river-bar and gravel-plain placers which are fairly thick and have a level bedrock. The dredge must operate while floating on the water, and hence the conditions must be such that a pond for it can be maintained. Numerous large boulders in the gravel may seriously interfere with dredging operations. Dredges are expensive, but they handle material at a lower cost per cubic yard than is possible by any other method.

## MINING AND MILLING OF GOLD ORES

Lode gold ores are ordinarily mined in the same manner as the lode deposits of other metals having the same size, shape and physical characteristics. A discussion of methods is beyond the scope of this report,

Gold ores consist of (a) shipping ores, or those rich enough in gold to be shipped to a smelter, and (b) milling ores, or those too low in gold content to stand transportation and smelter treatment costs, but which can be profitably milled near the deposit and the resulting bullion or other product marketed. Some ores that are

below shipping grade as mined can be hand sorted, and a product obtained that is acceptable at the smelter. At most gold deposits the amount of milling ore is many times larger than the shipping ore. Most of the ore taken from New Mexico gold mines has been milled.

Many gold mills have been constructed and then operated for only a few weeks or months because of a deficiency in the amount or value of the ore, or both. It is never advisable to construct a mill until a sufficient quantity of ore of satisfactory grade is blocked out to justify its cost, and only after experimental work has definitely indicated the best milling process.

The most important milling methods for gold ores are amalgamation, cyanidation and concentration. In the amalgamation process the ore is usually crushed in a stamp mill and the gold collected by mercury. This process is only adaptable to free-milling ores - those in which the gold is in the native form. This class of ore is usually confined to the oxidized zone, and the deeper sulphide ores may not be amenable to this process. The amalgam, consisting of mercury and gold, is retorted, and the residue containing the gold is melted into bars, in which form it is sold. Silver in the native form is also recovered by this process.

In the cyanide process the ore is ground to the necessary fineness and the gold is dissolved in an alkaline solution of potassium or sodium cyanide. From the solution the gold is precipitated by zinc shavings or zinc dust. The precipitate is run through a filter press and melted into bullion bars for the market. Cyanidation is effective for the recovery of both gold and silver in the native form and also when contained in the sulphides and other minerals. Copper in the ore may interfere with cyaniding.

In some mills gold ores are concentrated by gravity methods or flotation, and the concentrates are sold to a smelter. Payment is made by the smelter not only for the gold and silver in the concentrates but for certain other metals if present in sufficient amounts. For many ores some combination of the above methods gives best results.

## HISTORY

It is possible that the Indians obtained small amounts of gold from the gravels of the State before the arrival of the Spaniards, and there is some evidence that the early Spanish settlers did some mining for gold and silver. However, the first recorded discovery of gold was made in 1828 when the Old Placers in the Ortiz Mountains south of Santa Fe were opened. This discovery inaugurated the era of placer mining in New Mexico.

Though these rich placers were worked by the most primitive methods, a great deal of gold was taken from them in the next ten years. In 1839 the still richer New Placers at the foot of the San Pedro Mountains were discovered. The production soon decreased, but it is safe to say that more or less placer gold has been obtained each year since 1828 from one or both of these districts, Placer gold was found in the Elizabethtown district, Colfax County, Pinos Altos district, Grant County, and the White Oaks district, Lincoln

County, in the sixties, and these and other placer districts yielded considerable gold prior to the important lode mining of the eighties.

Lode mining for gold began in 1833 when the Ortiz gold quartz vein was discovered near the Old Placers. Aside from operations in this district, lode deposits received but little attention until 1860-1870, when discoveries were made in Colfax, Grant, Lincoln and other counties. The Civil War and the later depredations of the Indians retarded development, and important gold lode mining operations did not begin until about 1885. The period of most active lode mining for gold was from that year to the beginning of the present century.

## PRODUCTION

The production of gold from lodes and gravels in New Mexico prior to 1880 was about 749,000 ounces, valued at \$15,483,000; from 1880 until 1904 the output is estimated at 654,717 ounces, valued at \$13,534,219; and official records show that from January 1, 1904 until December 31, 1939, the amount produced was 1,117,273 ounces, valued at \$26,304,707; making an estimated total for the State of 2,520,990 ounces, valued at \$55,321,926. Placer mines have yielded \$12,000,000 to \$15,000,000.

Similarly, in the 9 year period from January 1, 1930 until December 31, 1938, lode and placer mines produced 291,213 ounces of gold, the value of which was \$8,698,383. Of this amount 102,030 ounces, or 35 percent, was yielded by dry and siliceous gold, gold-silver, and silver ores; 13.7 percent came from copper and copper-lead ores; 44.9 percent from lead, lead-zinc, and zinc ores; and 6.3 percent came from placer mines.

These figures show a marked increase in placer gold production.

## GENERAL FEATURES OF THE DEPOSITS

### Placer Deposits

Gold placer deposits consist of sand, gravel or other detrital rock containing gold in commercial amounts. The material is usually called gravel, and the deposits are known as placers.

