1909-1910

BIENNIAL REPORT

STATE BUREAU OF MINES

COLORADO

Compliments of

STATE OF COLORADO

T. J. DALZELL

Commissioner of Mines

REPORT *of the* STATE BUREAU OF MINES

DENVER, U. S. A.

T. J. DALZELL, *Commissioner*

COLORADO

FOR THE YEARS 1909-10

LETTER OF TRANSMITTAL.

Office of the Bureau of Mines.
State of Colorado.

To His Excellency,

JOHN F. SHAFROTH.

I have the honor to transmit herewith the report of the Bureau of Mines for the years 1909 and 1910.

Respectfully submitted,

T. J. DALZELL,
Commissioner of Mines.

During the past biennial period the Bureau has had the full and zealous co-operation of its inspectors in the various districts into which the State is divided for this purpose. For the Cripple Creek District, M. J. McCarthy; for the Gilpin County and Clear Creek section, W. H. Parenteau, and for the Leadville and Southwest District, John R. Curley, have all given the Department and the State the most energetic service, and have fully looked after the interests of the Bureau of Mines in the field.

The mine managers and mine superintendents generally have shown this Bureau many courtesies, have promptly responded to its requests and recommendations; and the thanks of the Commissioner are hereby extended to them.

In the matter of yearly reports of the various mines, the Bureau wishes to state that it has received more responses in 1910 than in any previous year, and to add that many of the reports received are in commendable detail, thus giving the Burau exeellent information regarding the operation and production of the mines throughout the State.

The Commissioner has experienced during this period a great need for increasing the work of the Bureau so that it could collect and preserve important statistical information. In no other way has the State provided for the collection and preservation of such data.

To this date the library of the Bureau contains a complete list of the Survey Publications, constituting the Monographs, Professional Papers, Annual Reports, Bulletins, Water Supply Papers, Mineral Resources, Maps and Geological Atlases.

The Commissioner takes this opportunity to express to President Alderson and the School of Mines at Golden, and to Professor R. D. George, of the State University at Boulder, his thanks for the favors extended the Bureau in the past two years. He wishes also to express his obligations and thanks to Mr. John R. Wood, and the Metal Mining Association of Boulder County, for many courtesies and material assistance.

The Press of the State has extended the Department many courtesies during the past two years, and the Commissioner begs to state his appreciation of these favors, which have been of material assistance.

The accidents and fatalities for the biennial period are about the same in number as in the previous two years.

No exact record of visitors to the Mineral Collection can be preserved, but a careful estimate has been made, showing that upwards of 50,000 people annually inspect the cabinets and go through the museum.

In the year 1895, Mr. Harry Allen Lee, then Commissioner of Mines, recognizing the value of the Dr. John Elsner Collection, and realizing the fact that the collection contained many rare minerals that were discovered early in the history of the State and might not be duplicated, made an arrangement with Dr. Elsner for the purchase of the collection for the State, at a price of $15,000, and had the collection placed in the Bureau of Mines, with the hope of raising, by subscription, donations of monies or legislative appropriation, the necessary amount to complete the purchase. Through the efforts of Mr. Lee, $2,500 of this amount was raised and paid to Dr. Elsner. No further payments having been made, in 1907 a very liberal offer was made to Dr. Elsner for the collection. He was inclined, much against his wishes, to accept the offer, and remove the minerals from the exhibit at the State Capitol. At this time, in order to retain the collection for the State, it was necessary to raise funds in some way and make a payment to Dr. Elsner. The Board of Capitol Managers, realizing the necessity of keeping that collection of minerals in the State, advanced $2,500, with the understanding that an effort would be made to have the next General Assembly make an appropriation to pay the balance due. In compliance with this arrangement, a bill was introduced in the Seventeenth General Assembly for an appropriation of $10,000. This was cut down by the Finance Committee to $5,000, and was passed, Dr. Elsner having agreed to wait two years for the remainder.

A bill for an appropriation of $5,000, to make final payment to Dr. Elsner, is now being considered by the Eighteenth General Assembly, and will undoubtedly pass. Thus the Dr. John Elsner Collection will become the property of the State of Colorado.

Only the earnest desire of Dr. Elsner that this collection should always remain in the State of Colorado made it possible for the collection to remain in the Bureau of Mines for all these years.

COLORADO'S MINERAL RESOURCES.

The accompanying tables, giving carefully collected figures of the mineral output of Colorado for 1910, show the State's production to be $33,000,623.74, divided as follows: Gold, $20,297,535.69; silver, $4,392,735.72; lead, $3,158,380.54; copper, $1,048,834.60; zinc, $3,366,437.41, and tungsten, $736,700.00. The mineral output for 1909 was $33,211,527.32, divided as follows: Gold, $21,946,684.13; silver, $4,587,643.34; lead, $2 765,511.72; copper, $1,220,641.95; zinc, $2,295,045.88, and tungs ten, $396,000.00. The total metal output for the State in its entire history therefore reaches the magnificent sum of $1,085, 303,804.10.

Many changes are disclosed in the comparison of the above figures with those for the years 1907 and 1908. The production of precious metals has fallen off slightly, that of lead has in creased a little, and the output of zinc has grown 47 per cent since 1908. Probably no more marked instance of conserva tion exists than is illustrated by the State's production of this metal. In all the years of the smelting industry, we knew of zinc in large quantities in the ores, but we knew no good of it in its form of occurrence and admixture with the metals we desired to save. Hence we penalized it by a charge for each per cent. over and above a given figure, and forthwith proceeded to waste the metal in furnace slags, deploring the fact that it could not all be so disposed of, and that some of it returned to curse us in the form of furnace products, necessitating re-smelting. Now, the situation has been changed by the inven tion and application of methods of zinc concentration and re covery that have resulted in the orderly procedure of saving all the metals in an ore. These advances are elsewhere de scribed in this report.

Thus, while Colorado has lacked advancement in respect to the production of some of the metals, the State has gone for ward in its old-time way as the pioneer in new fields of met allurgy. There only needs to be a revival of the business of prospecting to complete the picture and, with the discovery of much-needed new fields for mining effort, bring our State to its former position of leadership in production of all the heavy metals except copper.

Cripple Creek has still remained our great gold-producer, and the completion of the Roosevelt Tunnel gives guarantee of continued prosperity in that section. To this prosperity the more general application of cyanidation to the treatment of low as well as medium-grade ores will greatly add. Leadville has added one-third in 1910 to its 1909 mineral production, entirely

by reason of the new discoveries of immense bodies of carbonate of zinc left in the old upper workings of the principal mines, many of which had been considered as worked out and ready to be abandoned. Boulder County's tungsten production is very large, while its gold output remains about the same. The output of vanadium has in the past two years become an important factor in the State's metal and mineral production, and that of uranium gives promise of increasing. On the whole, Clear Creek and Gilpin County sections have done very well, and hold out a bright prospect for the present year. In the Southwest much has been accomplished in advanced milling operations upon low-grade ores, maintaining the gross output under some otherwise unfavorable conditions, and furnishing the basis for expectation that the business of local ore treatment is certain to grow to large proportions in the coming biennial period. Gold-dredging should show a doubling in the same period. New fields for placer operations have been discovered, and the values in the old ones have been shown to be figures per cubic yard far in excess of those of the long-operated and well-known California regions.

STATISTICAL REVIEW.

In the years 1909 and 1910 the value of the precious and base metal production, exclusive of iron, is shown by the following table, which includes the production for the years 1907 and 1908:

Year.	Value of Mineral Production.
1907	$41,399,834.55
1908	33,283,010.91
1909	33,211,527.32
1910	33,000,623.74

The detailed production by counties will be found elsewhere in this report. While the fluctuations in the selling price of all the metals except gold would present some facts which would slightly affect the percentages above given, no attempt will be made to exhibit such differences beyond giving below the average prices, New York market, for the silver, lead and copper for the last four years.

AVERAGE METAL PRICES, NEW YORK MARKET.

YEAR.	Silver.	Lead.	Copper.	Zinc.
1905	.6035	.047	.1559	.0588
1906	.6679	.05347	.0927	.0619
1907	.6533	.0534	.2014	.0620
1908	.5283	.0421	.1326	.0458
1909	.5150	.04273	.1210	.0550
1910	.5347	.0449	.1263	.0539

In the past two years one main branch of ore-treatment operations has suffered a notable and distinct decline in activity. The smelting industry has been operated by the American Smelting and Refining Company in the four plants at Denver, Pueblo, Leadville and Durango, at reduced tonnages, reaching at present to little more than half capacity. A lack of ore production, occasioned in part by the prevailing low prices of the metals in 1910, has been one of the causes of this decline. Other causes have combined to produce this temporary depression in the mining industries, among which should be mentioned the lack of prospecting for new finds of mineral, and the railroad freight rates prevailing in some sections of the State.

The smaller amount of prospecting is chiefly due to the restrictions which the withdrawals of land from the public do-

main have put around the prospector, rendering him less anxious to prospect, and quite unwilling to be substantially under the orders of a range rider as to whether or not his discovery shall be allowed him.

In the southwestern part of the State the prevalence of uniformly high freight rates has likewise limited mining growth by embarrassing the small producer of ore, who naturally has no milling or concentrating facilities at his command, and who must therefore ship his output to smelters. The large producer is not so affected, since he is able to apply concentration or cyanidation aids either to reduce his tonnage to be shipped or to effect a complete commercial extraction of value.

These evils, while not perhaps constituting all the difficulties that have hedged progress, comprise two most important ones, the definite influences of which have frequently come under the observation of the Bureau of Mines. Relief from these drawbacks is being discovered in a partial way by some of the individual mines in the section most affected, and it is taking the form of more intense application of methods of concentration and extraction, to the end that a smaller net shipment in tons results from the treatment of an equal or increased tonnage of ore.

Smelting in lead shaft furnaces still constitutes the chief method of treatment for the ores produced by the State. During the past two years, while, as compared with the two previous years, the lead output of Colorado has fallen, and with it the silver production also, the American Smelting and Refining Company has made economic advances in connection with the production of new and useful products out of waste and by-products of their plants. Among these are oxide of arsenic, or the white arsenic of commerce, cadmium metal and oxide, metallic zinc in the form of zinc dust for cyanide use, and cobalt products. The new zinc ore production of Leadville, being mined out of the upper and abandoned stopes of the old properties, means another advance for the State; and, coming as it does with a decline in lead production, it furnishes a cheerful relief to what would otherwise be a more serious situation. We therefore see a practical illustration of conservation, and have, in a sense, two blades of grass where but one grew before.

Among the other smelting plants in operation in the past two years and previously, one, the Argo works of the Boston and Colorado Smelting Company, closed its career in March, 1910, after a history of nearly forty years. Scarcity of copper ores in Colorado's production caused the stoppage of the plant, together, perhaps, with a closer competitive market for such ores as are purchased by smelters using lead as a base instead of copper. During 1909 and 1910, the Salida Smelter, of the Ohio and Colorado Smelting Company, ran on a somewhat curtailed ore supply, due to the same causes that affected the out-

put of the American Smelting and Refining Company—a reduced production of lead and silver ores. In the past year the North American Smelter and Mines Company began operations at Golden, drawing its ore supply chiefly from the Clear Creek Mining District. An innovation in the smelting business failed in the early part of 1910, after a desultory operation extending over the twelve months previous—the Modern Smelting and Refining Company, at Utah Junction, adjoining Denver.

In zinc-smelting the United States Zinc Company, at Pueblo, has continued full operations during the past two years, with a plant consisting of six furnaces and 1,440 retorts or Rhenish furnaces with muffles. The new and important zinc-ore production of Leadville naturally gives promise of expansion of the business of smelting zinc in Colorado, whether in Pueblo or elsewhere. The production of zinc ore in the State is far in advance of the reduction of the same to spelter. In 1907 Colorado produced 142,510 tons of zinc ore, as against 114,000 tons for 1906, with a production of only 5,200 tons of spelter for 1907, and 6,260 tons for 1906. In 1907 the State's production of zinc ore constituted about 16 per cent. of that of the United States. The range of prices for zinc the past four years has been as follows:

1907	.0620
1908	.0458
1909	.055
1910	.0539

The milling branch of the ore-treatment industry of the State has been in fuller operation than the smelting branch during the years 1909 and 1910. The Cripple Creek production of ore has been mainly treated by the mills; of these, the Golden Cycle, the Portland and Standard plants, at Colorado City, have treated together a monthly tonnage of about 46,000 tons of ore, of an approximate value of $20.00 per ton in gold.

As anticipated in the last report of the Bureau of Mines, the excellent example of extraction, daily tonnage, and tonnage cost, furnished by the Golden Cycle Mill, has been a stimulus to the increased application of cyanidation to the treatment of low-grade ores of the Cripple Creek District. The Portland Mine has constructed a low-grade-ore treatment mill at its mines and is crushing low-grade dumps in cyanide solution, following it with concentration and the shipment of concentrates to the roasting plant of the company at Colorado City for final treament. The low-grade treatment plant of Stratton's Independence, Limited, was built in 1909, and has been in constant and increasing tonnage operation ever since. The ore is from dump saving, and contains about $3.60 per ton average value. Both these mills treat the ore in a raw, or unroasted, state. There are some five or six other locally situ-

ated mills in the Cripple Creek District, all of which have been in operation during the past two years on ores of too low a grade to bear railroad freight shipment charges. The success of these plants has been constant, and it has been fully demonstrated that the low-grade material available for such treatment is practically unlimited.

The process of chlorination treatment, followed by a cyanidation of the tailings, has continued to be the method of treatment used in the Portland and Standard plants, at Colorado City, both of which have been in continuous operation during the past two years.

In the Golden Cycle Mill process, the ore is roasted in Edwards furnaces, ground to twenty-five-mesh in cyanide solution, classified and leached as to its sands, with vacuum filtration of the slimes. The plant has treated, in the year, 312,000 tons of ore, making a very high extraction of value at a low cost per ton.

In other districts in the State milling or concentration processes have been in constant use, as before. The Georgetown District will have, in the year 1911, in addition to the usual stamp-milling methods, a new method of the application of dry chlorination, known as the "Malm Process," to the treatment of the base ores which the section produces. The results of the new process will be awaited with deep interest by ore-producers all over the State. It is becoming more and more necessary for the mine-owner to render himself somewhat independent in the matter of the local treatment of his ores; and if he can find relief in this new process, or in the application of any present practiced methods, the production of all our camps will see great increases in tonnage and value in the present year.

In the San Juan District, ore treatment is conducted in the usual way of stamp crushing, and at several plants in Telluride and Ouray. At the plant of the Liberty Bell Gold Mining Company, eighty stamps are in daily use, crushing about 400 tons of an average value of about $9.50 to $10.00 per ton. The extraction attained is extremely high, being 88 per cent., and done at a cost of mining and milling of $5.00 per ton, with excellent prospects of further reducing this figure.

In connection with the industry of mining zinc ores, numerous plants for the preparation and concentration of the ores to about 30 per cent. zinc content, or upward, have been established in the past two years. These plants are based mainly on crushing, followed by roasting and magnetic separation of the iron from the roasted product, and subsequent separation of zinc from lead on concentrating tables of various design. The Western Chemical Manufacturing Company, of Denver; the American Zinc Extraction Company, of Leadville; the Wilson Mining Company, of Robinson; the Kokomo Metals

Company, of Kokomo, and the Eagle Mining and Milling Company, of Red Cliff, are at present operating plants, in addition to the ore-dressing department of the United States Zinc Company, of Pueblo.

The Empire Zinc Company, of Canon City, has in the past two years exhibited unusual activity in the business of zinc-ore concentration, and has, perhaps, more than any other company, indulged in much experimental work intended to determine the most advantageous methods of ore-dressing to be applied to the various ores.

The problems connected with the mining and metallurgy of zinc furnish a distinct and broad field, and questions are already presented which not only affect the phase of percentage extraction of zinc, or zinc and lead when two metals are to be saved, but concern ways and means of cheaply concentrating the large tonnage which the new finds in Leadville are providing. Necessarily, most of this gross tonnage will be of a grade too low to ship to the zinc smelters, and will require concentration.

As stated, the chief advance in practical metallurgy of concentrating has beneficially affected the business of treating the rebellious sulphide mixtures of lead, zinc and iron. Many of these are extremely low grade, carrying as low as $1.00 per ton in gold, 5 ounces of silver, from 3 to 7 per cent. lead, and the balance consisting of sulphides of iron and zinc. The zinc content approximates from 18 to 25 per cent. No one or two metals are sufficiently valuable in such a mixture to warrant the material being considered payable ore, and it is necessary to effect a large saving of each in order to produce a profit. The method usually pursued is to give the ground ore a quick roast to effect a coating of magnetic oxide over the sulphide, remove the iron by a magnetic or an electrostatic separator, pass the resulting zinc lead sulphide, mixed with gangue, over concentrating tables, which effects a separation of zinc sulphide of about 40 per cent. grade zinc, a lead sulphide concentrate running close to 70 per cent. lead, and a waste tailing usually containing 1 to 1.5 ounces of silver. The result in percentage savings means close to 80 per cent. of the lead and precious metals, and about 65 per cent. of the zinc. The iron concentrates command a profitable price also, and the net result is a commercial profit in mining and concentrating such ores, which were, until the past two or three years, considered absolute waste. No better example of conservation could be cited, and when it is remembered that in Colorado new treatment plants are already treating nearly 1,000 tons daily of such product, its importance to the welfare of the State is very great. These plants are the American Zinc Extraction Company, Leadville; United States Zinc Company, Pueblo; Wilson Mining Company, Robinson; Kokomo Metals Company, Kokomo; Eagle Mining and Milling Company, Red Cliff; and the Western Chemical

Manufacturing Company, Denver. In the Creede District the plants long since established are adapted to treating an ore carrying much less iron than the above mentioned, and consist of jigs and concentrating tables. They have no magnetic or electrostatic equipment, such as is made necessary by the presence of considerable percentages of iron sulphides in the above cases.