The formation of placers is dependent on the occurrence of gold in lode deposits in rocks which are subject to erosion; the freeing of the gold from the rock by weathering or abrasion; and the transportation, sorting and deposition of the gold-containing detrital material resulting from erosion. Original placers may be reworked by later stream action and new placers formed.

Workable placers may result from the erosion of lode deposits too poor for profitable mining, and high-grade lode deposits in which the gold is finely divided may not yield placer deposits. Placers may have come from high-grade primary deposits now entirely removed by erosion.

In most placers the greatest concentration of gold occurs at or near bedrock. Impervious beds within the gravels may have gold concentrated just above them and are spoken of as "false bedrock." The rich gravels usually are in ribbon-like "pay streaks" which may or may not follow the course of the present drainage channels. The gold varies in size from nuggets to minute flakes called "colors." Fine, flaky gold is difficult to save. Placer gold is usually accompanied by "black sand," consisting of magnetite, ilmenite, hematite, garnet, zircon and other heavy minerals. Because of their high specific gravity, these minerals usually collect with the gold during concentration, even though not closely associated with it in the gravel. Some "black sands" contain gold which cannot be separated from the minerals mechanically, in which case the sands may be marketable at a smelter. New Mexico placer gold is mostly above .900 fine.

Placers may be classified as (a) residual or eluvial placers when formed directly over the outcrops of the lode deposits; (b) hill-side placers on valley slopes, which are partly sorted by running water but not in distinct channels; (c) gulch or creek placers which are shallow placers in or adjacent to the beds of small streams; (d) bench placers or terrace gravels, consisting of old stream gravels partly removed by later streams which have cut into the original bedrock; (e) river-bar placers, which occur in river bars and in gravel flats adjacent to larger streams of small gradient; (f) gravel-plain placers formed in flood plains, deltas and alluvial fans; and (g) buried placers, which have been buried by a later accumulation of sediments or by surface flows of igneous rock.

The New Mexico placers, include most if not all of the above types. In general they are shallow, 50 feet being an unusual depth. In the Elizabethtown district some deep gravels are reported, but they have not been explored. The placers are largely of Quaternary age, but in places, as in the vicinity of the San Pedro Mountains where erosion has been active with little interruption since Tertiary time, some of the lower gravels may have accumulated in that period. No ancient well-defined buried channel systems of placers, like those in California, have been discovered, but they may possibly occur.

The principal New Mexico placer districts are the Old Placers at Dolores, and the New Placers at Golden, both in Santa Fe County; the Elizabethtown or Moreno placers and smaller placers on Cimarroncito and Ponil Creeks, Colfax County; the Hopewell placers, Rio Arriba County; the Hillsboro (Las Animas) placers, and the Pittsburg placers near Shandon, Sierra County; the Nogal and Jicarilla placers, Lincoln County; and the Pinos Altos placers, Grant County.

#### Lode Deposits

Gold or silver, or both, are contained in the ores of nearly every mining district in New Mexico. In many of them the precious metals are subordinate to copper, lead or zinc, but there are a number of districts whose ores are valuable chiefly for their contained gold. Only those districts in which gold is especially important are considered in this report,

Deposits Connected with Tertiary Intrusive Rocks. - Many of the gold lode deposits of the State are connected with stocks, dikes and other intrusions of monzonite and related rocks of Tertiary age. They occur chiefly in veins, shear zones and brecciated zones in the intrusive rocks, but in part as veins and replacement deposits in the adjacent sedimentary or igneous rocks. In places the invaded rocks have been greatly metamorphosed by the intrusions, and the deposits in them are essentially contact-metamorphic deposits. The gold occurs chiefly in the native form, in pyrite and other sulphides, and sparingly as the telluride. Silver is present in varying amounts as argentite, horn silver, alloyed with native gold, and as an impurity in minerals of the other metals. One or more of the sulphides pyrite, chalcopyrite, bornite, galena and sphalerite, are usually present in small or moderate amounts, and in some deposits the base-metal sulphides are of economic importance. In places near the surface the sulphides have been changed to limonite, copper carbonates, smithsonite, cerussite and other oxidized-zone minerals. In some deposits oxidation has extended to considerable depths. Quartz is the chief gangue mineral but in places it is accompanied by calcite, fluorite and barite. Placers have resulted from the erosion of these deposits.

Deposits in Tertiary Extrusive Rocks. - Surface flows of rhyolite, latite, andesite and related rocks contain a number of important gold deposits. These flows occupy large areas and are thousands of feet thick in places. The deposits have no apparent connection with intrusive igneous rocks. They consist of veins, many of which are short and irregular. The mineralogy of the deposits is quite similar to that of the deposits connected with Tertiary intrusive rocks, but ruby silver and related silver minerals occur. Much of the gold is so finely divided that no colors can be obtained by panning. In general, copper, lead and zinc are present in very small amounts, and the veins consist chiefly of gangue minerals. As a rule these deposits do not yield placers.

Deposits in Pre-Cambrian Rocks. - Gold lode deposits of minor importance occur in the pre-Cambrian rocks. Some of these deposits may have formed in pre-Cambrian time, but others are doubtless more recent. They consist of veins, shear zones, and disseminated deposits in schist. The minerals are much the same as in the deposits connected with Tertiary intrusive rocks, but copper is relatively more abundant, zinc is present in moderate or small amounts, and lead is usually absent. The gangue of veins is mainly quartz, which is accompanied by calcite, siderite, tourmaline and specularite. The gold of these deposits frequently collects in placers.

#### AREAS FAVORABLE FOR NEW DISCOVERIES

The areas considered most promising for prospecting for placer deposits are those containing gravels which have been eroded from the known gold lode districts, and particularly those which have yielded placer gold in the past. These areas are specified or indicated in the discussion of the districts in the latter part of this report. If the older rocks contain no gold and give no evidence of primary metallization, the gravels derived from them are almost certain to be barren.

Additional gold lode deposits of value no doubt will be found from time to time. In general, the areas near the proved districts which have similar geologic features offer the most promise for new finds. Other areas in which Tertiary intrusive rocks are prominent deserve attention, and the pre-Cambrian areas are moderately promising. Additional discoveries are possible in the thick Tertiary extrusive rocks, but large areas of these rocks are undoubtedly barren. The most favorable parts are those consisting of thick-bedded brittle flows.

The known mineralized portion of the State is a broad zone which extends from the north to the south boundary and includes Taos, eastern Rio Arriba, western San Miguel, Santa Fe, Sandoval, eastern Bernalillo, eastern Valencia, western Tarrant, western Lincoln, Socorro, southern Catron, Sierra, Otero, Dona Ana, Luna, Grant and Hidalgo counties. The north-central part of Valencia County, although not in this zone, is also mineralized. Future gold discoveries are more probable in these areas than in the remainder of the State.

## CATRON COUNTY

### Mogollon (Cooney) District

This district is in the southwestern part of Catron County and about 85 miles by good road from Silver City. It was discovered in 1875, but active production did not begin until the nineties. The deposits occur as veins in Tertiary rhyolite, andesite and latite, and contain gold, silver and copper. The total production of the district has been about \$20,000,000, approximately one-third of which represents gold. The principal mines were closed down in 1925, but Ira L. Wright and associates of Silver City have recently leased and resumed mining and development work at the Fanny mine,

Gravels of the Mogollon district have yielded little, if any, placer gold.

## COLFAX COUNTY

### Elizabethtown District and Vicinity

Placer gold was found near what is now Elizabethtown, Colfax County, in 1866, and in the following Spring there was a great influx of miners to the district. Most of the early work was in gravels, although some lode deposits, including the famous Aztec mine, were located. The total production of this region has been about \$6,000,000, over 99 percent of which was derived from lode and placer gold. Lode deposits have yielded a little over 55 percent of the total gold. About 1900 the production rose to \$100,000 a year in consequence of dredge operations, which were soon discontinued.

The lode deposits occur as quartz veins and as contact-metamorphic bodies at the contact of the Raton conglomerate with the underlying Pierre shale. Most of the ore has been taken from the shale, in which it generally occurs at the crest of minor folds.

The placer deposits occur mainly on Moreno, Ute, and Ponil Creeks and most of the production has come from the Moreno drainage area. The gold undoubtedly has been supplied largely by the eroded part of the Aztec lode. In 1869 water was first received at these workings through the "Big Ditch." This ditch was 41 miles long and brought water from the headwaters of the Red River, 11 miles west of Elizabethtown.

The placers in this region vary in thickness from a few feet to over 300 feet, but for the most part they are confined to narrow valleys where the steep gradient has not permitted the building up of thick deposits. These placers have been worked by dredges, hydraulicking, ground sluicing, and simple hand methods. In places the gravel has been removed to bedrock, but in others considerable yardage remains.

The "Big Ditch" is no longer kept in repair, and most of the water now used comes through relatively short ditches from sources closer to the gravels being worked. Reservoirs are sometimes used to accumulate enough water for a few days' work. Recent operations have been sporadic and comparatively unimportant, but in periods of unemployment miners have re-worked the gravels, earning a few dollars a day.

The gravels are on the Maxwell land grant, and information concerning their availability for lease or purchase can no doubt be obtained from the Maxwell Land Grant Co., Raton, N. Mex.

#### DONA ANA COUNTY

The mines of Dona Ana County, from the first recorded production to the end of 1938, produced \$127,342 worth of gold, most of which was derived as a by-product from the base-metal ores of the Organ district.

##### Black Mountain and Texas Creek Districts

In the Black Mountain and Texas Creek Districts small amounts of gold occur associated with pyrite and other sulphides in quartz veins. The gold is free only near the surface. A small production has been reported.

#### GRANT COUNTY

##### Gold Hill District

This district lies 16 miles by road northeast of Lordsburg in Grant County. Veins of massive quartz occurring in pre-Cambrian granite and associated with pyrite or its oxidation product, limonite, were discovered here in 1884. Two stamp mills were erected and operated on \$15 to \$40 ore until the apparent exhaustion of the oxidized ores. There is very little activity in this district at present.