The growth of the cyanide process has been great in Colorado in the past two years. The tendency has been to grind very fine, and to nearly or quite slime the ore in the first grinding or in the tube-mill grinding. Unquestionably the extraction has thereby increased by from 5 to 12 per cent. over the practice of former years.

The ore-grinding machines which have been applied with advantage to cyanide practice are principally the Chilean mill and the tube mill. The former are producing excellent results on moderately hard ores, and are most economically installed and operated in comparison with other mechines of equal tonnage capacity. It is common to grind from 6,000 to 9,000 tons of ore without re-dressing the rollers. They are extremely compact machines, and are operated with a comparatively low consumption of horsepower, due chiefly to the momentum of rapid revolution. Tube mills are being lengthened, and it is found that the capacity is increased in greater proportion than the consumption of power.

Mechanical aids to subsequent classification, agitation and filtration have kept pace with the necessities introduced by fine grinding. Various machines have been introduced and many tried in the practice of this State. Their respective merits, from a cost and tonnage standpoint, are not yet weighed to the exclusion of any and the exclusive use of one. Naturally, greater interest has attached to the devices to assist slime filtration. The old method of use of zinc shavings for precipitation of the gold out of the solutions is rapidly being superceded by the use of zinc dust. While no tonnage cost economy is attained, the latter method permits the constant cleaning up of the values in the solutions, with only the delay of permitting a filter press to become charged; the older method necessarily entailing the use of a great many zinc boxes, of which the larger number must always be in use.

The newly published and exploited "Clancy Cyanide and Cyanamide Process" is said to be about to be introduced in the Cripple Creek District, and a mill constructed to operate it along the exact lines as published by the inventor.

In Boulder County there is opportunity for the application of the same economies in the handling of its sulpho-telluride ores as have already been demonstrated in the Cripple Creek District. The cyanide process, as already applied to low-grade ores of Cripple Creek, is particularly adapted to well-

known large low-grade deposits in Boulder County. One plant of 100 tons daily for custom business has already been projected for 1911. In the same way the great success in Mexico in cyanide treatment of silver ores may be usefully applied in Boulder County district of Caribou. Later development and application of the promising Clancy Cyanamide Cyanide Process to Cripple Creek will, without doubt, make the new process a success for Boulder County gold ores of the sulpho-telluride class, which now require the comparatively expensive method of roasting to free the gold for cyanide or other treatment.

The Georgetown District has seen, during the past year, the completion of two new enterprises, which will play an important part in the added prosperity of the Clear Creek and Gilpin County sections of the State. Both will mark an advance in practical conservation, and the result will be, on the one hand, an increased production of ore of the usual former average grade, a new production of lower-grade ores, both at some reduced cost per ton over former figures, and a cheaper and larger concentration of values on low-grade ores, from which the concentrates will be shipped to the smelting plants. The former is the Newhouse Tunnel, completed last year, and the latter is the new Frontenac Mill.

Commercial clubs and associations in various parts of the State have been already useful in advancing the interests of the sections which they serve. In mining matters they have been useful in originating new interest in their particular fields, and several instances have come to this Bureau of the resumption of work on old mining properties through their effort. These, and other similar influences that may result in mining and new prospecting, will be most welcome to this important industry of our State. The Bureau has made the acquaintance of the commercial associations of Ouray, Silverton and Telluride, and of the Metal Mining Association of Boulder County.

Both the long-established smelting industry, dealing with shaft, roasting and reverberatory furnaces, and the gold-milling industry yearly present problems the solution of which vitally affects the mining industry of the State, since all such improvements result in some division of the good accomplished, by which the producer of the ore reaps a part of the benefit. In a like way, the problems connected with the more profitable concentration or extraction of value from the ores of the rarer metals, tungsten, vanadium and uranium, are of interest to the producer of such ores, and the successful solution of such questions has added, and will continue to add, to the mineral production of the State.

ZINC CARBONATES.

The finding of enormous bodies of carbonates of zinc in the old upper workings of a great number of Leadville mines has opened a new era for the prosperity of the camp. These bodies were supposed, when encountered, to be spar, and were considered valueless. Such old mines as the Iron Silver, Henrietta and Maid, Wolftone and Louisville, have been proved to contain great amounts of zinc ore, running from 15 to 30 per cent. zinc, and at this time—the early part of 1911— it is estimated that more than a million tons of such ore exist in the old workings of mines opened on the white-lime contact. The full utilization of these deposits will require new metallurgical methods to aid in either their treatment or their concentration. In the past, Colorado metallurgists have not failed in solving such problems, and the State may look for new and commercially successful methods which will permit the mining of these new mineral resources of the Leadville District. These new zinc deposits have increased the production of the Leadville District already 33 1/3 per cent. in 1910, as compared with 1909.

TUNNELS AND DREDGING.

The largest mining tunnels in the State are the Newhouse, at Idaho Springs; the Roosevelt, at Cripple Creek; the Yak, at Leadville; the Revenue, at Ouray, and the Big Five, at upper Idaho Springs. Their use has given the mining industry the highest kind of conservation. They have in many cases closely demonstrated the existence of the veins at considerable depths. They have drained the surrounding area, and are constantly increasing the drainage area they affect. They have reduced the cost of mining ore by largely removing the necessity of hoisting, and they have practically eliminated the wagon transportation. They have assisted ventilation of mines; and, in the Clear Creek District particularly, the methods and cost of ore treatment have been improved and reduced by assembling the ores of the various mines at centrally operated plants located at the mouth of the tunnel, at which points the entire ore product is treated by the usual methods which have for years proved serviceable in this district. The yearly output of Clear Creek and Gilpin counties was in the neighborhood of $4,000,000 twenty years ago, but has declined gradually, until that for 1908 was $2,500,000. The improvements and advances which will now mark the completion of the Newhouse Tunnel will go a long way toward bringing a return of the old prosperity of these two pioneer mining districts. The drainage tunnel will also have a present effect on the new mines opened, making the beginning work easier and of less cost, by reason of relieving the operator of the necessity of pumping.

In the Cripple Creek District the enormous help of the Roosevelt Drainage Tunnel lies in this, that practically all the mines are drained an additional 754 feet, and the use of many separate and expensive pumping plants is made unnecessary. The tunnel is 14,000 feet in length, and was finished in November, 1910, to the extent of first drainage connection being made. Laterals will now be run to tap the various hills or sections of the district. The Cripple Creek District has produced, in its life of seventeen years, approximately 210 millions, More than half of this sum was produced in the first eight or nine years of its history, from the zones in which little or no drainage was necessary or effected. In late years, the production of more than 50,000 tons of ore monthly has shown what has been made possible by tunnel drainage, and there is every reason to suppose that the present tunnel, and other enterprises of like character, will maintain the reputation of the district as the greatest gold-producing section ever known.

The water has begun to fall at a regular rate per day or week—a rate that is practically the same all over the district.

Measurements extending over periods of thirty days give a subsidence of three inches per twenty-four hours. While this seems small now, it must be remembered that it is the drainage from but the one water course thus far cut. Very soon another important channel will be intersected and connected with the drainage course, and the heading of the tunnel will also be advanced. It is likely that the drainage will settle itself to a subsidence of six inches daily, at which rate the 754 feet additional mining territory afforded will be drained in eighteen months. This period will not only suffice to develop the productiveness of this new territory, but also serve to permit plans and organization for the driving of a still lower tunnel, for which the site is already available and the project shown to be feasible at a length of about 30,000 feet.

Dredging in this State is carried on at Breckenridge, and in Routt County only. The past two years have been successful ones. There are five dredges in operation in Breckenridge, most of them working even through the winter, and capable of handling up to 3,000 yards per day. The Reliance is the largest dredge in the district, and is one of two dredges operating in French Gulch; the others are working on the Blue River. The yield is in the neighborhood of 20 cents or 30 cents per cubic yard, and the field offers extremely promising opportunities to the investor and placer miner.

A comparison with similar placer-mining operations in California shows very clearly what may be accomplished in Colorado and to what extensive proportions the placer industry in this State may grow. In California, during the past two years particularly, the State has maintained its position as a gold-producer and reached a figure which enabled it to pass Colorado and regain first place among the States, solely by reason of the use of the great dredges in the placer deposits. It is safe to say that the lode or vein production of gold in California has, in two years, fallen off $3,000,000 per annum, and that in the same period the State's production from placers has increased $5,000,000. At the present time much the larger portion of the total gold product of California is from placer-mining operations. In Colorado the placer gold production is almost insignificant, and our chief district, Breckenridge, should produce millions, where it now adds only hundreds of thousands. Many other known placer deposits of known value exist in Colorado, and should be worked. At similar tonnages dredged, this State can realize California costs per cubic yard, and these are about 6 cents, with some instances of even lower figures.

CONSERVATION.

The industry of mining the country over, whether it be coal or metal mining, has in the past few years suffered an unnecessary setback, by reason of the National Government having allowed the policy of conservation to be carried to what may be termed extreme lengths. It has been manifested here in the enormous withdrawal of lands from the public domain, and their incorporation in various timber and forest reserves, regardless of the fact that in fully half the cases in this State there is not an available foot of timber growing. In this way there is now withdrawn thirty million, out of Colorado's sixty-five million acres. The result has been that prospecting has almost ceased as an industry, and the State practically been debarred from the chance of any new mining field or district being located and developed.

It must be understood that, while the Forest Reserve regulations do not prohibit prospecting work or mining locations, they do, however, make it so difficult and uncertain for the mineral discoverer to secure and retain his locations that the miner has been discouraged from attempting such pioneer work. The prospector is obliged to await the pleasure of the range rider, and be subjected to such a limited intelligence in mining matters before he is granted any valued location claimed. This is only the main difficulty, but it is sufficient to cripple that necessary branch of the mining industry.

MECHANICAL ORE-DRESSING AND CONCENTRATION.

In no biennial period since the establishment of the Bureau of Mines has so great progress marked the science and practice of ore-dressing and concentration. It has been not only in Colorado, but country-wide. Our State has benefited chiefly in ores and minerals of lead, iron and zinc, while other States have noted advances in the treatment of copper ores. The advances have been in larger and bolder operations on low-grade ores, as well as in improvements in equipment and in the resulting saving. In the latter class belong the features of greater uniformity in grinding and sizing before treatment on tables and vanners. Slimes are now entirely removed from the fine sands, and the coarse sands are reground in mills. These features are notably illustrated in the practice at the Independence, Limited, and New Portland Mills, at Cripple Creek, and in the Golden Cycle and Liberty Bell Mills, at Colorado City and Telluride, respectively.

For grinding immediately succeeding crushing, Chilean mills are largely used, both because of their effectiveness in grinding to the required mesh of the discharge screen and for their large capacity. In two instances known to the Bureau, the grinding capacity of these mills is 150 tons per day on 16-mesh discharge screen.

Tables are numerous in makes, though not in types. In the latter respect they are in this State practically limited to the Wilfley, Card and Diester tables, of which the last-named is the slime table which is replacing the belt vanner and the traveling canvas table.

Of classifiers, the drag and spiral types are successfully working in several mills to separate sands from slimes.

Some problems of both mechanical and commercial nature are yet to be solved. This Bureau stated in its last Biennial Report that the treatment of much less than $8.00 per ton ore from the Cripple Creek District was a coming commercial possibility, and its prediction has been fully justified in the present profit being derived from the treatment of ore of slightly less than $4.00 per ton in gross value. Most of this advance has come from the reduced cost and economies effected in mechanical handling, and unquestionably much will yet arise from further simplification of treatment, or by reason of increased tonnage operations; and it is perfectly clear that even $2.50 to $3.00 per ton gross value refractory ore can yet be made to yield a profit. All these advances are helps to counterbalance and atone for some lost ground in the mining field.

TUNGSTEN.

This Bureau referred, in its preceding Biennial Report, to the coming prosperity which tungsten mining in Boulder county was to experience. At present 80 per cent. of the product of the United States is mined and concentrated in Boulder county. It has become the chief mining industry of the county. The problems of effecting a high percentage concentration of the tungsten mineral, ferberite, from its accompanying gangue, has been a difficult one. The tendency of such brittle minerals to slime in crushing has added to the problem. The Monell slimer seems to have solved the question best. It is a long traveling belt of canvas with a feed at one side, discharging at the other, and an end motion.

To the end of 1910 Boulder county has produced $2,465,567.00 in tungsten value, all as a concentrate of about 60 per cent. The tungsten minerals were discovered in 1900 to exist in and about the town of Nederland, but four years elapsed before progress brought the yield in 1904 to 740 tons of concentrates, worth $184,000.00. In the following two years it rose to 928 tons of concentrates, to the value of $348,867.00.

In 1907 the price per unit rose to $14.00, and, with an increased production of concentrates, the output reached about $552,000.00. In the next year the value and production dropped off to about one-half of the last-named figure, and in 1909 it advanced again. The figures for the past two years are:

	Tons Concentrates.	Value.
1909	1,100	$396,000.00
1910	1,535	736,700.00

The price per unit, or 20 pounds, rose in 1910 from $6.50 to $8.50.

The Pioneer Mill, the Wolf Tongue, at Nederland, has had much to do with the development of the tungsten fields. Recently the Primos Chemical people have constructed a plant at Lakewood, below Cardinal, at a cost of $150,000.00, and the district is now well supplied with custom plants. The Wolf Tongue Mill, belonging to the Firth Sterling Steel Corporation, of Pittsburg, Pa., has been the practical dictator of the price of tungsten oxide per unit of concentrates. The 1910 product constituted 80 per cent. of the entire production of the United States.

Much has been learned in regard to the tungsten deposits during these years of work in the field: First, that, while the ore upon the surface is phenomenally high-grade, instead of the ore lying in kidneys or lenses, its occurrence in this county is

always in veins; second, that the deeper these veins were opened, the more consistent they became in size and regularity of the ore bodies, while the values maintained their grade; third, that the area of the occurrence of tungsten had steadily extended, until it was found in paying quantity over a section eleven by thirteen miles, with fair assurance that it would outreach these limits very speedily. The average ore of the county is 10 per cent. This returns the miner $45.00 per ton. A fair prophecy for 1911 is that the output will reach one million dollars. Eight concentrating mills will be in operation this year, with a probability that one or two more will go into commission before the year is out.

Active calls from France and Germany are being made for the metal, and steps are being taken to supply the demand directly from the field.

This year will also see a reduction mill erected in the county in which the ore will be reduced to ferro-tungsten, and the profits accruing to the eastern middlemen be retained at home, besides affording the great saving in freight rates over shipping the concentrates.

The Conger Shaft of the Primos Chemical Company is 500 feet in depth, and the company is now putting a new working shaft down to 1,000 feet. A tunnel has been started on an adjoining tract that will open a system of veins to the same depth. Thus, tungsten production is being placed upon a par with the large mining developments of the State.

The Monell slime-concentrating table has produced such excellent results in both gold and tungsten ore use that it deserves especial mention as one of the agencies contributing to the prosperity of the county. It is an endless four-ply rubber and canvas belt, 53 feet long and 5 feet wide, with corrugated rubber edges. The belt sets on a redwood floor suspended on rods, so that the belt may travel and at the same time be given an end motion of 180 vibrations per minute; thus perfectly simulating a gold pan in concentration and in shaking the fine concentrates to the bottom of the bed. The feed occupies one-half the length of the table on top surface of the belt and a width of 3 feet. The reamining 2 feet of width of the table belt slopes so as to afford a discharge. Thus the wash water carries off the sands while shaking the heavier mineral safely under the bed. It is said that this slimer has raised the saving in gold and tungsten ores from under 70 per cent. to 85 per cent.

The increasing demand for tungsten metal, ferro-tungsten and concentrates from the ores, will furnish employment for hundreds of men in addition to those now employed. New discoveries will undoubtedly be numerous, whether stimulated by lower mining costs, greater prevailing information, or higher prices for the concentrates, and a prosperous year may be

looked for in this particular one of Colorado's mineral industries.

Tungsten in the form of ferro-tungsten, and used as such an alloy, has become a most important factor in the manufacture of what is known as high-speed tool steel. Such tools can be run at a cutting speed up to 100 feet per minute, and endure a consequent dull-red heat without loss of temper. For this purpose tungsten enters into the composition of the steel to the extent of 5 per cent. and upward. One of several other metals assists and is usually employed with tungsten, but the latter is the chief factor in the result attained. Another most important use for tungsten is in incandescent lamp filaments. It is stated on excellent authority that an electric-power saving of 50 to 65 per cent. has already been effected by the tungsten lamp.

VANADIUM.

The development in vanadium ore mining and reduction has not in the past two years been as considerable as was expected. This result is not confined to the scarcity of ore, since the developments of the past six months seem to have shown large deposits of the vanadium mica, roscoelite, in the sandstones exposed along the San Miguel river and the diverging canyons. The industry has been retarded by reason of some difficulties encountered in effecting a salt roast, to produce vanadate of soda without considerable losses by volatilization. The Primos Chemical Company, with the parent organization at Primos, Delaware County, Pa., is operating the reduction works at Newmire, Colorado, formerly owned by the Vanadium Alloys Company. There they employ about thirty-five men and are said to treat daily about 30 tons of vanadium-bearing sandstone carrying 1.25 to 3 per cent. vanadium. The sodium vanadate produced by the ore roasted with salt, is leached out, and subsequently precipitated by iron sulphate or copperas, in the form of vanadate of iron. This product runs 25 to 40 per cent. vanadium, is worth $2.00 per pound, and is then shipped to Pennsylvania, where it is converted into the alloy known as ferro-vanadium, and in this form sold to steel and tool-makers. The Primos Chemical Company, at Newmire, is indisposed to give the Bureau of Mines much information relative to its operations, and no data was obtainable on the commercial extraction obtained in this plant. It is said a two-thirds extraction is being made by the Newmire plant.