### Malone District

The ores of the Malone district were discovered in 1884, but placer mining had been carried on in this vicinity for several years prior to the lode discovery. The district is in the southern part of the Burro Mountains, Grant County, and is a few miles north of Gold Hill.

The lode deposits occur as quartz veins along a fault contact of lava and granite. The veins extend into the granite but show little tendency to cross the fault into the lava. Oxidized gold ores have furnished the principal production to date, but sulphides of iron, lead and zinc occur on the deeper levels.

### Pinos Altos District

This district is located in the Pinos Altos Mountains, Grant County, about 8 miles northeast of Silver City. Placer gold was found here in 1860, and later in the same year the Pacific vein was discovered. The district has yielded over \$8,000,000 in gold, silver, copper, lead and zinc. Probably 30 to 40 per cent of this amount came from gold alone, of which 25 to 30 per cent was recovered from the gravels. In the early years of activity placers probably furnished more than one-half the gold. Several small-scale operations have been carried on during recent years.

The lode deposits are fissure veins in intrusive rocks and replacement deposits in limestone. The veins contain chiefly pyrite, chalcopyrite, gold and silver in a quartz gangue.

Working of the gravels is hampered by the intermittent water supply, and placer production has been derived to a large extent from small operations by individuals. Bear Creek Gulch and Rich Gulch, a tributary to it, on the north, Whisky Gulch on the east, and the gulch heading near the old Gillette shaft were the principal producers. Flood waters from heavy summer rains occasionally work over the gravels, causing a reconcentration of the gold into workable deposits.

According to tests made by the United States Geological Survey in 1905, the gravels contain as much as 40 percent "black sands." One sample of "black sand" contained 83 per cent magnetite, 3 per cent garnet, 8 per cent hematite, and \$9.30 a ton in gold. Since 800 pounds of this sand was recovered from a ton of gravel, each ton of the original gravel contained about \$3.70 in gold locked up with the heavy minerals. Another sample of "black sand," 200 pounds of which was recovered from a ton of gravel, assayed \$13.23 a ton, indicating a value of \$1.32 for each ton of original gravel. Still another sample showed less than one cent to the ton. All values have been calculated at the old price of \$20.67 per fine ounce of gold.

Steeple Rock District

This district is in western Grant County near the Arizona line and is about 20 miles northeast of Duncan, Ariz., by road. Ore was first discovered about 1880 and the camp had an active life of about 15 or 20 years. Recent operations have been important, notably on the East Camp and Carlisle groups. The Carlisle was long the most important mine of the district and is said to have produced \$3,000,000, mostly from gold.

The ore deposits consist of quartz veins in extrusive Tertiary rocks. Pyrite, sphalerite, chalcopyrite, galena and some calcite occur with the quartz. The best ore has been found within 300 feet of the surface,

HIDALGO COUNTY

Kimball (Steins Pass) District

This district lies close to the Arizona line north of Steins Pass station on the Southern Pacific Railroad. It was discovered in 1875, but active mining did not begin until about ten years later. Silver was the chief product, but considerable gold was obtained.

The ore deposits of the Federal group apparently are richer in gold than those of any other property in the camp. The deposits are not true veins but are zones of brecciation in the country rock, which is silicified rhyolite or diorite porphyry. The breccia zones are greatly silicified and outcrop prominently. They vary in width from 5 to 20 feet.

Sylvanite District

The Sylvanite district is about 12 miles southwest of Hachita in the central part of the Little Hatchet Mountains. Copper was discovered in this region in the early eighties, but it was not until 1908 that gold was found.

The lode deposits occur as quartz veins in monzonite, in syenite dikes, and in sedimentary beds. The vein filling within about 60 feet of the surface consists of quartz, calcite, oxidized iron and copper minerals, free gold and some tetradymite. Below this depth low-grade gold-bearing sulphides appear. In some places copper is present in sufficient quantities to be of value.

Placer gold has been recovered from most of the gulches on the west side of the Little Hatchet Mountains and was discovered before the search for gold lodes began. Placer mining did not continue very long, and the total production from gravels is estimated at about \$2,500.

LINCOLN COUNTY

Jicarilla District

The Jicarilla district is located in the central part of Lincoln County about 7 miles southeast of Ancho. It is in a group of

hills known as the Jicarilla Mountains, at the north end of the Sierra Blanca. It is said that placer mining was carried on as early as 1850, but no lodes were found until the eighties, Production from placers amounts to about \$145,000, and some low-grade gold ore has been treated.

The lodes occur as pyrite-quartz veinlets in small fractures in the intrusive monzonite porphyry. The country rock is somewhat silicified and impregnated with pyrite, and in some places it carries gold over a width of 40 feet or more, The gold occurs in the pyrite, and copper and silver are found with the gold in some mines.

The placers were derived from the lodes, and the gold has not been transported very far. In places they gradually merge downward into undecomposed porphyry carrying some gold. Along the bedrock are streaks of good pay dirt, but they are usually overlain by several feet of overburden containing little if any gold. Water is scarce. About 40 years ago a large dredge was erected on Ancho Creek, but on account of depth to pay gravel and lack of water it was unsuccessful and was operated for only a short period. Since that time most of the placer mining has consisted of the intermittent small-scale activities of individuals. Some machinery has been installed since the price of gold went up and placer production has increased.