Several shipments, probably 200 to 300 tons, were made during 1909 and 1910 from East Paradox Valley, where the American Vanadium Company opened a deposit of vanadium ore high up on the sandstone cliffs or walls bounding the south side of the valley. The deposit was a mixture of roscoeite and carnotite, and contained 3 per cent. vanadium and 1.5 to 2 per cent. uranium. The ore was shipped to the International Vanadium Company, at Liverpool, England.

Many discoveries have been made of vanadium and uranium throughout the canyon valleys of the San Miguel and Dolores rivers. The localities which have already produced in these sections are Snyders and McIntyres, near the Dolores River; Hydraulic and Vixen, at the mouth of and along the San Miguel River; East Paradox Valley, La Sal Creek, and several points along the upper parts of the San Miguel River and Leopold Creek.

Uranium oxides are used in the arts chiefly for coloring purposes in the manufacture of glass and porcelains. Vanad-

ium, when alloyed with iron, as ferro-vanadium has a great value in steel-making. Its hardening and toughening qualities are remarkable. Addition of from one-tenth of 1 per cent. up to one-half of 1 per cent. gives an enormous strength to steel products, and the increase of elastic limit with this use has been found to be 100 per cent. For high-speed tools, and for the highest grade of tools, this metal will be in increasing demand.

CYANIDE MILLING ON CRIPPLE CREEK ORE.

For some years past the cyanide process for the treatment of Cripple Creek ores has been gaining in favor over the formerly generally used chlorination process. The signal success of fine grinding, and the increased extraction produced, marked the decisive victory, and, were it not for the amounts invested, the users of chlorine for the extraction of the gold from the Cripple Creek ores would abandon present practice and adopt the cyanide method.

The large plant of the Golden Cycle Mining Company, located at Colorado City, is, *par excellence*, tthe best of its kind. Its mode of treatment procedure is gyratory crushing, roll grinding, nearly sweet roasting, Chilean mill grinding of roasted ore to 25 mesh in cyanide solution, passing over blankets, and classifying in Dorr tanks. The sand is leached, and the slime agitated and filtered in vacuum presses. The roasters are six Edwards furnaces of 125 to 150 tons' daily capacity, and constitute the best mechanical roasting plant in the entire western country. Mechanical and rearrangement improvements are still being made, and the cost of operation reduced. At no time in the history of cyanidation has so high an extraction been realized in an ore-treatment plant as is being made at the Golden Cycle Mill. It is fully 95 per cent., and the daily tonnage treated is 900. During 1910 this plant produced five millions in gold from ores averaging between $17.00 and $18.00 a ton in value. This was almost 50 per cent. of the entire production of the Cripple Creek District for that year.

The chlorination process of treating roasted Cripple Creek ores has been for years in successful operation at the plants of the United States Reduction and Refining Company and the Portland Gold Mining Company, both located at Colorado City. The roasted ore is treated in large, lead-lined, revolving barrels, with either chlorine manufactured from salt or by the action of sulphuric acid on the bleaching powder of commerce. The gold is dissolved, filtered from out the barrel, and the gold precipitated from the solutions by hydrogen sulphide gas. The tailings, or waste ore, still contain some value to be recovered, and are further crushed in weak cyanide solution, with the usual treatment of such solution to save the gold.

The two chlorination plants above named have a daily capacity of 750 to 800 tons per twenty-four hours. The Cripple Creek District is thus supplied with excellent reduction works facilities, which has undoubtedly had much to do with the prosperity of this great gold-producing section.

The commercial use of the cyanide process of extraction of gold value from the average and low-grade ores of the Crip-

ple Creek District has gone by leaps and bounds. In the past two years new mills have been constructed in the district and put into operation on ores of $4.00 per ton and even less in value. The first to be built and operated was the Independence Mill, on the Stratton's Independence, Limited, Mine. It was at first intended that the mill should operate exclusively on a former waste-ore dump which had been carefully sampled by test shafts sunk in it and estimated to contain slightly more than a million tons of $3.60 average value. In its first year of operation it handled over 200 tons per day of this material, and as a result of such practical test the plant was increased to 350 tons' daily capacity in early 1910. It is running at this rate and treating monthly from 8,500 to 9,500 tons of material. Of this, about three-quarters is from the low-grade ore dumps above referred to, and the balance is the mill grade out of the mine, carrying perhaps an average of $7.00 to $8.00 per ton in value. These products are delivered to separate crushing plants, from which they go to the Chilean mills; and after this grinding and classification succeeding it, the sands are tube-mill ground. The table concentration is carried on by Wilfley and Deister tables and vanners. The pulp is then pumped to the cyanide tanks for final treatment. Drag spiral classifiers are most successfully used to separate the sands from the slimes. The concentrates carry between $85.00 and $110.00 per ton in value, and constitute about 40 per cent. of the product of the plant. Considering the low grade of the dump material handled, a very high extraction is made and at an extremely low cost. Throughout, the plant is automatic. Its results must be extremely gratifying to the management of the mine, and constitute also material dividends to the shareholders. There is full ten years' supply of dump material for treatment.

The low-grade-ore mill of the Portland Gold Mining Company to treat ore dump material, and the mine output not heretofore shipped to the company's chlorination plant at Colorado City, was erected in the first half of 1910 and started in the fall of the same year. The low-grade mine or dump ore is delivered to the mill in five-ton side-dumping cars operated by the third-rail system. It is broken in a very large Dodge crusher, and from there goes to two crushing-rolls, size 18″x48″. The product is about 1½ inches maximum size, and is conveyed by a long traveling rubber belt into the main mill building, where it is distributed into four steel tank storage bins set above the same number of Chilean mills. These have each a capacity of 100 to 125 tons per day. The ore is ground in cyanide solution of strength of one-fortieth of 1 per cent., and is discharged through 25-mesh screens from these mills to Wilfley concentrators, which give the first table concentration. From this it goes to Card concentrating tables, which are operated to recover the finer portion of the concentrates. The plant has the Deister treatment. The ore pulp from the tables is then handled by table on trial on this material, intended to supplement the Card

tables. The concentrates, which are about 20 to 25 tons daily from 350 to 400 tons of low-grade or dump ores, carry approximately $30.00 per ton in value, and are shipped to the company's chlorination works at Colorado City for roasting and further Akins classifiers (large spiral conveyors set at a flat angle), which separate the sand from the slime. After two washings these sands are discharged to the waste dump, since it has been found that their value is negligible when the plant is running on the hard, low-grade ore from the present mine operation. The slimes and solution material are conveyed to agitators designed by Rothwell and Akins, and the solution is filtered off by the large Portland revolving slime filter, which operates very well.

The clear solution is then precipitated by zinc dust, and the gold slime filtered in Merrill filter presses. This product is packed in sealed tin cans, holding each about 300 to 400 pounds of the wet gold slime, and expressed to the plant at Colorado City, where it is refined for sale to the United States Mint. In connection with the agitation treatment the company uses a secret method devised by some of the working staff and known as the Crow-Tippett process. The plant is handling nearly 400 tons daily of low-grade material, and at a cost per ton of $1.50 or under. The recovery on the material referred to is probably around 75 to 80 per cent., and is highly creditable to the company.

Power is all electrical, purchased of the Colorado Electric Power Company at Canon City, and the average load is approximately 350 horsepower.

Unquestionably these two mills operating on low-grade ore have already successfully demonstrated that there is a slight margin of profit in handling ore as low as $2.50 per ton at a rate of 350 tons per day or upward. Thus we see the cyanide method applied successfully to grades that we heretofore considered could only be profitably worked by methods such as used at the Homestake and Treadwell plants, and at tonnages of upwards of several thousand per day.

THE SAN JUAN SECTION.

The ruggedness of the mountains of the San Juan country, and the difficulties of mining operations in that particular portion lying between Ouray on the north and Silverton on the south, afford excellent illustrations of that enterprise of the Colorado miner in overcoming material difficulties which has made him a leader in the business of mining in entire western America. Perhaps nowhere in the extent of the Rocky Mountains are the mountain peaks more precipitous or more closely adjacent to each other.

Treatment of low grades, demonstrated first as commercially possible by Stoiber and Terry on the Silver Lake and Sunnyside properties respectively, followed by the Gold King and others, has been, and will continue to be, the secret of success in the Silverton District. With universal delivery of electrical power to any point, no mining operation need be interfered with or stopped by winter weather, provided only that a winter's equipment of provisions and supplies is first laid in. Even the formerly much-feared snowslides need not longer be considered a bar to the prosecution of winter mining operations in the southwest sections of the State.

The coming year promises to see great improvement in the operation of several old properties, due to more efficient metallurgical methods. This is particularly true with respect to lead-zinc ores of this portion of the San Juan, and the same success will here attend magnetic concentration and ore-dressing as has so greatly increased the zinc output in the central part of the State.

The Telluride Power Company, with its plants at Ilium, Telluride, Ames, Ouray and Silver Lake, is playing a part of increasing importance in developing the San Juan section. Coal for power is a thing of the past; and while heretofore mining operations could not be conducted in many places in winter, the season makes no difference with the transfer of the electric current. In this way many of the smaller mines are growing.

The Liberty Bell, Smuggler Union, Tomboy and Japan Mines all have their large mills, and employ 1,000 men daily between them. Other properties, such as the Black Bear, Lewis and Alta, operate their own plants in smaller ore productions, and are doing very well.

Special mention may be made of the Liberty Bell Mine and Mill, since it has taken such a prominent place as a profit-earner. In age, it is one of the youngest of the mines. It is connected with the mill by an effective tramway, delivering 400 tons at the rate of two buckets per minute, each bucket holding

one-third of a ton. The tramway operates ten hours per day. Eighty stamps crush the ore through a 16-mesh discharge screen, and, after passing over amalgamation plates, the pulp is concentrated on Wilfley tables for a rough saving only. The sand and pulp is then ground in tube mills, after which it is passed over Deister tables for a second concentration. All this crushing and concentration is conducted in very weak cyanide solutions. From the Deister tables the pulp goes to slime settlers and classifiers, and thence to four Moore filters. The cyanide solutions carrying the gold are precipitated in zinc boxes. Gold exceeds the silver in value in dollars, and the mill treatment is saving 94 per cent. of the gold and 67 per cent. of the silver, making an average extraction in dollars of 88 per cent. The net product is about $100,000.00 per month, on a gross value of $11.00 ore. It is expected that their total cost of mining and milling will be reduced to $4.00 per ton the coming year. The Liberty Bell is by far the banner mine for San Miguel County.

At the Smuggler Mine 30 stamps are dropping in one mill most of the year and 80 in the other plant of the company. A number of lessees have been at work on part of the mine the past two years, and a large force of men has been on the property most of the time.

The Tomboy Mine and Mill has continued its regular production with 200 men, and the Japan Flora Mines are preparing to largely increase their output.

The Rico section of the San Juan presents very great possibilities to the prospector and miner, and may be termed practically virgin territory. Outside of the fairly well-developed properties of the United Rico Company, the section may be termed a new field. Several well-known properties to the west, not extensively operated in the past twenty years, are now being opened. These lie in the region of Anchor Mountain. New production has been made in 1910.

In the older developed mines of Rico much interest attaches to the recovery of zinc, which exists in considerable percentages, and was heretofore not only wasted, but was a detriment to the value of the ore. It now increases the value of such ores to a greater extent than it formerly reduced it. The newly adapted successful methods of wet dressing and magnetic concentration are highly applicable to these ores.

The largest operating company in the Rico District is preparing to reopen the mines of Newman Hill through the Syndicate Tunnel and explore the lower shale and lime contacts for other and new deposits of ore, and to determine the present unsolved question of whether or not the veins and ore channels below present workings are enriched as were the upper ones; or, if the primary ore carries sufficient value to pay on modern cheapened methods of treatment, which have given higher recoveries in every direction.

In the Ouray division of the San Juan section the mining industry had a great improvement in 1910. Part of this was due to new activity in prospecting in Ouray County and to the production of some small properties. There is a smelter of small capacity being built at Ironton, and successful operation of it will mean a great deal for the district. The two largest properties, Revenue and Camp Bird, have been in full operation the entire year of 1910. The close of the year marks a successful producing life of thirty-five years for the Revenue Mine and Tunnel. The Camp Bird is the banner mine of the San Juan section. In 1910 it paid dividends of nearly 20 per cent. on its capital stock of a little over $5,000,000.00, and made a production of two million dollars in silver and gold, together with two and one-quarter million pounds of lead. The company has thus far opened but a small portion of its acreage, and while some of the present productive area has not shown satisfactory development in the last portion of 1910, the immense territory owned by the company gives the mine a long life yet.

WATER POWER IN MINING.

The Colorado Rocky Mountain Range, while higher than the Sierra Nevada and Coast or Cascade Ranges of mountains, does not present such spectacular opportunities as the two last named for the utilization of water power from harnessing the streams that have their origin in the great inter-mountain or Continental Divide watershed. In the Pacific Coast mountains the fall is usually much and steep within a few miles of flow of the streams, and it has been comparatively easy to take economic advantage of the existence of the natural great storage lakes, or to lead considerable flows of water by ditches to a point of precipitous drop or fall. Thus, in California several water-power plants between 50,000 and 90,000 H. P. have been established, and the power conducted to San Francisco and other California cities where manufacturing thrives. In Oregon, Portland has several similar large installations, which entirely provide for lighting and traction company power, as well as to operate mills and factories. Only recently a new installation has been begun on the John Day River, at a point where it runs in canyons before reaching the Columbia. Farther north there is a 30,000 H. P. plant at Electron, with the power produced by some of the streams which rise around Mount Tacoma, a peak 14,400 feet high and towering that great height from practically sea-level datum. Above Seattle is the Snoqualmie installation, where the full volume of the river of the same name is made to fall in a vertical shaft upraised from the bottom of a 368-foot falls. In this way 25,000 to 30,000 H. P. is produced, and the Electron and Snoqualmie plants furnish light and power for the cities of Tacoma, Seattle and Everett, besides operating the street railways, interurban lines and many factory plants.

Colorado was, by reason of the absence of these marked strategic advantages, somewhat tardy in working out similar commercial plans. Many small isolated and individual plants have been known in mining sections for operation of mills, but it remained for two large companies to come later and furnish commercial power from water equipment, with the auxiliary of large coal steaming plants to operate in cases of emergency or accident. Great commercial development has been always associated with cheap power, and it follows, therefore, that the present availability in Colorado of power at moderate cost is to be succeeded by manufacturing growth and expansion. This has been the history of the cotton-mill industry of New England years ago. It was succeeded by similar growth in the South, when the rivers were controlled and their fall and flow utilized

for the development of power. Thus a large portion of the business of cotton goods manufacture has been transferred from New England to the sections where cotton grows. Not alone, however, must the power exist and the commercial industry be possible, but the two need the aid of electrical transfer to make them properly available for mankind.

It is in joining these two elements that the two largest companies of the State have marked an advance, and the plants of the Northern and Central Colorado Power Companies have come to serve the mining and metallurgical industries, as well as the manufacturing. The Central Colorado Power Company has established its Shoshone plant on the Grand River, and has developed 25,000 H. P., which it brings through Denver at high pressure, and connects the lines with those of a similar plant at Boulder, which is to operate on reservoired water in distinction to the power developed on the western slope from flowing water. Each plant will be of 25,000 H. P. capacity. Distributing lines operate throughout the mining sections covered by this long transmission line, and Red Cliff, Leadville, Breckenridge and Boulder are already supplied with their magnificent power. At Idaho Springs the Central Colorado Power Company has an auxiliary hydro-electrical plant, which gives that section continuous service and supplies mines and mills with power, manufactured there from the local streams. The Northern Colorado Power Company develops its power directly from coal at its Lafayette plant, and, while not serving the mining sections to so great an extent, is still an important factor in the State's newer industrial development.

Of rates charged by these companies for the operation of mine hoists and equipment, mills, reduction works and dredges, nothing can be said but praise. The charges are adjusted to figures which range around from one-half to three-fifths the former costs for coal. Besides this, service is afforded at places that were heretofore out of the reach of coal, and the business of mining and lessened costs in mining have been materially advanced.

The Colorado Electric Power Company, at Canon City, has been in operation for thirteen years. It was established primarily to furnish power for the Cripple Creek Mining District, and proved immediately to be a great boon to mining operations in that district. Previously, the mines were subject to a charge of $5.00 per ton for coal to generate steam power, and the coming of electrical power not only materially reduced this feature of mining costs, but gave the camp an unfailing power supply. It further aided the smaller operators and lessees who would not otherwise have been able to conduct mining operations. Later, its power has been used also by the cities adjacent and by the Colorado Fuel and Iron Company in its coal mines throughout Fremont County.

The power is generated from cheap coal, and the maximum load is 6,600 H. P.

This great business and aid to mining has sure fields of development in the southerly and southwesterly mining sections of the State. The Trout Lake Plant and the Telluride Power Company have already done a great deal, but still cheapened power for mine and mill operation is certain to yet come to the San Juan country from further harnessing of the mountain streams everywhere falling out of the high sections. The high mountains are here; reservoir sites abound; the great streams that constitute tributaries to some of our country's largest and most majestic streams have their origins in the Continental Divide; and it is certain that hydro-electric power is sure to play a very large part in the mining industry of this, the foremost mining State of the Union.

IRON AND IRON ORES.

The production of pig iron in Colorado for the biennial period closed December 31, 1910, was:

1909	310,779 gross tons
1910	373,407 gross tons

As Wyoming and New Mexico produced the bulk of the iron ores from which this tonnage of pig iron was manufactured, the figures below, representing the production of Colorado, bear but a small proportion to the total. The Wyoming production is from Sunrise, and the New Mexico output from several separately located mines.

The Colorado production of iron ore was entirely from the Orient mines in Saguache county, and for the past two years was as follows:

	Iron Ore.	Manganese Ore.
1909	10,413 tons	.....
1910	11,975 tons	947 tons

No Spiegel iron was produced by the Colorado Fuel and Iron Company during the biennial period.

In addition to these figures, Colorado mines produced, mainly from Lake County, 52,194 tons manganiferous iron ore, of a value of $234,873.00, which was used as flux in the lead-silver smelting industry.

GRANITE AND BUILDING STONE.

Gunnison granite is a term of almost as wide a use and meaning as Vermont granite. Indeed, the two are as similar in strength and value, from the building standpoint, as two stones could be. The only difference is one of color, due to the feldspar in the Vermont granite being white or whitish in color, while the feldspar of the Gunnison variety is pink and red. The numerous quarries producing building stones, such as sandstone, lava stone, slate and granite, have not furnished the Bureau with data of production from which tabulated results could be prepared.

The industry is important enough for the State to secure and preserve a record of the past and present product of its stone quarries, and the Bureau should be enabled by proper appropriation to include in its biennial reports information of great interest to the whole State, covering the State's resources in respect to mineral products, which are, like granite, sandstone, etc., of a non-metallic character.

The Salida granite area, owing perhaps to its nearness to broad-gauge transportation, is the most important section in the State. The product is known by the term Salida, and the quarries are located eleven miles from Salida and at an elevation of 9,000 feet. The company has the largest finishing plant west of Vermont, and can put out twelve tons daily of cut stone. The stone is dark in color, and possesses qualities in composition that give a light hue to the lettering or hammering. The product of these quarries has been very large for each of the past two years, and will be even larger in 1911.

At Silver Plume, in Clear Creek, some granite has been produced for monumental purposes particularly.

In close competition with granites, for both beauty and utility, comes Colorado sandstone. Quarries are numerous in the Lyons and St. Vrain sections, as well as in the southern part of the State. This comprises the range of territory from which production may be economically marketed in the State, and for supplying nearby demands; but it has no reference to the extent of workable deposits of magnificent sandstone which exists over on the Western Slope from the northern to the southern Colorado line. The area included probably measures one-fifth the area of the entire State, and it needs but the illustration of the great sandstone cliffs along the Grand River to emphasize the extent and value of the State's resources in this respect.

As before stated, the chief drawback is the difficulty of seeking an interstate business, due to the unwillingness of the trans-continental railroads to establish such a commodity rate

as the business warrants, and such as exists elsewhere on the same railroads between other points of the same mileage, but farther east.

In a measure, the use of concrete has affected the growth of granite and stone quarry business, since concrete has taken more than 50 per cent. of all the business of new construction.

The best data of production of granite and sandstone for the past biennial period are as follows:

For all purposes—rough, building, monumental and curbing:	1909.	1910.
Granite	$125,250.00	$127,200.00
Sandstone	160,000.00	155,250.00

MARBLE.

The past biennial period has witnessed the remarkable growth of the Yule Marble Quarries in Gunnison County. The extent of the deposit is only hinted at in the accompanying figures of production. Naturally, the quarries are but partially opened, and the superiority of the product to any known production in the entire United States gives assurance that this industry will occupy a very important place in the list of the State's mineral wealth. The new Federal Building in Denver is being constructed of marble from these Yule Quarries, and the beauty and texture of the stone have already enabled it to compete successfully in other parts of the United States with the renowned Italian marbles.

The production was as follows:

1909.....50,000 cubic feet
1910.....70,000 cubic feet

The average value of this output is $2.00 per cubic foot at the mines. At the quarries and the manufacturing plant 500 men are employed. The additional ground opened in 1910 was an increase of 33 1/3 per cent. over 1909.

CEMENT.

The Portland cement industry of the State is located in Fremont County, where the plants of two companies produce 4,500 barrels per day. The shale and lime used outcrop on the bluffs along the Arkansas River and furnish the raw material to the two plants; the Ideal Company, located at Portland, and the United States Company, located at Concrete. Fine grinding in ball mills precedes clinkering in revolving cylindrical furnaces, after which latter the cement is ground for the market.

The product of these two plants for the year 1910 was 4,500 barrels daily of Portland cement, and 60 tons daily of lime plaster for fertilizer use. In the year 1911 the Ideal Company intends to increase its production of lime plaster to 100 tons per day, since the demand for this material as a fertilizer is so great.

BOULDER COUNTY OIL FIELD.

The year 1910 was an auspicious one for this portion of the oil-bearing fields of Colorado. A gain over 1909 of three wells, producing 250 gallons of oil per diem, is recorded.

Another gain of prime importance is recorded in the first practical, definite determination of the trend of the oil sands, and the breadth of the field east and west. Commercial wells, to the number of 30, are now producing regularly over an area of nine miles long by two miles wide, the city of Boulder lying on the southern border.

The northern and southern trend of the field is now well defined, but its reach in either direction is not determined. The oil sand is encountered at from 1,800 feet to 2,600 feet in depth, and, though about 100 wells have been started since the first discovery, and there are only 30 commercial wells now producing, still no well has been put down without showing some oil. The last well to produce was struck the first of February, 1911, giving a production of 50 barrels.

The best oil-drilling experience in the State has, for the past two years, been devoted to exploitation of the Boulder County oil fields. Finds of a valuable character have been made during 1910 to the north and east of Boulder, and several new wells have been recently located. The high character of the oil makes these comparatively new oil fields especially valuable. From developments to the present time there is reason to expect that the near future will see this field extended somewhat toward the north, but more particularly in a southerly direction. It may be the southern and Florence fields will prove to be connected with the recent Boulder County development. There are two refineries being operated.

Four sets of tools are now at work constantly in the field. Probably no field in the State has a more promising future. The production of the field is now 400 barrels daily.

Boulder County oil has uniformly commanded the highest market price paid. In the past two years the figure has been from $1.30 to $1.50 per barrel, while in the same period the heavier Florence field oil ranged from 68 cents to 72 cents per barrel. The field is being most carefully studied by men trained in the oil business, with the result already that favorable points have been determined as to best locations between anticlinal and synclinal folds in the formation, with respect to thickness of the wash or overburden, and the depth of the oil-bearing formation.

Gas flow has been discovered, and the present flow is already considered enough to become a feature of economical

importance, with the assured ultimate result that gas wells will become more numerous, and Boulder will see new business of a manufacturing character started. Nearly, or quite, 2,000,000 cubic feet of gas is now flowing from the present wells. Three wells were opened in 1910, giving, among the three, a yield of 1,000,000 cubic feet of gas.

The record of production for the years 1907-1910, inclusive, in barrels and value, is as follows for both the Boulder and the Florence oil fields:

	BOULDER		FLORENCE		TOTAL	
Year	Quantity	Value	Quantity	Value	Quantity	Value
1907.....	68,353	$ 75,188.00	263,498	$ 197,625.00	331,851	$272,813.00
1908.....	84,174	124,794.00	295,479	221,609.00	379,653	346,403.00
1909.....	85,709	129,812.00	225,062	187,900.00	310,771	317,712.00
1910.....	39,647	59,471.00	201,337	201,337.00	240,984	260,808.00

MINERAL WATERS.

The State's production of these is covered mainly by the output of the various springs at Manitou and those at Pueblo, known as Magnetic Springs. Health-seekers have yearly come in large numbers to both these places, and been benefited by their use of the springs, as well as adding to the material prosperity of the State. Other well-known springs, such as those at Pagosa, Deckers, Placerville, Wagonwheel Gap, Steamboat, Hot Sulphur and Idaho, merit mention when the subject is considered.

Naturally, records can cover only shipments of mineral waters from the various springs, and not the amount or value of the waters used at their points of production. For 1909, the value of shipments was $90,000.00, and for 1910, $95,000.00. As these figures cover only the springs at the two first-named places, Manitou and Pueblo, it is fair to consider that the value of the mineral water output is not entirely included in these totals.

RECOMMENDATIONS.

Since the establishment of the Bureau of Mines by legislation, act of April 1, 1889, afterwards added to by legislation, act of March 30, 1895, there has been a constantly growing need for its services all over the State. Not only is it important, as first thought, that the Bureau should direct the carrying out at each mine of the measures of safety in mining and milling operations that are directed by statute for the protection of the lives of the labor employed, as well as to collect and report the result and scope of operations which produce yearly the mineral wealth of the State, but it has developed that there is both a field and a demand for Bureau work which will actually assist in developing the resources of the State. In this field of work I refer to such portions of the State as may be said to be geographically somewhat remote from supply and smelting centers, and therefore not in a position to enjoy an average low transportation rate. The mining industry in such places could be fostered, if the Bureau had facilities for promoting such cooperation among the smaller producers as would result in a reduction of the fixed charges against the ore product. Such work would require a special deputy, qualified to successfully consider, deal with and pass on matters of ore treatment, as well as the business methods necessary to putting such cooperation into effect.

In an enlarged field of work, the Bureau should foster the growth of what are at present the smaller branches of mineral production, such as the mining of the rarer metals—tungsten, vanadium and uranium. By the collection of information relative to the localities and modes and occurrence of the ores of these metals, and by the securing of data looking to affording the miner the best market for his ores, growth in their mining fields could be fostered. At present the Bureau has no appropriation, authority or help to enable it to do these things.

The Bureau needs also the services of a special statistician to examine into and collect information on the subjects of the non-metallic mineral products of the State, such as cement, clays, marble, stone, limestone, asphalt, gilsonite, oil, etc. When the large value of these products, and their importance to the mineral wealth of the State, is considered, it seems that the subject has been much neglected in being omitted from the work of the State Bureau of Mines.

I therefore recommend that the working force of the Bureau be increased by the following:

First—A Deputy Commissioner, with especial reference to metallurgical qualifications.

Second—A Statistician.

Third—An additional inspector, making four in all, and a division of the State into as many districts.

The Mineral Exhibit of the State, under charge of the Bureau of Mines, is perhaps the most extensive in the country, and still there are many additions which should be made to it. It is a matter of present great need that this large and important collection should be properly classified and catalogued. I therefore strongly recommend that a special deputy, or Deputy Commissioner, be appointed to review and catalogue the State's valuable Mineral Museum.

THE NEW ORE DRESSING AND METALLURGICAL EXPERIMENTAL PLANT OF THE COLORADO SCHOOL OF MINES.

BY F. W. TRAPHAGEN,
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The need of working laboratories in metallurgy and ore-dressing for schools of mines is generally conceded. As to just what the scope of such laboratories shall be, however, the agreement is not unanimous.

At some schools it is held that the small laboratory, where the gram, ounce or pound is the unit of weight to be operated upon, serves the entire purpose of school instruction, and that principles can be as fully appreciated by well-conducted small-scale operations as by those conducted upon a working scale.

At other institutions the tendency is in the extremely opposite direction, and commercial scale machines are believed to be the only ones that will serve the purpose.

It may, perhaps, be well to add here that location has much to do with these views, the former opinions generally being held where the laboratory is distant from the ore supply, while the latter is held by the instructors who are able easily to obtain desirable ore in carload lots.

At one well-known school the scale for working operations is a matter of departmental opinion only; one department operating on a small laboratory scale, while the other operates on a much larger scale, using many commercial-size machines, and adopting that size even though remote from a source of ore supply.

In general, it may be said that ore-dressing operations are far more flexible than metallurgical, and make possible a commercial-scale treatment under conditions approachable in mining schools. This is largely because of the fact that in ore-dressing it is possible to work on short shifts, because the various machines soon reach conditions of normal running and quickly respond to variations of adjustment, and, further, the material undergoing concentration does not lose its identity, and, except for reduction in size, may be restored to its initial condition by careful mixing, when it is ready for another cycle.

On the other hand, the commercial unit of most metallurgical devices is so large, their capacity so great, that the time required to reach a normal condition of operation so long, that, aside from other objections, a commercial-size machine is almost prohibited. These objections apply especially to furnace opera-

tions, but in many other metallurgical operations they are important factors. At the same time, as shown by successful operation in several schools, much valuable experience can be gained by the running of relatively small furnace units. At the Colorado School of Mines, a few years ago, in connection with their thesis work, a small group of seniors made a number of successful matte runs in an eight-inch blast furnace, gaining experience and confidence of great value to them.

Small-scale laboratory operations are invaluable and cannot be dispensed with, but wherever possible it seems highly desirable also to operate on the larger scale.

When the present administration of the Colorado School of Mines took hold of affairs seven years ago, the equipment for ore-dressing and metallurgical work was extremely meager, and it became necessary to take steps to improve this condition. Carefully organized inspection trips were instituted, and the especially favorable location of the school with reference to successful operating plants was made use of to the fullest extent possible. The small-scale apparatus was added to, and a course of ore-dressing and metallurgical experimentation mapped out.

This was good as far as it went, but still there was something lacking. This want was partially supplied by the use of a commercial ore-testing plant which was leased for a certain period during the spring of two different years. Ore was treated in carload lots, with the senior class in charge of the plant. In later years mills and mines in mining sections were leased, and all operations called for, including repairs, were conducted by the students.

These experiences served to impress us with the absolute necessity of a plant of our own, for no commercial plant can fully meet the needs of a class of students.

In designing our school plant we had several purposes in mind which it must serve. It was to permit:

1. A study of the principles on which ore-dressing and metallurgical operations are based. This will be accomplished mainly by small-scale apparatus.

2. A study of machines; the construction of machines of various types, with the important parts, and methods of adjustment.

3. A study of the operation of individual machines; the conditions of proper feed, water ratio, capacity, effects of adjustment and horsepower required.

4. A study of operations, especially with reference to variation of conditions and arrangement. This involves preliminary testing with small-scale apparatus.

5. For a study of the problems involved in the various theses required of senior students before graduation, and to

afford a means for the study of proposed lines of ore treatment on both small and large scales.

6. A thorough investigation of methods for the treatment of ores by skilled engineers, who are to be allowed the use of the plant under conditions to be determined later, and who would thus have provided them the very best equipment available, and at the same time be able to carry out their own ideas in experimentation without interferences of any sort. It is expected that our students will profit by observation of the methods employed by these men.

7. Finally, and most important of all, is the opportunity for research work that will be possible with an equipment as complete as that here provided.

As earlier stated, the necessity for a suitable plant was recognized long ago, and during a considerable period the various essentials which such a plant should possess had been receiving careful attention. When it was decided to ask the Colorado Legislature for an appropriation to build and equip our plant, it was thought best to outline in a few words the scope of work required and the general plan of operation. After the appropriation had been made the metallurgical department, embracing the subjects of assaying, ore-dressing and metallurgy, got out a series of what might be called "general specifications," in which the particular points necessary in such a plant were mentioned and most of the more important operations and machines were specified. These specifications were generally distributed with requests for suggestions, and several very important ideas were gleaned as a result.

Matters were then in excellent shape to begin actual planning, and the Board of Trustees appointed Frank E. Shepard, of the Denver Engineering Works Company, as consulting engineer. The preliminary plans were the result of the work of Mr. Shepard, assisted by P. D. Grommon, of the class of 1907 of the Colorado School of Mines, together with frequent conferences with the metallurgical department of the school. These plans are not final, for before the equipment is placed it is expected that criticisms called for in the general distribution of the reduced plans will cause alterations in many particulars. What we want is a building and equipment that will, as completely as possible, meet the needs of a school such as ours, and also permit investigations that shall be of the greatest value to our commonwealth and to the mining fraternity at large.

DETAILED DESCRIPTION OF PLANT.

Reference to the floor plan will show that the mill is composed of several sections or units, each completely equipped for its own type of work, and all housed in one common building, where any unit can readily be reached from any other unit.

With the exception of the dry concentrating, smelting and cyanide units, the mill is designed to have an approximate capacity of 50 tons per 24-hour day. The three units mentioned are of such a nature that small lots, say 5 tons maximum, are as large as it will be desirable to run in them.

The ore will be brought to the mill either over a spur to be run from the railroad tracks, as indicated in the plans, or by an aerial tramway from an unloading station on the main line of the Colorado & Southern Railway. In either case it will be handled so that it can be dumped into any one of the twelve storage bins. These bins are of steel, 25 tons' capacity, with hopper bottoms and swinging draw-off gates. They will be used variously for receiving ore, storage of lots after preliminary crushing and sampling, and for the storage of lime and fuel for the smelting unit.

CRUSHING UNIT.

The ore is drawn from the bin into a 16 or 20 cubic foot ore car, trammed over the scales, where it can be weighed if desired, to the platform elevator, elevated and dumped over either the grizzlies into the crusher below. The undersize from the grizzly and the crushed product can be delivered into separate cars in order to determine the percentage of raw or run-of-mine ore that needs no crushing. There is room at this point for four cars, so that if both crushers are running all products can be kept separate; or, if desired, all can be laundered to one or two cars. The crushed ore is trammed out, weighed as above indicated, and elevated, either back to another bin, or farther up into the traveling bin of the sampling unit.

The machines of this unit are two 3′ by 8′ taper bar grizzlies, one standard 7″ by 10″ Blake crusher and a No. 2 Gates gyratory crusher or its equivalent. Space has been left for the addition of a third grizzly and crusher, as well as ample floor space for working and making adjustments.

SAMPLING UNIT.

In this unit there is a wide range of possibilities as to flow of ore, so that each machine can be tried out against the others under identical conditions. The ore is received in a hopper-bottom traveling steel bin of 5 tons' capacity, moved by a motor, so that it may be discharged by a plunger feeder into any one of the three sampling machines, viz., a Vezin, Brunton or Snyder.