#### Nogal District

The Nogal mining region in Lincoln County comprises several small districts scattered over the Sierra Blanca southeast of Carrizozo, Vera Cruz, Parsons (Bonita), Schelerville (Church Mountain), and Alto (Cedar Creek) are some of the names that have been applied to the camps in this region. Placer gold was found in Dry Gulch northeast of Nogal Peak about 1865. A lode was located in 1868, but active prospecting did not begin until after the area was taken from the Mescalero Indian Reservation in 1882. The output of the district has been estimated at about a quarter of a million dollars.

There are two types of lode deposits in the district. One, which includes the American, Helen Rae and other mines, consists of gold-bearing sulphides of copper, lead and zinc in a gangue of quartz, calcite and dolomite. The vein on which these mines are located occurs for the most part in the monzonite porphyry and is 3 to 5 feet thick. The other type occurs at the Hopeful and Vera Cruz mines. This deposit is simply altered porphyry, much bleached and kaolinized. It is said to be 900 feet long, 120 feet wide and to reach a known depth of 260 feet. The gold content of this material is small.

#### White, Oaks District

This district, which is in Lincoln County, centers about Baxter Mountain approximately 10 miles northeast of Carrizozo. In 1879 lode gold was discovered at what became known as the North Homestake mine and soon thereafter the Old Abe, South Homestake, and other claims were located, A small intermittent production of placer gold had been made for 25 years prior to the lode discovery. The total production of the camps is estimated at about \$3,000,000.

The gold deposits are narrow stringers or wider lodes in a fine-grained monzonite which is intruded into shale. Some of the shale has been mineralized and forms ore bodies. Tungsten minerals, fluorite and gypsum are associated with the quartz and auriferous pyrite. The Old Abe mine was worked to a depth of 1,380 feet, but the richest ore occurred near the surface in the form of high-grade pockets and shoots. The ore that was mined had a value of about \$20 a ton.

## OTERO COUNTY

### Jarilla (Orogrande, Silver Hill) District

The Jarilla district is situated in an isolated group of hills known as the Jarilla Mountains in Otero County, and is about 50 miles northeast of El Paso, Tex. Some work was done about 1880, and prior to 1904 the district had produced approximately \$100,000 in gold and copper, about \$8,000 of which was recovered from dry placers. More extensive metal-mining operations began about 1900 after the discovery of turquoise in the district had brought more miners to the area. The district has produced over \$375,000 in gold.

The lode deposits occur as contact-metamorphic bodies in the lime stone near its contact with the intrusive mass of monzonite. The gold is associated with iron and copper sulphides, and the ores contain about 3 ounces of silver to every ounce of gold.

The placer deposits lie on the southeastern slope of the Jarilla Hills east of the Nannie Baird mine. Water is very scarce and in the early days was shipped into the camp in tank cars. Most of the placer gold has been recovered with some form of dry washer. The gravels are reported to contain about 11 a cubic yard. "Black sand" constitutes approximately one per cent of the gravel. A sample of this sand tested by the United States Geological Survey in 1905 was found to contain 10 per cent magnetite, 1.5 per cent ilmenite, 11 per cent hematite, 1 per cent zircon, 56 per cent quartz, and \$40 a ton in gold. If this sand is uniformly distributed through the pay gravel and is uniform in content, the figures above indicate that each ton of gravel contains 400 in gold associated with the "black sand." Another sample of "black sand" from this district contained \$377 a ton in gold but only 2.5 lbs. of this sand was recovered from a ton of gravel. According to this sample, the original gravel contains about 45¢ a ton in gold.

## RIO ARRIBA COUNTY

### El Rito District

The so-called El Rito district is in Rio Arriba County and about 4 miles north of the town of El Rito. It is in the Chama Basin and largely between El Rito Creek and Arroyo Seco. The district has a length from north to south of about 10 miles and a width of about 4 miles.

The gold deposits of the district consist of conglomerate and minor sandstone beds resting on older formations. These beds, which are essentially horizontal, attain a maximum thickness of at least

1,000 feet, and are hundreds of feet thick in much of the area. The conglomerate is well cemented and in large part is colored a bright red by the iron oxide, hematite. Gold is very sparingly distributed through parts of the conglomerate, commonly in the fine or cementing material.

Several years ago the Arriba Gold Fields, Ltd. was organized, ostensibly to work these deposits. The company was capitalized for \$25,000,000, and stock was issued on this basis with a par value of \$1.00 per share. Considerable stock was sold at 50¢ and 75¢ a share.

Advertising matter which was circulated among possible investors claimed that the property contained up to 44 billion tons of ore. The grade of this ore was placed at from \$3.00 to \$8.00 a ton in gold, and it was claimed that the ore also contains 2½ ounces of silver and 3 pounds of mercury to the ton. The total gross value of the deposits in gold alone was estimated at 264 billion dollars by one especially optimistic investigator of the deposits. It was stated that "it is a virgin property that has never been defiled by the hands of man." Favorable reports were submitted by five men who were at least inferred to have the degree of "Engineer of Mines"; also by a "consulting engineer" and a graduate civil engineer.