The reject from the samplers passes to an ore car and the sample is ground in a set of 12″ by 20″ rigid rolls with feeder attached. If this sample is small enough, the subsequent cutting down and grinding can then be done by hand; but if too large, the sample can be elevated in a 6″ by 4″ belt and bucket elevator directly into the hopper of one of the other samplers, and the

sample there obtained further reground in a Sampson crusher, laboratory crusher or sampler grinder, and finally cut down by Jones riffles or similar devices. In this way a sample of any desired size can be obtained, regardless of whether the lot be so large as to require two or more cuttings, or so small that one cutting will suffice. The traveling bin can deliver to any sampler; any sampler to the rolls; the rolls to the elevator, and the elevator to any sampler again, so that, with the exception of the final splitting and grinding of the sample, the entire operation may be made automatic. When the sample is small and it is desirable to omit the use of the belt and bucket elevator, the rolls are high enough to discharge into an ore car, which can then be elevated and dumped into the hopper of a sampler. The total reject, or the entire lot minus the sample, can now be returned to the original bin, thence to be drawn off as desired, or it can be sent direct to one of the four bins below.

STAMP MILL UNIT.

This unit contains a standard 850-pound 5-stamp battery, and a battery of two Nissen single stamps. Each battery has its own steel bin and feeder, and in front of both runs a track on which the plates are mounted so that they may be used interchangeably with either battery. A Pierce amalgamator and a mercury or amalgam trap form the rest of the equipment of this unit.

It is intended to have the two Nissen stamps of widely different types, and to have the 5-stamp battery of modern construction, and so built that various conditions can be tried, such as height of drop, discharge, etc.

The tailings from the plates or amalgamator will be laundered to a small sump in the floor which feeds a centrifugal pump delivering to the classifier system. The latter will be described under the concentrating unit.

ROLL CRUSHING UNIT.

There are so many possibilities for changing the flow of ore through this unit that only a description of the general scheme and a few possible arrangements will be described. The previously crushed and sampled ore is delivered into the 15-ton ore bin, whence it is fed automatically by a plunger feeder to a 10″ belt and bucket elevator and delivered to the first of a train of three 36″ by 6′ revolving screens. Oversize from No. 1 screen or trommel is sent back to a set of 14″ by 27″ spring rolls, which discharge into the same elevator. Undersize goes to No. 2 trommel, and its undersize to No. 3 trommel. Oversize from No. 2 trommel can be sent to either a 3″ 6-compartment Richards pulsator jig, or a single 4-compartment all-iron Harz jig; or it may be reground in any one of the various regrinding devices to be mentioned later. Oversize from No. 3 trommel will

go to the jig not fed by No. 2, while the undersize from No. 3 will go to the classifier system.

Two Impact screens in tandem will be installed as shown, and used interchangeably, or in parallel with No. 2 and No. 3 trommels. The former will be equipped for either wet or dry work, and both they and the three trommels will be provided with extra screens on frames, so that the mesh of any screen can be changed with very little trouble.

Jig middlings or tailings, or both, from either or both jigs can be reground in any one of the following devices:

1. A set of 14″ by 27″ rigid rolls so located as to discharge into either the 10″ elevator or the centrifugal pump sump.
2. A 3½′ Huntington mill discharging as above.
3. A 3½′ Chilean mill discharging as above.
4. A set of 5″ x 8″ Triplex rolls.
5. A small ball mill.

The last two will probably discharge to the sump.

From the general arrangement of this unit it will be seen that:

1. Trommels and Impact screens can be used interchangeably.
2. Either jig may be used as the fine, and the other as the coarse jig.
3. Coarse jig middlings or tailings, or both, can be reground in any one of three machines, and sent back through the screen system to be caught on the fine jig.
4. Fine jig products to be retreated can be reground in any one of five machines, and the product pumped directly to the classifier system.

In short, any two machines of similar character can be used in parallel under exactly the same conditions, or in series, thus giving ample opportunity to compare the advantages of the various machines on different classes of work.

CLASSIFIER SYSTEM AND CONCENTRATING UNIT.

At the head of the classifier system is a cone thickening tank, 48″ in diameter, of the bottom-draw-off, rim-overflow type. As stated before, this tank is fed either directly with the undersize from the last screen, or by a centrifugal pump from the small sump. An exception to this procedure may be made by omitting the thickening, and sending the feed from the screen to a 3-compartment spitzkasten whose products go directly to the tables. When the thickening tank is used, the thickened pulp is fed to a 3″ 6-compartment Richards pulsator classifier, a train of two Callow traveling belt screens or two King revolving screens. In any case either of the products can be laundered to any table desired. The overflow from the

thickening tank will go to an 8′ tank, the overflow from which will probably be clear enough to discard, and the thickened pulp can be sent to the slime tables.

Nine concentrating tables and slimers are shown in the plan, with room provided for several others. The proposed equipment consists of two Wilfley tables, two Card tables, one each of the Overstrom, Deister No. 2 and Deister No. 3 tables, a Johnston or Frue vanner, and an Akins & Evans slimer or some other canvas table.

A 10″ by 54″ Frenier spiral sand pump will handle any table product for regrinding, pumping it back to any one of the regrinding devices mentioned before, so that it may be prepared for treatment on the slime tables. The table tailings may be sent either to the dump or to the cyanide unit for further treatment. The table concentrates are shoveled from the boxes directly into cars and trammed to a steam drying plate from which they can be transferred to another car and taken to any point desired.

DRY CONCENTRATION UNIT.

In this unit will be installed various machines for dry concentration. It is arranged so that the bin can discharge directly into the feed hopper of a cylinder which can be used either for drying or for giving a magnetizing roast. This is followed by a cooling cylinder. A fine grinding device of some sort will be installed here, as well as a set of Columbian vibrating screens for dry work. The screened products can then be treated in any one of the machines, being fed by hand if the lot is small, or handled by the overhead track, if large.

The equipment as shown in the plan includes magnetic separators of the Wetherill and Dings type, a Blake-Morscher electrostatic separator, a Sutton, Steele & Steele dry concentrator and a Behrend dry concentrator. All of these machines are of the small, or laboratory, size.

The room containing the dry concentration unit probably will be separated from the rest of the mill by a partition constructed for the most part of glass.

CYANIDE UNIT.

Since commercial cyanide tests can be made satisfactorily on a scale smaller than would be suitable for other tests, the equipment of this unit is designed to handle a charge of about 5 tons. It will be apparent that a 50-ton capacity cyanide unit would occupy needless space.

The grinding equipment of this unit will be a 4′ Hardinge conical tube mill, and a 4′ by 10′ cylindrical, belt-driven tube mill, both for grinding the sand to slime if such treatment is desired. A centrifugal pump is provided to take the original feed or the tube-mill discharge, according to the plan of treat-

ment, delivering the same to either a Dorr classifier or a Richards sand-slime classifier. Both of the latter machines are of laboratory size.

Slime may be treated in a 6′ by 5′ conical-bottom agitating and thickening tank with a rim overflow, or in a 3½′ by 10′ Pachuca tank. The thickened product can then be treated in either a Moore or Butters vacuum filter, or in a Burt pressure filter. The three latter machines are small sizes.

The sand may be returned to one of the tube mills if a straight slime treatment is desired, or may be treated in a filter-bottom, sand-leaching tank.

Two solution tanks, 6′ by 6′, one for barren or dilute solution and the other for gold solution, are set at such a height as to discharge by gravity.

For precipitation of the gold from pregnant solution, zinc shavings may be used in a 6-compartment zinc box mounted directly over the sump tank, or zinc dust precipitation may be used followed by filter pressing. It is further planned to provide means for electrolytic precipitation.

All tailings from this unit will be sluiced out through a large cement-lined launder to be located under the floor.

A small barrel for chlorination work also will be installed in this unit, and space has been provided for additional leaching devices.

SMELTING UNIT.

As previously stated, a number of bins at the head of the mill will be reserved for the storage of fuel and fluxes. The unit is divided into two sub-units or sections, viz., the roasting section and the smelting section proper.

In the roasting section are a hand reverberatory furnace and an English cupellation furnace. The hand reverberatory will have a hearth area of about 4′ by 9′, with rabbling doors at each side. The cupellation furnace will be of the type used in the Massachusetts Institute of Technology. It can be adapted to many uses by changing the nature of the hearth, and will be used for high roasts, cupelling and making blister copper. Both of these furnaces can be charged from cars on an upper level and discharged into others on the ground floor.

The equipment of the smelting section proper has not been decided upon definitely, but it will consist of small furnaces and roasters of various types. The blast furnace will be rectangular, of 18″ by 36″ cross-section, and water-jacketed in sections to permit of easy dismantling. A track will be placed underneath the furnace, and it will be so arranged that the crucible used in lead-smelting can be changed for the hearth used in copper-smelting by running the one out and the other into place. This idea will be carried out, as far as possible, with a view to making the one furnace serve for either lead or copper work.

A blower for compressed air, and the necessary forehearth, matte and slag pots, and other accessories, will be included in the equipment of this unit.

LABORATORY UNIT.

This unit, located in the corner of the building nearest the present school buildings and adjoining the sampling unit, will be equipped with desks for chemical work, assay furnaces, balances, etc. The clean-up room for the batteries and cyanide unit also will be in this section and will include amalgamating pan, clean-up pan and a retort and bullion-melting furnace.

The room marked "Rare Metals Laboratory" in the floor plans will be used, as implied by its name, for experimental work on miscellaneous and rare metals.

EXPERIMENTAL MACHINES.

The small-size, or experimental, machines will be located in either the present ore-dressing laboratories in Stratton Hall of Metallurgy, or moved into the room adjoining the cyanide unit, marked in the plan "Experimental Machines." These machines may be used for preliminary tests prior to the regular mill tests.

GENERAL CONSIDERATIONS.

Ample space has been provided in the mill to include newly installed machines in any flow-sheet. Besides the water piping necessary for the operation of individual machines, valves and nipples will be provided at convenient places for flushing and cleaning, and all floors are designed with drains and sufficient slope to take care of the water. Air will be on tap for cleaning up machines operating on dry ore. A heating plant of ample size will be installed as shown in the plan. The mill will have ample natural light and ventilation, but electric lights will be distributed at convenient places so that there will be perfect light at all times. Inasmuch as in a mill of this kind a considerable portion of the plant will be idle at various times, all launders, tanks and frames supporting machinery doing wet work will be constructed of steel, as wood would either rot or warp badly. The water supply will be from wells sunk near the bed of Clear Creek, whence it can be elevated to tanks commanding the entire plant. Settling ponds and sump tanks can be provided below the mill, for the settling of tailings and recovery of water.

Electrical power is supplied from the central power plant of the school. Special care has been exercised to make sampling accurate and absolutely free from the possibility of self-salting. Independent motors will be used freely and weighing and measuring apparatus provided generously in order to determine

power and water consumption and actual capacities of the various machines in use. Comparison of machines will be possible under identical conditions, and all possible variations of practice, logical and illogical, will be made possible by the scheme of installation, the keynote of which is "flexibility."

When we finally have adopted our plans and have erected and equipped our buildings, we feel that the Colorado School of Mines will be in a position to render to the mining industry such services as shall place her name high on the roll of honor.

After considerable delay, machinery and structural steel are rapidly being delivered at the site, where foundations and sumps are already completed, but without doubt the building will be enclosed and under roof before winter and much of the installation will be in place by early spring.

TABLES

Men Employed in Mining, Milling and Smelting During Years 1909-1910

NUMBER ENGAGED IN MINING, MILLING AND SMELTING.

COUNTY	1902	1903	1904	1905	1906	1907	1908	1909	1910
Arapahoe	1,615	1,382	.....	.....	.....	.....	.....	.....	.....
Archuleta	18	7	10	4	6	12	8	10	14
Boulder	1,556	1,310	1,087	975	1,042	1,076	1,050	823	746
Chaffee	725	470	680	742	615	820	780	576	532
Clear Creek	2,010	1,748	1,936	1,860	1,985	2,036	2,050	938	854
Conejos	18	20	15	6	4	7	8	6	8
Costilla	35	30	32	10	14	12	14	7	9
Custer	350	566	625	647	521	464	480	216	187
Delta	5	10	12	8	6	9	11	8	7
Denver	.....	.....	1,175	1,210	1,175	1,060	1,042	914	873
Dolores	352	325	378	418	396	337	365	125	95
Douglas	7	5	7	3	7	14	12	8	7
Eagle	305	240	265	340	376	384	350	182	153
El Paso	830	792	742	518	785	797	940	942	928
Fremont	725	630	768	610	630	563	586	220	45
Garfield	15	12	20	10	15	20	18	12	10
Gilpin	2,322	1,985	1,860	1 990	1,837	1,971	1,940	876	741
Grand	75	90	100	36	28	116	145	38	46
Gunnison	630	537	687	590	672	642	630	374	498
Hinsdale	580	332	420	432	395	408	370	187	162
Huerfano	35	10	12	8	12	11	10	.....	.....
Jefferson	85	52	115	185	76	76	84	63	58

Lake	5,772	6,300	6,380	6,425	6,911	5,906	5,836	2,630	2,460
La Plata	475	525	784	792	642	640	625	427	630
Larimer	45	82	85	77	96	126	108	10	14
Mineral	920	918	1,010	873	964	872	866	618	526
Montrose	152	110	132	80	75	76	64	.....	.....
Mesa	65	35	146	168	210	140	162	.....	.....
Montezuma	143	190	185	170	148	135	125	78	106
Ouray	1,609	1,465	1,586	1,626	1,510	1,468	1,430	867	752
Pueblo	1,485	1,500	1,945	1,744	1,867	1,832	1,684	1,620	1,684
Park	406	420	635	690	682	586	570	482	476
Pitkin	1,355	900	1,252	1,035	1,108	980	916	628	538
Rio Blanco	25	12	10	11	15	12	14	15	18
Rio Grande	145	110	131	120	94	74	86	22	27
Routt	135	200	233	190	217	186	232	116	132
Saguache	310	280	385	375	348	274	295	137	119
San Juan	1,595	1,647	1,860	1,740	1,836	1,890	1,756	872	743
San Miguel	1,625	1,250	1,190	1,233	1,320	1,640	1,460	1,084	1,142
Summit	623	570	814	860	851	580	615	310	485
Teller	5,940	5,200	5,667	5,480	5,196	4,762	4,983	3,861	3,743
TOTAL	35,118	32,267	35,376	34,287	34,790	33,014	32,720	20,302	19,568

EMPLOYES ABOVE AND UNDERGROUND.

	1902	1903	1904	1905	1906	1907	1908	1909	1910
Number of men engaged in mining, milling and smelting	35,118	32,267	35,376	34,278	34,790	33,014	32,720	20,302	19,568
Number of men engaged above ground	14,047	12,907	14,150	13,754	13,916	13,041	12,854	7,840	7,626
Number of men engaged underground	21,071	19,360	21,226	20,533	20,874	19,973	19,866	12,462	11,942

ACCIDENTS.

CAUSE OF ACCIDENT.

ABOVE GROUND	1909		1910	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Machinery accidents	3	20	6	14
Mill accidents	3	9	.....	37
Smelter accidents	.....	.....	.....	.....
Overwinding cage or bucket	.....	.....	.....	.....
Falling from gallows frame or staging	.....	10	.....	2
Gravity tram	1	7	.....	4
Tramming or dumping cars	.....	10	.....	9
Handling loose rock or ore	.....	.....	.....	4
Falls while carrying tools or material	.....	.....	.....	.....
Falling down shaft from surface	1	.....	.....	.....
Getting on or off cage or bucket at surface	.....	.....	.....	.....
Falls in chute or bin or caught with running ore	1	2	.....	.....
Falling into uncovered prospect hole	.....	.....	.....	.....
Operating hydraulic machine	.....	.....	.....	.....
Came in contact with live wires	1	2	.....	.....
Miscellaneous	1	20	.....	9
TOTAL	11	80	6	79

SHAFT ACCIDENTS	1909		1910	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Getting on or off cage or bucket in motion at station	.....	.....	.....	.....
Falls from bucket or cage while being hoisted or lowered	.....	.....	.....	.....
Caught in shaft while being hoisted or lowered	.....	.....	1	5
Falls from ladder	.....	.....	.....	.....
Material falling from level or side of shaft	.....	.....	1	1
Struck by descending cage or bucket	.....	1	1	1
Pushing car into open shaft, going down with same	.....	.....	.....	.....
Falls of rock or earth in shaft	.....	.....	.....	.....
Falling down shaft from level	.....	.....	.....	.....
Material falling from overloaded bucket	.....	.....	.....	.....
Cable becoming detached, letting cage down shaft	1	8	2	3
Miscellaneous	.....	4	.....	2
TOTAL	1	13	5	12

ACCIDENTS—Concluded.

UNDERGROUND ACCIDENTS	1909		1910	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Falls of rock	12	122	14	78
Falls of timber while timbering	.....	6	.....	8
Falls from ladder	.....	2	.....	1
Falls from overloaded staging	5	18	.....	13
Falls in chute, winze, upraise or manway	3	7	8	7
Caught in chute with running ore	.....	3	.....	3
Injured by tram car	.....	28	1	19
Struck by flying rock or steel from hammer or pick	.....	4	.....	3
Struck with hammer by helper or by self	.....	5	.....	8
Injured handling loose rock	.....	7	.....	9
Falls while carrying tools or material in mine	.....	4	.....	.....
Suffocation, burning shaft house or tunnel bldg	3	.....	.....	.....
Suffocation, bad air or powder smoke	.....	.....	.....	.....
Operating machine drill	.....	7	2	5
Miscellaneous	4	15	1	10
TOTAL	27	228	26	164

EXPLOSIVES	1909		1910	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Thawing powder over candle, in stove, hot water or sand	.....	.....	.....	.....
Picking out missed shot	.....	.....	.....	.....
Drilled into hole that missed fire	5	7	3	8
Blast exploded while loading	2	6	5	4
Remaining too long after lighting fuse	.....	1	1	.....
Returned before blast exploded	.....	2	.....	.....
Struck unexploded powder or caps with pick or shovel while cleaning away muck	1	4	1	3
Hit with flying rock from blast, not being in place of safety	1	1	1	.....
Explosion, cause unknown	2	3	3	2
Electricity	1	2	.....	2
TOTAL	12	26	14	19
GRAND TOTAL	51	347	51	274

SUMMARY OF ACCIDENTS 1909-1910, INCLUSIVE.

	1902	1903	1904	1905	1906	1907	1908	1909	1910
Number of men engaged in mining, milling and smelting	35,118	32,267	35,376	34,287	34,790	33,014	32,720	20,302	19,568
Number of accidents investigated	643	561	640	595	518	377	377	398	325
Number of non-fatal accidents	561	494	539	486	436	300	313	347	274
Number of fatal accidents	82	67	101	109	82	77	64	51	51
Number of non-fatal accidents above ground	106	109	105	103	72	43	45	80	79
Number of fatal accidents above ground	13	6	13	11	12	17	5	11	6
Number of non-fatal accidents under ground	455	385	434	383	364	257	230	267	195
Number of fatal accidents under ground	69	61	88	98	70	60	48	40	45
Proportion non-fatal accidents per 1,000 men employed	15.97	15.31	15.24	14.14	12.53	9.08	9.56	17.09	14
Proportion of fatal accidents per 1,000 men employed	2.30	2.08	2.86	3.18	2.37	2.33	1.95	2.5	2.6
Per cent. non-fatal accidents per 1,000 men above ground	7.55	8.45	7.42	7.49	5.17	3.29	3.50	10.2	10.3
Per cent. fatal accidents per 1,000 men above ground	.92	.47	.92	.8	.86	1.30	.38	1.4	.70
Per cent. non-fatal accidents per 1,000 men underground	21.59	19.88	20.45	18.65	17.44	12.86	11.59	21.41	16.32
Per cent. of fatal accidents per 1,000 men underground	3.27	3.15	4.15	4.77	3.35	3.00	2.41	3.21	3.76

DURING THE FISCAL YEARS OF 1909 AND 1910 THE FOLLOWING ORDERS WERE ISSUED BY THE DEPARTMENT.

	1909	1910
Regarding timbers	24	13
Regarding explosives	60	16
Regulating amount of powder kept in storage	12	2
Use of steel or iron tamping bar	6	3
Removing old timbers from mine	4	7
Regarding employment of hoisting engineer	7	4
Regarding indicator on hoisting machinery	31	6
Posting uniform code of signals	24	2
Regarding fire protection	.....	1
Timbering shafts, stopes, raises and securing same	8	7
Partitioning shafts or divide into compartments	1	2
Placing ladders in shaft, with stations as law provides	14	6
Provide or repair ladders in upraise or winzes-manway	6	2
Provide tunnel or adit with connection to surface with suitable ladders, as provided by law	8	7
Provide chain ladders in shaft or incline when sinking	1	2
Provide shaft collar with cover, bonnet or doors	2	.....
Equip cage with safety clutches or repair same	6	1
Make passageway around working shaft	1	2
Provide guard rails at shaft stations	11	11
Cover winzes or mill holes, or surround with guard rails	4	6
Leave pillar ground standing on side of shaft	2	1
Cover or fence abandoned mine shafts or pits	3	1
Notice of number of men permitted to ride upon cage, skip or bucket	1	.....
Repair cable, or replace cable, or test cable	7	3
Repair machinery	3	.....
Place fire doors near mouth of tunnel and in shafts	14	9
Regarding sanitary conditions	2	1
Provide chairs or overwinding device	1	1
Miscellaneous	8	7
Electricity, electric wire, etc	3	2

APPOINTMENTS.

M. J. McCarthy was reappointed mine inspector for a term of two years, beginning June 1, 1909.

John R. Curley was appointed mine inspector for a term of two years, beginning June 1, 1909.

W. H. Parenteau was appointed mine inspector for a term of two years, beginning June 1, 1909.

Fenno Wakeman was appointed clerk and assistant curator for a term of four years, beginning June 1, 1907.

Mrs. A. M. Nickerson was reappointed stenographer and clerk for a term of four years, beginning June 1, 1907.

STATEMENT OF DISBURSEMENTS OF THE BUREAU OF MINES.

APPROPRIATION FOR THE FISCAL YEARS OF 1909-1910.

Appropriation		$ 27,000.00
Commissioner of Mines T. J. Dalzell, salary	$ 5,000.00	
Commissioner of Mines T. J. Dalzell, expense account	1,444.35	
Inspector M. J. McCarthy, salary	3,000.00	
Inspector M. J. McCarthy, expense account	1,995.70	
Inspector John R. Curley, salary	3,000.00	
Inspector John R. Curley, expense account	1,908.85	
Inspector W. H. Parenteau, salary	3,000.00	
Inspector W. H. Parenteau, expense account	1,356.60	
Clerk and Asst. Curator Fenno Wakeman, salary	3,000.00	
Stenographer A. M. Nickerson, salary	2,000.00	
Balance	1,294.50	
	$ 27,000.00	$27,000.00

ANNUAL PRODUCTION

BY COUNTIES

Of Gold, Silver, Lead, Copper and Zinc
1900-1910 Inclusive

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1900.

COLORADO	GOLD		SILVER		LEAD		COPPER		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Arapahoe	12	$ 248.04	.....	.....	.....	.....	.....	.....	$ 248.04
Arkansas	7	144.69	30	$ 18.43	.....	.....	.....	.....	163.12
Baca	5	103.35	102	62.64	.....	.....	8,900	$ 1,470.28	1,636.27
Boulder	29,367	607,015.89	90,327	55,469.80	76,076	$ 3,598.39	20,371	3,365.29	669,449.37
Chaffee	8,354	172,677.18	125,330	76,965.15	833,462	39,422.75	753,677	124,507.44	413,572.52
Clear Creek	22,518	465,447.06	1,358,143	834,035.62	4,994,263	236,228.64	244,092	40,324.00	1,576,035.32
Conejos	137	2,831.79	1,014	622.70	2,200	104.06	4,527	747.86	4,306.41
Costilla	100	2,067.00	314	192.83	.....	.....	107	17.68	2,277.51
Custer	1,008	20,835.36	82,605	50,727 73	709,349	33,552.22	2,301	380.13	105,495.44
Delta	47	971.49	97	59.57	.....	.....	.....	.....	1,031.06
Dolores	2,425	50,124.75	159,318	97,837.18	210,380	9,950.97	36,009	5,948.69	163,861.59
Douglas	3	62.01	24	14.74	.....	.....	.....	.....	76.75
Eagle	5,012	103,598.04	234,674	144,113.30	3,679,828	174,055.86	359,054	59,315.72	481,082.92
El Paso	95	1,963.65	.....	.....	.....	.....	.....	.....	1,963.65
Fremont	402	8,309.34	2,199	1,350.40	8,282	391.74	6,725	1,110.97	11,162.45
Gilpin	80,092	1,655,501.64	236,400	145,173.24	735,773	34,802.06	799,478	132,073.77	1,967,550.71
Grand	182	3,761.94	21	12.90	.....	.....	.....	.....	3,774.84
Garfield	25	516.75	13	7.98	.....	.....	.....	.....	524.73
Gunnison	4,057	83,858.19	146,746	90,116.72	1,583,320	74,891.04	42,790	7,068.90	255,934.85

Hinsdale	2,732	56,470.44	155,485	95,483.34	9,377,062	443,535.03	29,180	4,820.54	600,309.35
Huerfano	6	124.02	20	12.28					136.30
Jefferson	34	702.78	51	31.32					734.10
Lake	122,376	2,529,511.92	6,967,279	4,278,606.03	62,599,654	2,960,963.63	2,728,553	450,756.96	10,219,838.54
La Plata	726	15,006.42	7,084	4,350.28	14,500	685.85	350	57.82	20,100.37
Larimer	79	1,632.93	126	77.38			13,806	2,280.75	3,991.06
Las Animas									
Mineral	10,130	209,387.10	2,280,038	1,400,171.34	14,951,956	707,227.52	2,614	431.83	2,317,217.79
Montrose	79	1,632.93	19,652	12,068.29			32,026	5,290.70	18,991.92
Mesa	6	124.02	311	313.80			2,150	355.18	793.00
Montezuma	480	9,921.60	103	63.25					9,984.85
Ouray	69,565	1,437,908.55	1,985,267	1,219,152.46	9,478,657	448,340.48	352,368	58,211.19	3,163,612.68
Park	5,639	116,558.13	43,138	26,491.05	682,107	32,263.66	15,000	2,478.00	177,790.84
Pitkin	651	13,456.17	4,119,116	2,529,549.14	27,452,260	1,298,491.90	6,082	1,004.75	3,842,501.96
Pueblo	12	248.04	9	5.53					253.57
Rio Grande	5,207	107,628.69	3,075	1,888.36	26,260	1,242.10	8,599	1,420.55	112,179.70
Routt	159	3,286.53	477	292.93			5,765	952.38	4,531.84
Saguache	386	7,978.62	15,793	9,698.48	316,061	14,949.69	16,129	2,664.50	35,291.29
San Juan	36,633	757,204.11	681,317	418,396.77	17,579,177	831,495.07	1,972,087	325,788.77	2,332,884.72
San Miguel	88,406	1,827,352.02	1,136,692	698,042.56	3,353,425	158,617.00	311,045	51,384.63	2,735,396.21
Summit	16,361	338,181.87	403,330	247,684.95	5,610,710	265,386.58	53,030	8,760.56	840,013.96
Teller	877,972	18,147,681.24	80,792	49,614.37			134	22.14	18,197,317.75
TOTAL	1,391,287	$28,762,036.29	20,336,712	$12,488,774.84	164,274,762	$7,770,196.24	7,826,949	$1,293,011.98	$50,314,019.35

NOTE—In the above table the calculation is on the average market price of the metal for the year See page 76.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1901.

COLORADO	GOLD		SILVER		LEAD		COPPER		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Arapahoe	16	$ 330.72							$ 330.72
Archuleta	6	124.02	18	$ 10.61					134.63
Baca	4	82.68	80	47.16			590	$ 97.67	227.51
Boulder	37,460	774,298.20	113,782	67,074.49	191,987	$ 8,320.72	22,186	3,672.89	853,366.30
Chaffee	7,677	158,683.59	76,286	44,970.60	209,768	9,091.35	576,251	95,398.35	308,143.89
Clear Creek	26,172	540,975.24	1,271,227	749,388.32	3,890,216	168,601.96	374,534	62,004.10	1,520,969.62
Conejos	57	1,178.19	102	60.13	1,200	52.01	210	34.77	1,325.10
Costilla	47	971.49	153	90.19			235	38.90	1,100.58
Custer	538	11,120.46	50,394	29,707.26	400,481	17,356.85	40,528	6,709.41	64,893.98
Delta	25	516.75	10	5.90					522.65
Dolores	1,079	22,302.93	111,632	65,807.06	367,057	15,908.25	13,106	2,169.70	106,187.94
Douglas	5	103.35	10	5.89					109.24
Eagle	4,711	97,376.37	175,181	103,269.20	2,775,291	120,281.11	157,914	26,142.66	347,069.34
El Paso	78	1,612.26	15	8.84					1,621.10
Fremont	312	6,449.04	933	550.00	33,945	1,471.18	15,907	2,633.40	11,103.62
Gilpin	79,292	1,638,965.64	271,638	160,130.60	670,018	29,038.58	731,194	121,049.17	1,949,183.99
Garfield	17	351.39	13	7.66					359.05
Grand	50	1,033.50	30	17.68					1,051.18
Gunnison	4,037	83,444.79	93,243	54,966.75	656,631	28,458.39	53,396	8,839.71	175,709.64

Hinsdale	3,684	76,148.28	152,122	89,675.92	7,588,675	328,893.17	1,253.27	2,074.67	496,792.04
Huerfano	4	82.68	10	5.90					88.58
Jefferson	15	310.05	20	11.80					321.85
Lake	85,928	1,776,131.76	6,830,084	4,026,334.51	56,359,708	2,442,629.94	1,930,556	319,603.55	8,564,699.56
La Plata	1,316	27,201.72	5,528	3,258.76	6,197	268.58	132	21.85	30,750.91
Larimer	45	930.15	73	43.03			18,140	3,003.08	3,976.26
Mineral	4,974	102,812.58	1,816,023	1,070,545.56	10,519,895	455,932.25	1,007	166.71	1,629,457.10
Montrose	75	1,550.25	101,359	59,751.13			55,944	9,261.52	70,562.90
Mesa	99	2,046.33	155	91.37			7,795	1,290.46	3,428.16
Montezuma	175	3,617.25	60	35.37					3,652.62
Ouray	74,810	1,546,322.70	1,633,725	963,080.89	7,904,724	342,590.74	652,937	108,093.72	2,960,088.05
Park	4,660	96,322.20	69,175	40,778.66	421,955	18,287.53	9,657	1,598 72	156,987.11
Pitkin	227	4,692.09	3,532,863	2,082,622.74	32,749,511	1,419,363.81	50,786	8,407.62	3,515,086.26
Pueblo	8	165.36	52	30.65			210	34.77	230.78
Rio Grande	1,593	32,927.31	6,926	4,082.88	677	29.34	65,603	10,860.58	47,900.11
Routt	215	4,444.05	239	140.89	2,193	95.04	500	82.77	4,762.75
Saguache	3,869	79,972.23	20,507	12,088.88	235,750	10,217.40	15,253	2,525.13	104,803.64
San Juan	46,588	962,973.96	784,218	462,296.51	15,473,187	670,607.92	2,740,042	453,613.95	2,549,492.34
San Miguel	99,152	2,049,471.84	916,245	540,126.43	3,309,517	143,434.47	308,322	51,042.72	2,784,075.46
Summit	16,387	338,719.29	368,887	217,458.89	4,342,437	188,201.22	17,062	2,824.62	747,204.02
Teller	833,705	17,232,682.35	89,545	52,786.78					17,285,469.13
TOTAL	1,339,112	$27,679,445.04	18,492,563	$10,901,365.89	148,111,020	$6,419,131.61	7,872,529	$1,303,297.17	$46,303,239.71

NOTE—In the above table the calculation is on the average market price of the metals for the year. Gold, 20.67. Silver, .5895. Lead, .04334. Copper, .16555.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1902.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe	11	$ 227.37									$ 227.37
Archuleta	4	82.68	10	$ 5.22							87.90
Baca	5	103.35	59	30.77			1,929	$ 229.30			363.42
Boulder	26,062	538,701.54	82,710	43,141.54	13 493	$ 549.03	11,090	1,318.27			583,710.38
Chaffee	20,199	417,513.33	114 155	59,543.25	456,889	18,590.81	173,538	20,628.46	220,500	$ 10.672.20	526,948.05
Clear Creek	45,016	930,480.72	1,279,050	667,152.48	3,282,270	133.555.57	473,754	56,315.14	317,705	15,376.92	1,802,880.83
Conejos	61	1,260.87	81	42.25			78	9.27			1,312.39
Costilla	57	1,178.19	205	106.93							1,285.12
Custer	1,147	23,708.49	28,189	14,703.38	94,662	3,851.80	32,945	3,916.17	40,500	1,960.20	48,140.04
Delta	20	413.40	12	6.26							419.66
Dolores	2,296	47,458.32	121.311	63,275.82	388,806	15,820.52	15,054	1,789.47	248,680	12,036.11	140,380.24
Douglas	3	62.01	10	5.22							67.23
Eagle	1,546	31,955.82	45,336	23,647.26	832,846	33,888.50	150,134	17,846.43			107,338.01
El Paso	35	523.45									723.45
Fremont	357	7,379.19	515	268.62	2,836	115.40	22,300	2,650.80	22 825	1,104.73	11,518.74
Gilpin	75.038	1,551,035.46	303,638	158,377.58	497,366	20.237.82	765,516	90,996.89			1,820,647.75
Garfield	8	165.36	5	2.61							167.97
Grand	63	1.302.21	24	12.52							1,314.73
Gunnison	5 009	103,536.03	123,138	64,228.78	728.935	29 660.37	28,686	3,409.90	131,975	6,387.59	207 222.67