The stock selling activities of this company were brought to the attention of Mr. L. A. Tamme of the Blue Sky department of the office of the New Mexico Bank Examiner. At his request the property was briefly examined by Mr. C. G. Staley, state geologist, and Mr. W. C. Powell, geologist for the state engineer. Seven samples taken by these men, some of them from the same exposures that were sampled by men reporting favorably for the company; showed an average of 10¢ a ton in gold, a trace of silver (of no value), and no mercury. The highest grade sample taken by Staley and Powell contained 30¢ a ton in gold. The material sampled is so well cemented that it would require blasting and crushing prior to treatment. The deposit was considered by Staley and Powell to offer no possibilities for commercial mining.

#### Hopewell District

The Hopewell district is a westward extension of the Bromide district and lies in an area of pre-Cambrian rocks about 15 miles west of Tres Piedras, Taos County, and about 25 miles south of the Colorado line. Placer deposits were discovered in 1881 in Eureka Gulch, and several lodes were found the same year. The district has produced over \$300,000 in gold, approximately 95 per cent of which was recovered from placers.

The lode deposits consist of quartz veins and fahlbands occurring generally in the schist. The veins are only a few inches wide but occasionally are found close enough together to form a lode, Pyrite is the most common sulphide, but some chalcopyrite is found. The gold occurs in pyrite and in the oxidized zone as free gold.

It is reported that \$175,000 in gold was recovered from placers during the first three years of mining. A few nuggets worth from \$30 to \$96 were found. There are two placer areas in the district,

both on Eureka Creek. The Fairview placer lies immediately west of the town of Hopewell. It is said that this ground was very rich where the valley narrows to a steep-sided channel. The Lower Flat placer is about a mile farther down the creek at the junction of Eureka Creek with a branch of Vallecitos Creeks. The gravel of this deposit was over 35 feet deep in some places. An attempt at Hydraulic mining was made here many years ago, but the water supply apparently was too meager for such operations. There has been but little activity in this district in the last 35 years, the production of placer gold for that period having been about \$2,000.

## SANDOVAL COUNTY

### Cochiti (Bland) District

The Cochiti district in Sandoval County is in the southern foothills of the Valle Mountains about 30 miles west-northwest of Santa Fe. Some prospectors visited the area as early as 1880, but it was not until 1894 that production began. Since that date the district has produced approximately \$1,230,000 in gold and silver, about 70 per cent of which came from gold. There has been no placer production from this district.

The region is one of extensive rhyolite flows surrounding a mass of monzonite. The ores are confined to the monzonite, and at no place are they known to extend into the rhyolite. The ore bodies consist of quartz veins and lodes in brecciated zones. Argentite, presumably auriferous, is the principal ore mineral, although some galena and chalcopyrite and abundant pyrite and sphalerite are found. Small rich pockets of ore were common.

### Placitas District

The Placitas district is in the northern end of the Sandia Mountains about 8 miles east of Bernalillo. Some prospecting has been done on lode deposits of lead, copper, and silver, and a deposit of gold-bearing gravel conglomerate has been worked as a placer mine. The only recorded production of placer gold from Sandoval County was made in 1904 when \$1,013 was reported. This may have come from the Placitas district.

## SANTA FE COUNTY

Two of the richest placer districts in New Mexico, the Old Placers and the New Placers, were discovered by Spanish Americans in 1828 and 1832. For many years they yielded a heavy production. It has been estimated that the Old Placers yielded \$60,000 to \$80,000 annually from 1832 to 1835, but in later years not more than \$30,000 to \$40,000. These placers have yielded close to \$4,000,000 or approximately 25 per cent of the placer yield of New Mexico and 6 to 8 per cent of the total gold yield of the State.

### Old Placers (Ortiz Dolores) District

The Old Placers district is on the Ortiz Grant in Santa Fe County, It is in the Ortiz Mountains between the San Pedro Mountains and the Cerillos Hills. The lode deposits consist of quartz veins and contact-metamorphic bodies. The quartz veins occur in brecciated porphyry. Rich ore shoots were found in the oxidized zone, generally within 200 feet of the surface. The contact-metamorphic ores consist of garnetized limestone through which are scattered grains of auriferous (gold-bearing) chalcopyrite.

The placers are situated at the mouth of Cunningham Canyon at the old town of Dolores and on Dolores Gulch and Arroyo Viejo, The gravels form a mesa which is the upper part of an old alluvial fan. They occupy a large area, and considerable valuable ground is said to remain, In some places the gravels are as much as 100 feet thick. The scarcity of water is a serious handicap to profitable operations, but the gravels are too wet for strictly dry placer methods. Many years ago Thomas A. Edison tried to work the gravels by an electrostatic concentration process, but the dampness of the gravels prevented economic recovery. From 2 to 50 pounds of "black sand" are recovered from each ton of gravel; and this sand contains from \$4 to \$30 a ton in gold. Recently the district has yielded a small amount of gold each year obtained mainly by Spanish-American miners operating on a very small scale. The gold is about .918 fine.

### New Placers (San Pedro) District

This district, located in the San Pedro Mountains and partly in the Ortiz Grant, Santa Fe County, has been one of the richest placer areas in the State and contains lode deposits of gold, copper and lead. The ore deposits are similar in many ways to those of the Old Placers district. The veins are small but very abundant, both in porphyry and in the sedimentary rocks. Auriferous copper sulphides in a garnet gangue are found in the contact zone. The gold is distributed erratically through the veins, and although high-grade pockets have been found, no lode mine of permanent value has been developed. The depth of oxidation rarely exceeds 100 feet.

Gold-bearing gravels have accumulated at the foot of the San Pedro Mountains, especially to the north, west, and south. As the erosion of these mountains has proceeded the detritus of porphyry and limestone has extended for miles in every direction, especially westward along Tuerto Creek. All this subangular gravel is said to contain gold, and every creek and gulch cutting it has reconcentrated the gold in the stream bed.

Several unsuccessful attempts to work the placers of this district with dipper dredges have been made. The overburden varies from 10 to 40 feet in thickness. The gravels contain 10 cents or more in gold to the cubic yard, and it is thought that a fairly large yardage containing \$1 or more is available at bedrock. The greatest difficulty is the serious scarcity of water, for the mountains contain no perennial streams. Water is found in wells at a depth of 500 to 800 feet, and this water rises to within 100 or 200 feet of the surface. Several wells have been drilled and so far have yielded as much as

25 gallons a minute from each hole.

Along Tuerto Creek a few miles below Golden are the gold-bearing "cement-beds," which have been worked unsuccessfully a number of times. These beds rest on sandstone of the "Red Beds" series and are 50 to 100 feet in thickness. They are roughly stratified sub-angular gravel deposits consisting largely of porphyry and limestone fragments, presumably derived from the San Pedro Mountains. At least one attempt has been made at recovery by stamp-milling.

## SIERRA COUNTY

### Hillsboro (Las Animas) District

Hillsboro, the county seat of Sierra County, is about 17 miles north of Lake Valley and 16 miles west of the Rio Grande. Float from the vein that was subsequently located as the Rattlesnake mine was discovered in 1877, and later in the same year placer gold was discovered in Snake and Wicks Gulches. That winter one miner was said to have taken \$90,000 in gold from Wicks Gulch. The total production of the district is estimated at about \$7,500,000. About \$6,500,000 of this production represents gold, of which nearly one-half came from placers.

The gold lode deposits occur as quartz veins in shear zones in andesite. They consist chiefly of copper sulphides carrying gold and silver and some free gold. Most of the veins are narrow but high grade.

Intermittent and small-scale lode mining has been conducted in the district for many years. Recently a number of old mines have been reopened and development and mining resumed. Most of the old workings have been under water for many years.

Dry placer mining was carried on in what is known as the Las Animas or Gold Dust district about 6 miles northeast of Hillsboro, in 1912. According to V. C. Heikes ("Dry Placers in New Mexico"; U. S. Geological Survey Mineral Resources of the United States, calendar year 1912, Part I, p. 262, 1913) the placers which were worked cover several square miles from one-half inch to several feet deep, and the gold is found on false bedrock. Heikes says that fake tests averaged \$1.25 a cubic yard but working tests showed only 22¢ to 25¢ a yard.

In recent years considerable attention has been directed to placers in the Hillsboro district by several companies, the successful of which has been the John I. Hallett Construction Co. Since 1934, this company has been the chief producer of the district. The company operates two draglines and recovers the gold in a Coulter-Ainlay four-bowl plant mounted on wheels. Water is obtained from wells.

The total amount of gold in these gravels is undoubtedly large, but most of the ground is low grade. Here, again, the water situation is serious. Several wells have been drilled and at least one was dug. Little information is at hand as to the quantity of water

thus made available, except for the report that one or two of these wells will yield about 25 gallons per minute.

#### Pittsburg (Shandon) District

The Pittsburg district lies on the east side of the Rio Grande River and on the southwest slopes of the Caballos Mountains. The known gold-bearing gravels are in sections 16, 17, 20, and 21, T.16 S., R. 4 W., mainly along Trujillo Gulch. The gold occurs in a coarse granitic sand which is several feet deep in places. This sand was derived from the granite of the Caballos Mountains which contains gold-quartz veins.. The district has produced about \$175,000 in placer gold. Very little water is obtainable at the diggings.

Encarnacion Silva began working these deposits about 1900, but the discovery did not become generally known until 1903. Several companies have worked these gravels with water pumped from the Rio Grande, two miles away.

### SOCORRO COUNTY

#### Rhyolite District

This district is in the southern end of the San Mateo Mountains about 30 miles southwest of San Marcial and about 20 miles south of Rosedale. The lode occurs along a wide fault zone in rhyolite porphyry. The values are in gold. Very little development has been done, and the workings consist of a few small prospects.