Hinsdale	4,758	98,347.86	117,177	61,119.52	6,213,763	252,838.02	8,314	988.29	319,000	15,439.60	428,733.29
Huerfano	41	847.47	260	135.62	.....	.....	.....	.....	.....	.....	983.09
Jefferson	25	516.75	3	1.56	.....	.....	2,978	353.99	.....	.....	872.30
Lake	58,245	1,203,924.15	5,641,857	2,942,792.61	39,450,178	1,605,227.74	2,611.167	310,389.42	47,637,490	2,305 654.52	8,367,988.44
La Plata	6,030	124,640.10	7,387	3,853.06	2,156	87.73	3,143	373.61	.....	.....	128,954.50
Larimer	39	806.13	49	25.56	.....	.....	24,888	2,958.44	.....	.....	3,790.13
Mineral	5 459	112,837.53	1,923,973	1,003,544.32	9,291,358	378,065.36	.....	.....	2,047,555	99,101.66	1,593,548.87
Montrose	288	5,952.96	3,149	1,642.52	64	2.60	2,505	297.77	.....	.....	7,895.85
Mesa	26	537.42	32	16.69	.....	.....	15,000	1,783.05	.....	.....	2,337.16
Montezuma	123	2,542.41	29	15.13	.....	.....	.....	.....	.....	.....	2,557.54
Ouray	117,113	2,420,725.71	789,855	411,988.37	4,262,063	173,423.34	526,541	62,589.95	.....	.....	3,068,727.35
Park	6,892	142 457.64	49,968	26,063 31	261 046	10,621.96	8,113	964.39	.....	.....	180,107.30
Pitkin	237	4,898.79	3,063,450	1,597,895.52	24,973,816	1,016,184.57	10,654	1,266.44	.....	.....	2,620,245.32
Rio Grande	690	14,262.30	3,171	1,653.99	166	6.75	1,260	149.78	.....	.....	16.072.82
Routt	733	15,151.11	136	70.93	.....	.....	.....	.....	.....	.....	15,222.04
Saguache	243	5,022.81	10,486	5,469.50	454,995	18,513.75	13,669	1,624.83	267,100	12,927.64	43,558.53
San Juan	73,741	1,524,226.47	838,102	437,154.00	7,699,883	313,308.24	3,012,283	358,070.08	.....	.....	2,632.758.79
San Miguel	97,129	2,007,656.43	1,056,640	551,143.42	4,296,849	174,838.79	454,790	54,060.89	.....	.....	2,787,699.53
Summit	11,736	242,583.12	274,571	143,310.12	3,092,387	125,829.22	93,609	11,127.30	1,329,180	64,332.31	587,182.07
Teller	819,153	16,931,892.51	62,780	32,746.05	6,547	266.40	.....	.....	.....	.....	16,964,904.96
Total	1,379,638	$28,517,117.46	15,941,703	$8,315,192.29	106,303,374	$4,325,484.29	8,463,938	$1,006,108.31	52,582,510	$2,544,993.48	$44,708,895.83

Note—In the above table the calculation is on the average market price of the metals for the year See page 76

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1903.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe	8	$ 165.36									$ 165.36
Archuleta	3	62.01	6	$ 3.21							65.22
Boulder	20,879	431,568.93	61,833	33,049.74	115,100	$ 4,876.79	6,154	$ 814.48			470,309.94
Chaffee	8,192	169,328.64	129,900	69,431.55	249,308	10,563.18	79,581	10,532.55	3,000	$ 162.00	260,017.92
Clear Creek	22,838	472,061.46	851,638	455,224.56	3,451,849	146,254.84	289,876	38,365.09	656,000	35,424.00	1,147,329.95
Conejos	59	1,219.53	46	24.59							1,244.12
Costilla	48	992.16	179	95.68							1,087.84
Custer	4,006	82,804.02	160,175	85,613.54	387,301	16,409.92	52,242	6,914.23			191,741.71
Delta	12	248.04	8	4.28							252.32
Dolores	2,093	43,262.31	103,096	55,104.81	143,417	6,076.58	147,588	19,533.27			123,976.97
Douglas	2	41.34	2	1.07							42.41
Eagle	776	16,039.92	27,054	14,460.36	677,730	28,715.42	32,863	4,349.42			63,565.12
Fremont	307	6,345.69	223	119.19	2,091	88.60	20,777	2,749.84			9,303.32
Garfield	5	103.35	3	1.60							104.95
Gilpin	65,125	1,346,113.08	375,238	200,564.71	945,975	40,080.96	611,988	80,996.61			1,667,755.36
Grand	69	1,426.23	12	6.41							1,432.64
Gunnison	2,348	48,533.16	65,447	34,981.42	127,661	5,409.00	15,000	1,985.25	55,600	3,002.40	93,911.23
Hinsdale	799	16,515.33	33,139	17,712.80	459,462	19,467.40	11,263	1,490.66	106,000	5,724.00	60,910.19
Jefferson	12	248.04	5	2.67			218	28.85			279.56

Lake	64,827	1,339,974.09	4,973,033	2,658,086.14	36,353,239	1,540,286.74	2,556,583	338,363.76	76,566,000	4,134,564.00	10,011,274.73
La Plata	6,807	140,700.69	7,627	4,076.63	3,017	127.83	810	107.20			145,012.35
Larimer	79	1,632.93	10	5.35			56,700	7,504.24			9,142.52
Mineral	8,658	178,960.86	1,608,788	859,879.19	8,600,646	364,409.37	133	17.60	2,634,000	142,236.00	1,545,521.02
Montrose	136	2,811.12	2,061	1,101.60			10,920	1,445.26			5,357.98
Mesa	17	351.39	8	4.28							355.67
Montezuma	224	4,630.08	89	47.57							4,677.65
Ouray	105,056	2,171,507.52	417,343	223,069.63	3,350,569	141 963.61	380,409	50,347.13			2,586,888.09
Park	6,593	136,277.31	52,128	27,862.42	802,489	34,001.48	5,895	780.20			198.921.39
Pitkin	230	4,754.10	2,569,862	1,373.591.24	33,269,852	1 409,643.63	11,683	1,546.25			2,789,535.22
Rio Grande	626	12,939.42	3,410	1,822.63			5,098	674.72			15,436.77
Routt	1,008	20,835.36	117	62.54							20 897.90
Saguache	143	2,955.81	22,424	11,985.63	376,711	15,961.25	67,410	8.921.71	44,600	2,408.40	42,232.80
San Juan	82,758	1,710,607.86	781,358	417,635.85	6,969 093	295,280.47	2,939,018	388,979.03			2,812.503.21
San Miguel	56,933	1,176,805.11	737,028	393,941.47	3,704.201	156,947.00	466,264	61.710.04			1,789,403.62
Summit	10.753	222,264.51	220,543	117,880.23	1,523,703	64,559.30	41,447	5,485.51	550 800	29,743.20	439,932.75
Teller	572,824	11,840,272.08	41,605	22,237.87							11,862,509.95
TOTAL	1,045,252	$21,605,358.84	13,245,483	$7,079,710.66	101.513,414	$4,301,123.35	7,807,920	$1,033,642.90	80,616,000	$4,353,264.00	$38,373,099.75

NOTE—In the above table the calculation is on the average market price of the metals for the year See page 76

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1904.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe	12	$ 248.04	.....	.....	.....	.....	.....	.....	.....	.....	$ 248.04
Archuleta	6	124.02	10	$ 5.72	.....	.....	.....	.....	.....	.....	1,829.74
Boulder	19,912	411,581.04	57,424	32,858 01	62,111	$ 2,670 77	26,115	$ 3,348.73	.....	.....	450,458.55
Chaffee	3,113	64,345.71	69,045	39,507.55	652,238	28,046.23	263,239	33,755.14	294,440	$ 15,016.44	180,671.07
Clear Creek	30,799	636,615.33	873,949	500,073.62	3,913,976	170,364.97	401,180	51,443.31	906 705	46,214.95	1,404,739.18
Conejos	40	826.80	52	29.75	.....	.....	.....	.....	.....	.....	856.55
Costilla	42	668.14	151	86.40	.....	.....	.....	.....	.....	.....	954.54
Custer	2,586	53,452 62	87.373	49,994.83	126,593	5,443.50	15,068	1,932.17	.....	.....	110,823.12
Delta	17	351 39	9	5.15	.....	.....	.....	.....	.....	.....	356.54
Dolores	2,602	53,783.34	108,301	61,969.83	181,229	7,792.85	25,392	3,256.02	18,196	928.00	127,730.04
Douglas	14	289.38	5	2.86	.....	.....	.....	.....	.....	.....	292.24
Eagle	1,455	30,074.85	27,348	15,648.53	375,207	16,133.90	32,409	4,155.81	.....	.....	66,013.08
El Paso	15	310 05	.....	.....	.....	.....	.....	.....	.....	.....	.....
Fremont	226	4,671.42	208	119.02	1,071	46.05	1,024	131.31	.....	.....	4,967.80
Gilpin	67,918	1,403,865.06	318.406	182,191.91	859 293	36,949.60	638,945	81,931.92	.....	.....	1,704,938.49
Garfield	25	516.75	14	8.01	.....	.....	.....	.....	.....	.....	524.76
Grand	31	640.77	13	13.16	.....	.....	1,114	142.85	.....	.....	796.78
Gunnison	1,259	26,023.53	115,153	65,890.55	200,462	8,619.87	16,233	2,081.56	20,010	1,020.50	103,636.02
Hinsdale	509	10,521.03	46,585	26,655 94	1,041,222	44,772.55	13,187	1,690.97	59,089	3,013.54	86,654.03

Jefferson	17	351.39	12	6.87			538	68.99			427.25
Lake	57,419	1,186,850.73	5,085,151	2,909,723.40	47,180,865	2,028,777.20	3,734,593	478,886.86	58,254,353	2,970,972.00	9,575,210.19
La Plata	6,164	127,409.88	31,033	17,757.08	2,177	93.61	1,473	188.88			145,449.45
Larimer	57	1,178.19	11	6.29			23,028	2,952.88			4,137.36
Mineral	10,782	222,863.94	1,664,633	952,503.00	13,346,436	573,896.75	1,337	171.44	4,402,697	224,537.55	1,973,972.68
Montrose	72	1,488.24	1,067	610.54			7,476	958.65			3,057.43
Mesa	12	248.04	9	5.15							253.19
Montezuma	135	2,790.45	53	30.33							2,820.78
Ouray	104,367	2,157,265.89	294,028	168,242.82	2,044,525	87,914.58	420,191	53,881.09	4,332	220.93	2,467,525.31
Park	9,433	194,980.11	50,013	28,617.44	757,703	32,581.23	5,920	759.12			256,937.90
Pitkin	113	2,335.71	2,129,618	1,218,567.42	18,882,901	811,964.74	9,862	1,264.60	593,661	30,276.71	2,064,409.18
Rio Grande	194	4,009.98	2,281	1,305.19			650	83.35			5,398.52
Routt	1,172	24,225.24	181	103.57							24,328.81
Saguache	267	5,518.89	60,506	34,621.53	699,312	30,070.42	48,722	6,247.62	15,585	794.83	77,253.29
San Juan	67,569	1,396,651.23	1,042,044	596,257.58	9,288,643	399,411.65	3,467,124	444,589.31	317,254	16,179.95	2,853,089.72
San Miguel	74,072	1,531,068.24	667,710	382,063.66	5,704,708	245,302.44	239,520	30,713.65			2,189,147.99
Summit	10,069	208,126.23	180,554	103,313.00	2,178,182	93,661.82	7,510	963.00	89,913	4,585.56	410,649.61
Teller	699,397	14,456,535.99	47,817	27,360.89			63	8.08			14,483,904.96
TOTAL	1,171,892	$24,223,007.64	12,960,777	$7,416,156.60	107,546,854	$4,624,514.73	9,401,913	$1,205,607.31	64,976,235	$3,313,787.97	$40,783,074.25

NOTE—In the above table the calculation is on the average market price of the metals for the year See page 76 The zinc is figured on actual spelter recovered.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

SHOWING BY COUNTIES THE MINERAL PRODUCTIONS OF COLORADO FOR THE YEAR ENDING DECEMBER 31, 1905.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe	22	$ 454 74									$ 454.74
Archuleta	4	82 68	15	$ 9.05							91.73
Boulder	17,191	355,337 97	98,252	59,295.08	18,236	$ 857.09	14,106	$ 2,199.13			417,689.27
Chaffee	1,915	39 583.05	96,822	58,432.08	994,133	46,724.25	869,507	135,556.14	849,963	$ 49,977.82	330,273.34
Clear Creek	27,692	572,393.64	739,985	446,580.95	3,262,540	153,339.38	355,740	55,459.87	1,102,301	64,815.30	1,292,589.14
Conejos	21	434.07	25	15.09							449.16
Costilla	34	702 78	15	9.05			44	6.86			718.69
Custer	424	8,764.08	2,619	1,580.57	3,391	159.38	862	134.39			10,638.42
Delta	12	284 04	15	9.05							257.09
Dolores	2,275	47,024.25	88,374	53,333.71	564,256	26,520.03	71,122	11,087.92	556,266	32,708.44	170,674.35
Douglas	24	496.08	6	3.62							499.70
Eagle	2,155	44,543.85	67,695	40,853.93	349,850	16,422.95	65,179	10,161.40	605,612	35,609.99	147,612 12
El Paso											
Fremont	1,947	40,244.49	53 868	32,509.34	30,373	1,427.53	635	99.00	97,639	5,741.17	80,021.53
Gilpin	72,466	1,497,872 22	337,536	203,702 98	819,592	38,520.82	638,597	99,557.27	33,090	1,945.69	1,841,598.98
Garfield	21	434 07	1	60							434.67
Grand	101	2,087 67	26	15.69							2,103.36
Gunnison	1,313	27,139 71	88,307	53,293.27	184,481	8,670.61	36,997	5,767.83	17,905	1,052.81	95,924.23
Hinsdale	740	15.295.80	61,262	36,971 62	891,888	41,918.74	24,532	3,824.54	235,178	13,828.47	111,839.17

Huerfano	13	268.71	617	372.36							641.07
Jefferson	770	15,915.90	95	57.33							15,973.23
Lake	56,839	1,174,862.13	4,494 967	2,712,712 58	52,848,413	2,483,875.41	4,486,117	699,385.64	70,238,634	4,130,031.68	11,200.867.44
La Plata	12,096	250,024.32	88,085	53,159.30	610	28.67	425	66.26			303,278.55
Larimer	50	1,033.50	35	21.12			4,336	675.98			1,730.60
Las Animas											
Mineral	10,498	216,993.66	1,193,442	720,242.25	11,880,797	558,397.46	107	16.68	2,515,628	147,918.93	1,643,568.98
Montrose	54	1,116.18	395	238.38			2,440	380.40			1,734.96
Mesa	25	516.75	11	6.64							523.39
Montezuma	100	2,067.00									2,067.00
Ouray	115,742	2,392,387.14	758,107	457,517.57	5,348,264	251,368.41	524,199	81,722.62	102,812	6,045.35	3,189,041.09
Park	15,889	328,425.63	42,647	25,737.46	560,417	26,339.60	38,374	5.982.50			386,485.19
Pitkin	205	4,237.35	2,384,542	1,439,071.10	21,975,972	1,032,870.68	127,094	19 813.95	3,854,339	226,635.13	2,722,628.21
Rio Grande	196	4,051.32	1,055	636.69			123	19.18			4,707.19
Routt	486	10,045.62	133	80.27							10,125.89
Saguache	189	3,906.63	66,337	40,034.38	131,132	6.163.20	2,988	465.83	2,917	171.52	50,741.56
San Juan	40 035	727,523.45	739,363	446,205.57	6,445,583	302,942.40	2,274,106	354,533 13	163,845	9,634.09	1,940,838.64
San Miguel	91 013	1,881,238.71	1,174.900	709,052.15	7,100.640	333,730.08	272,513	42,484 78	17,214	1,012.18	2,967,517.90
Summit	8,149	168,439.83	194,843	117,587.75	2,275,344	106 941.17	44,033	6,864 74	805.601	47,369.34	447,202 83
Teller	756,737	15,641 753.79	56,951	34,369.93	26,996	1,268.81					15,677,392.53
TOTAL	1,237,443	$25,577,946.81	12,831,348	$7,743,718.51	115,712,908	$5,438,506.67	9,854,176	$1,536,266.04	81,198,944	$4,774.497.91	$45,070,935.94

NOTE—In the above table the calculation is on the average market price of the metals for the year See page 76 The zinc is figured on actual spelter recovered.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

SHOWING BY COUNTIES THE MINERAL PRODUCTIONS OF COLORADO FOR THE YEAR ENDING DECEMBER 31, 1906.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Arapahoe	12	$ 248.04									$ 248.04
Archuleta	5	103.35	10	$ 6.68							110.03
Boulder	12,290	254,034.30	51,028	34,082.11	59,738	$ 3,194.19	22,656	$ 4,367.62			295,678.22
Chaffee	2,753	56,904.51	66,473	44,397.98	791,075	42,298.78	743,310	143,295.30	623,955	$ 38,672.73	325,569.30
Clear Creek	22,183	458,522.61	610,699	407,891.97	2,877,077	153 837.31	272,411	52,515.39	1,733,477	107,440.90	1,180,208.18
Conejos	17	351.39	20	13.36							364.75
Costilla	38	785.46	34	22.71			83	16.00			824.17
Custer	795	16,432.65	76,266	50,938.82	120,389	6,437.20	10,975	2,115.76	971	60.18	75,984.61
Delta	15	310.05	13	8.68							318.73
Dolores	1,001	20,690.67	46,709	31,197.41	643,336	34,399.18	204,041	39,335.02	883,533	54,761.38	180 383.66
Douglas	21	434 07	4	2.67							436.74
Eagle	2,167	44,791 89	83,059	55,475.94	407,203	21,773.14	45,610	8,792.70	1,426,029	88,385.28	219,218.95
El Paso											
Fremont	254	5,250.18	153	102.19	200	10.69	365	70.36			5,433.42
Garfield	13	268.71	3	2.00							270.71
Gilpin	57,353	1.185,486.51	241,491	161,294.25	474,254	25,358.36	681,151	131,312.29	46,000	2,851.08	1,506,302.49
Grand	30	620.10	210	140.26							760.36
Gunnison	4,001	82,700.67	91,625	61,197.25	245,421	13,122.66	14,357	2,767.74	158,198	9,805.11	169,593.43
Hinsdale	1,051	21.724.17	72,177	48,207.74	883,315	47,230.85	55,487	10,696.78	38,387	2,379.23	130,238.77