#### Rosedale District

The Rosedale district is in the northern part of the San Mateo Mountains about 25 miles southwest of Magdalena. The first discovery was made in 1882, and after operations began in the nineties production was maintained until 1916. No production figures are available, but it is thought that gold worth about \$500,000 was recovered. There was no placer production.

The ore occurs as a manganese-stained quartz in well-defined shear zones in rhyolite porphyry. The silicified outcrops stand out clearly. The Rosedale mine has reached a depth of 732 feet with levels at 100-foot intervals. Water was encountered at 726 feet. The ore is entirely oxidized, and sulphides are absent.

#### San Jose (Nogal) District

The San Jose district has received considerable publicity during the past year as a result of the highly interesting discovery of high-grade gold-silver ore in the outcrop of the Pankey vein. The district is in the southern part of the San Mateo Mountains and about 3 miles north of the Rhyolite district. The Pankey vein shows prominently at the surface and can be followed on both sides of Springtime Canyon for several thousand feet. The vein consists of manganese-stained quartz in rhyolite and rhyolite porphyry. The ore is chiefly valuable for its gold content, but silver is an important constituent. Other veins occur in the district, and many claims have been located.

The Nogal Mines, Inc., has initiated an important development and mining program at the Pankey vein. An excellent camp has been built, and the road to the main highway between Socorro and Hot Springs has been improved. In March, 1932 the first shipment of several cars of low-grade ore mined from the outcrops of the vein was made to the El Paso Smelting Works of the American Smelting & Refining Co. The Springtime Mining Co. owns and intermittently operates a 40-ton flotation mill in the district,

## TAOS COUNTY

Since 1904 Taos County has produced \$17,000 in lode and placer gold, and the total gold production probably does not exceed \$75,000.

### Red River District

The Red River district lies near the head waters of Red River, close to the eastern border of Taos County and about 20 miles south of the Colorado line, Prospecting for placer deposits began about 1869 and some gold was produced, At least one attempt at hydraulic mining has been made. Production has been relatively unimportant, but small-scale operations have been carried on by native miners nearly every year.

The gold-bearing veins consist generally of the sulphides of silver, copper, and lead in a quartz gangue, Some tellurides have been found. The veins are narrow and discontinuous; they occur most commonly in the porphyry but cut the volcanic rocks in places.

### Rio Grande Valley

The sand and gravel deposits of the Rio Grande valley in Taos County have received the attention of a number of prospectors and engineers. These deposits occupy an area of several hundred square miles and are hundreds of feet thick in parts of the valley. Gold occurs in places in these sedimentary beds. The most promising part probably begins where Red River enters the Rio Grande in the northern part of the county and extends along the river to the south boundary and into Rio Arriba County as far as Embudo. The Rio Grande flows in a moderately deep gorge for a considerable distance in the gravel area.

The sedimentary deposits of the valley are erosional products from a number of mountainous areas within the drainage basin. In large part they have been derived from the Sangre de Cristo Range of New Mexico and Colorado. This range has a number of gold lode deposits, but in the New Mexico portion they are relatively unimportant and probably have not supplied any great amount of placer gold. In much of the upper Rio Grande drainage basin the older rocks give no evidence of primary gold mineralization.

Placers in this area consist of bench placers, river-bar placers and deep river placers. The bench deposits are the most extensive and they undoubtedly contain some gold. These sands and gravels are capped in large areas by a recent flow of basalt, and basalt flows of unknown extent are interbedded with the sediments. The river-bar

deposits are much, less in quantity than the bench deposits, but they have yielded practically all of the small amount of gold obtained. In places these gravels may be fairly rich. The gravels below the level of the river are of unknown thickness in most of the river channel, but bedrock is probably too deep to be reached in dredging operations in many places. Several tests of these sands and gravels are said to have obtained gold in encouraging amounts, with the greatest values just above bedrock,

The potential value of the sands and gravels of this part of the Rio Grande valley can be determined only by careful and thorough sampling, which in view of their extent would be an expensive undertaking. Little reliance should be placed on the returns from a few samples that may represent but a small fraction of the material that would have to be handled in working the deposits. Hydraulicking of the bench deposits would be feasible only if a considerable thickness is of workable grade. Certain "pay-streaks" might be won by drift mining, but the gold content would have to be much greater than for surface operations. The sampling of the river-bar gravels presents no formidable problems. The deep river gravels are worthy of special consideration because of the small cost of dredging operations under favorable conditions, but the accurate sampling of these gravels would require considerable painstaking and costly work,

The sedimentary deposits of the Rio Grande valley in Taos and eastern Rio Arriba counties illustrate a number of difficulties that successful placer mining may have to overcome. Disposal of the tailings in large-scale operations would probably interfere with farming along the Rio Grande to the south and would, no doubt, meet with objections from sportsmen because of its detrimental effect on fishing in the river. The numerous large basalt boulders would undoubtedly cause complications in dredging operations along the channel, and the occasional flood stages of the Rio Grande would have to be considered,

Detailed and accurate data on all features of these and other similar deposits should be obtained and properly evaluated prior to any large expenditure of money for promotion, equipment or operation.

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