Huerfano	23	475.41	56	37.40	.....	.....	37	7.13	.....	.....	519.94
Jefferson	15	310.05	30	20.04	.....	.....	.....	.....	.....	.....	330.09
Lake	51.063	1,055,472.21	4,487,251	2,997 079.82	47,836,328	2,557,808.46	4,028,497	776,613.65	70,198,462	4,350,900.67	11,737,874.81
La Plata	14,908	308,148.36	121,912	81,426.24	1,763	94.27	188	36.24	.....	.....	389,705.1
Larimer	5	103.35	10	6.68	.....	.....	.....	.....	.....	.....	110.03
Las Animas	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mineral	8,522	176,149.74	1,254,058	837,597.88	14,886,356	795,973.46	.....	.....	2,892.061	179,249.94	1,988,971.02
Montrose	15	310.05	12	8.01	.....	.....	.....	.....	.....	.....	318.06
Mesa	103	2,129.01	697	465.53	.....	.....	6,000	1,156.68	.....	.....	3,751.22
Montezuma	34	702.78	10	6.68	.....	.....	.....	.....	.....	.....	709.46
Ouray	47,627	984,450.09	912,099	609,200.04	5,721,599	305,933.90	662,111	127,641.76	54,883	3,401.65	2,030,627.44
Park	19,810	409.472.70	66,376	44,333.19	628,289	33,594.61	76,234	14,696.39	.....	.....	502,096.89
Pitkin	316	6,531.72	2,160,736	1,443,177.18	17,562,565	939,070.35	285,346	55,009.00	3,276,711	203,090.55	2,646,878.80
Rio Grande	420	8.681.40	1,293	863.61	.....	.....	1 432	276.06	.....	.....	9,821.07
Routt	333	6,833.11	175	116.88	.....	.....	.....	.....	.....	.....	6,999.99
Saguache	149	3,079.83	17,286	11,545.49	181,878	9,725.02	18,530	3,572.24	74,302	4,605.24	32,527.82
San Juan	40,363	834,303.21	688,894	460,119.19	4,139.588	221,343.77	2,094,066	403,694.04	718,192	44,513.54	1,963,973.75
San Miguel	122,965	2,541,686.55	1,476,977	986,487.71	7,039,046	376,377.79	319,692	61,630.22	.....	.....	3,966,182.27
Summit	8,208	169,659.36	130,093	86,890.42	1,482,060	79,245.75	22,740	4,383.82	3,363,740	208,484.61	548,663.96
Teller	673,949	13,930,525.83	67,943	45,379.82	3,060	163.62	.....	.....	.....	.....	13,976,069.27
TOTAL	1,092,827	$22,588,734.09	12,725,882	$8,499,743.83	105,984,540	$5.666 993.36	9.565,319	$1,844,002.19	85,488,901	$5,298,602.09	$43,898,075.56

NOTE—In the above table the calculation is on the average market price of the minerals for the year. See page 76.
Gold, 20,67; silver, .66791; lead, .05347; copper, .19278; zinc, .06198 The zinc is figured on actual spelter recovered.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

SHOWING BY COUNTIES THE MINERAL PRODUCTIONS OF COLORADO FOR THE YEAR ENDING DECEMBER 31, 1907.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Boulder	8,944	$ 184,872 48	24,888	$ 16,276 74	36,286	$ 1,937.67	21,026	$ 4,205.20	.....	.....	207,292.09
Chaffee	2,694	55,685 00	34,098	22,300 10	469,452	25,068.74	345,933	69,186.60	2,407,730	$ 149,399 64	321,640.08
Clear Creek	21,558	445,603 88	571,896	374,019.98	3,663,719	193,642.59	172,568	34 513.60	2,771,960	172,027.83	1,219,807.88
Custer	351	7,255 17	20,828	13,621.50	48,127	2,569 98	7,776	1,555.20	.....	.....	25,001.85
Dolores	589	12,174 63	40 369	26,401 34	44,403	2,371 12	102,389	20,477.80	.....	.....	61,424.89
Douglas	3	62 00	.....	.....	.....	.....	.....	.....	.....	.....	62.00
Eagle	1,506	31,129 02	68,167	44,581 22	346,644	18,510.80	88,319	17,663.80	429,198	26,631.73	138,516 57
Fremont	2	41.34	97	63.44	.....	.....	10	2.00	.....	.....	106 78
Gilpin	51 308	1,060,536.35	269,184	176,046 34	442,671	23,638.63	715,790	143,158 00	.....	.....	1,403.379.32
Gunnison	2,519	52,067.72	48,971	32,027 03	94,913	5,068.35	12,653	2,530.60	38,224	2,371.79	94,065 49
Hinsdale	396	8,285.33	46,292	30,274 96	939,855	50,188.26	131,712	26,342.40	.....	.....	115,090.95
Lake	53,982	1,115,807.44	4,604,480	3,011,330 56	34,064 162	1,819,026.25	5,366,759	1,073,351.80	67,247,381	4,172 700.00	11,192,216.05
La Plata	19,470	402,444 89	217,319	141,344 22	444	23.70	708	141.60	.....	.....	543 954 41
Larimer	6	124 02	.....	.....	.....	.....	7,988	1,597.60	.....	.....	1,721.62
Mineral	6,909	142,802 51	1,246,961	815,512 49	12 980,288	693,147.38	12.711	2,542.20	2,691,216	166,989 95	1,820,994.58
Montrose	16	330.72	165	107 90	.....	.....	11,222	2,244.40	.....	.....	2,683.02
Montezuma	23	475.41	116	75 86	.....	.....	.....	.....	.....	.....	551.27
Ouray	118.497	2,449,332 98	352,614	230,609 55	3,606,699	192,597.72	908,675	181,735.00	.....	.....	3,054,275.25
Park	25,057	517,930 25	126,287	82,591 68	1,052,113	56,182 83	115,363	23,072 60	.....	.....	679,777.36

Pitkin	803	16,598.00	1,693,477	1,107,533.95	13,914 993	743 059.42	234,493	46,898.60	4,688,693	290,933.40	2,205,023.37
Rio Grande	314	6,490.38	6,393	4,181.00	330	17.62	.....	.....	.....	.....	10,689 00
Routt	154	3.183.18	26	17.00	.....	.....	.....	.....	.....	.....	3,200 18
Saguache	122	2,521.74	13,829	9.044.11	480.150	25,640.01	12,928	2,585.60	.....	.....	39,791.46
San Juan	50,190	1,037,427.30	1,033,539	675,934.50	12,425,828	663,539.21	2,572,764	514,552.80	1,772,764	110,000.00	3,001,453.81
San Miguel	119,240	2,454,787.82	1 490,770	974,963.58	6,499,957	347,097.70	381,437	76,287.40	.....	.....	3,853,136.50
Summit	4,038	83,465.45	96,806	63,311.12	1,788,247	95,492.38	32,173	6,434.60	2,970,991	184,350.00	433,053.55
Teller	501,707	10,370,283.68	51,630	33,766.00	87,954	4,696.74	894	178.80	.....	.....	10,408,925.22
TOTAL	990,398	$20,471,526.66	12,059,202	$7,886,736.17	92,987,235	$4,965,517.10	11,256,291	$2.251,258.20	85,018,157	$5,275,376 64	$40,847,834.55

NOTE—In the above table the calculation is on the average market price of the minerals for the year.
Gold, 20.67; silver, .654; lead, .0534; copper, .20; zinc, .06205 The zinc is figured on actual spelter recovered.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

SHOWING BY COUNTIES THE MINERAL PRODUCTIONS OF COLORADO FOR THE YEAR ENDING DECEMBER 31, 1908.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Boulder	8,391.874	$ 173,480.03	29,270.03	$ 15,466.28	115,131	$ 4.847.01	12,518	$ 1,627.34	.....	.....	$ 195,420.66
Chaffee	1 659.514	34,302 15	19,301.06	10,198.68	416,312	17,526.73	303,170	39,412.10	754,860	$ 34.572.58	136,012.24
Clear Creek	26,135.627	540,223.41	529,436.77	279,754.38	2,410,253	101 471.65	197,588	25,686.44	3,714,309	170,115.35	1,117,251.23
Custer	1,690.060	34,933.54	62,574.65	33,064.44	72,637	3,058.01	320	41.61	.....	.....	71,097.60
Dolores	1.751.114	36,195.52	160,240.92	84,671.29	995,705	41,919.18	39,556	5,142.28	754,860	34,572.58	202,500.85
Douglas	6.501	134.37	.....	.....	.....	.....	.....	.....	.....	.....	134.37
Eagle	1,200.090	24,805.86	30,461.09	16,095.63	215,237	9,061.47	3,885	505.05	.....	.....	50,468.01
Fremont	11.636	240.51	3.00	1.58	.....	.....	.....	.....	.....	.....	242.09
Gilpin	53,163.718	1,098,894.05	264,193.75	139,599.97	573,631	24,149.86	631,381	82,079.53	810,850	37.136.93	1,381,860.34
Gunnison	2,056.040	42,498.34	11,841 03	6,256.80	246,843	10.392.09	3,646	473.59	694,956	31,828.98	91,449.80
Hinsdale	56.142	1,160.45	14,348.98	7,582.00	164,499	6,925.40	147,921	6,774.78	.....	.....	22,442.63
Lake	67,383.351	1,392,813.86	3,215,994.42	1,699,331.45	14,338,832	603,664.82	5,334,682	693,508.66	23,400,600	1,071,750.22	5,461,069.01
La Plata	5,124.343	105,920.16	72,817.89	38,476.97	748	31.49	458	59.54	.....	.....	144,488.16
Mineral	6,170.735	127,549.09	830,950.78	439,074.39	8,238,025	346,820.85	41	5.33	1,657,323	75,905.39	989,355.04
Montezuma	4 250	87.84	7.25	3.83	.....	.....	.....	.....	.....	.....	91.67
Ouray	96,945 575	2,003,865.03	408,469 28	215,835.16	3,033,352	127,699.90	1,189,587	154,646.31	.....	.....	2,502,046.40
Park	20,214.155	417,826.58	28,540 39	15,080 73	554,120	23,328.45	46,577	6,055.01	1,883,835	86,279.64	548,570.41
Pitkin	.....	.....	1 023,808.93	540,980.63	7,437,550	313,120.85	22,474	2,921.62	1,887,150	86,431.47	943.454.57
Rio Grande	11.857	245.08	1,407.05	743.48	.....	.....	.....	.....	.....	.....	988.56

Routt	130.121	2,689.60	22.00	11.62	.....	.....	.....	.....	.....	.....	2,701.22
Saguache	36.172	747.67	2,750.84	1,453.54	76,420	3,217.28	3,102	403.26	.....	.....	5,821.75
San Juan	47,375.009	979,241.43	941,553.01	497,516.61	10,266,101	432,202.85	2,133,323	277,331.99	15,610	714.93	2,187,007.81
San Miguel	119,718.856	2,474,588.75	1,651,687.52	872,751.68	7,135,863	300,419.83	562,888	73,175.44	1,154,392	52,871.15	3,773,806.85
Summit	8,284.227	171,234.97	64,074.74	33,857.09	1,407,610	59,260.38	10,763	1,399.19	2,542,010	116,424.05	382,175.68
Teller	630,474.957	13,031,917.35	52,270.44	27,619.70	13,129	552.73	219	28.47	.....	.....	13,061,118.25
TOTAL	1,097,995.924	$22,695,575.75	9,416,025.82	$4,975,428.05	57,711,898	$2,429,670.91	10,644,099	$1,383,732.87	39,270,815	$1,798,603.33	$33,283,010.91

NOTE—In the above table the calculation is on the average market price of the minerals for the year.
Gold, 20.67; silver, .5284; lead, .0421; copper, .13; zinc, .0458. The zinc figured on actual spelter recovered.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

SHOWING BY COUNTIES THE MINERAL PRODUCTIONS OF COLORADO FOR THE YEAR ENDING DECEMBER 31, 1909.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Boulder	7,829.636	$ 161,838.58	49,362.50	$ 25,621.68	412,538	$ 17,627.75	11,499	$ 1,391.38	.....	.....	$ 206,479.39
Chaffee	1,464.559	30,372.43	34,617.68	17,828.10	531,808	22,724.15	560,579	67,830.06	1,292,189	$ 71,070.40	209,825.14
Clear Creek	23,423.435	484,162.40	457,671.50	235,700.82	2,990,034	127,764.15	237,762	28,769.20	757,680	41,672.40	918,068.97
Custer	617.296	12,759.50	14,594.95	7,516.40	41,718	1,782.61	577	69.81	89,600	4,928.00	27,056.32
Dolores	1,127.951	23,314.75	107,381.41	55,301.42	463,360	18,799.37	30,449	3,684.32	686,200	37,741.00	138,840.86
Eagle	2,642.587	54,622.27	123,875.51	63,595.88	147,770	6,314.21	221,169	26,761.45	458,380	25,210.90	176,504.71
Fremont	23.757	491.05	313.27	161.33	6,906	294.09	926	112.40	.....	.....	1,058.87
Gilpin	45,708.737	944,799.60	214,084.64	110,253.59	663,337	28,344.00	499,560	60,446.76	.....	.....	1,143,843.95
Grand	45.620	942.96	3,596.77	1,852.34	.....	.....	.....	.....	.....	.....	2,795.30
Gunnison	5,218.039	107,860.86	30,454.66	15,684.15	419,723	17,934.75	4,762	576.20	525,000	28,875.00	170,930.96
Hinsdale	264.184	5,460.68	73,825.88	38,020.32	100,692	4,302.57	544,663	65,904.22	.....	.....	113,687.79
Lake	67,465.398	1,394,509.78	3,340,589.84	1,720,403.76	14,122,282	603,445.10	5,031,576	608,820.70	28,020,259	1,541,114.24	5,868,293.58
La Plata	6,160.845	127,344.86	74,871.70	38,558.92	2,980	127.33	392	47.43	.....	.....	166,078.54
Mineral	5,440.185	112,448.62	911,222.47	469,279.57	9,052,061	386,794.56	14,346	1,735.86	1,926,338	105,948.59	1,076,207.20
Ouray	145,686.412	3,011,338.14	341,904.90	176,081.02	2,708,369	115,728.60	805,608	97,478.56	21,358	1,174.69	3,401,801.01
Park	26,889.970	555,815.68	101,900.42	52,478.71	2,234,181	95,466.55	49,646	6,007.16	585,949	32,227.20	741,995.30
Pitkin	64.328	1,329.66	653,237.06	336,417.08	12,630,028	539,681.10	21,708	2,626.66	717,851	39,481.80	919,536.30
Rio Grande	.....	.....	654.35	336.98	245	10.46	.....	.....	.....	.....	347.44
Routt	90.284	1,866.17	20.81	10.71	.....	.....	.....	.....	.....	.....	1,876.88

Saguache.....	12.586	260.15	2 ,864.71	1,475.32	102,226	4,368.11	3,266	395.18	.....	.....	6,498.76
San Juan.....	34 076.241	706,355.90	848,669.42	437.064.75	9,841,112	420,510.71	1,566,524	189,549.40	1,345,927	74,025.98	1,827,506.74
San Miguel.....	112,222.111	2,319,631.03	1.361,966.54	701,412.76	4,909,422	209,779.60	478,437	57,891.88	1,005,376	55,295.68	3,344,010.95
Summit.....	20,461.175	422,932.48	97,160.85	50,037.83	3,303,134	141,142.91	3,833	463.80	4,296,000	236,280.00	850,857.02
Teller.....	554,727.943	11,466,226.58	63,203.70	32,549.90	36,720	1,569.04	668	80.82	.....	.....	11,500,426.34
Total.....	1,061,663.279	$21,946,684.13	8,908.045.54	$4,587,643.34	64,720,646 Boulder Co	$2,765,511.72 unty's productio	10 087,950 n of tungsten	$1,220,641.95 for 1909.....	41,728,107	$2,295,045 88	$32,815,527.32 396,000.00
											$33,211,527.32

Note—In the above table the calculation is on the average market price of the minerals for the year.
Gold, 20.67; silver, .515; lead, .04273; copper, .121; zinc, .055. The zinc figured on actual spelter recovered.

THE BUREAU OF MINES OF THE STATE OF COLORADO.

SHOWING BY COUNTIES THE MINERAL PRODUCTIONS OF COLORADO FOR THE YEAR ENDING DECEMBER 31, 1910.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Boulder	6,430.075	$132,909.65	44,161.82	$23,613.32	51,373	$2,306.64	21,851	$ 2,759.78	.....	.....	$ 161,589.39
Chaffee	3,524.866	72,858.98	170,768.69	91,310.02	1,026,297	46,080.74	185,314	23,405.16	1,254,637	67,624.93	301,279.83
Clear Creek	23,552.950	486,839.48	457,976.45	244,880.00	2,457,290	110,332.32	607,543	76,732.68	1,910,432	102,972.28	1,021,756.76
Costilla	112.151	2,318.16	9.27	4.96	.....	.....	.....	.....	.....	.....	2,323.12
Custer	442.150	9,139.24	7,268.74	3,886.60	15,712	705.47	4,242	535.76	.....	.....	14,267.07
Delta	3.439	71.08	.....	.....	.....	.....	.....	.....	.....	.....	144.96
Dolores	741.599	15,328.85	87,777.09	46,934.41	198,648	8,919.29	14,025	1,771.36	52,813	2,846.62	75,800.53
Douglas	4.005	82.78	.....	.....	.....	.....	.....	.....	.....	.....	82.78
Eagle	1,416.322	29,275.38	89,538.68	47,876.33	395,895	17,775.68	211,119	26,664.33	1,340,370	71,245 94	192,837.66
Garfield	175.346	3,624.40	304.25	162.68	.....	.....	499	63.02	.....	.....	3,850.10
Gilpin	28,637.398	591,935 02	143,732.57	76,853.80	570,845	25,630.94	518,631	65,503.10	.....	.....	759,922.86
Gunnison	11,482.855	237,350.61	45,074.69	24,101 44	566,694	25,441.56	22,306	2,817.25	357,394	19,263.54	308,977.40
Hinsdale	289 745	5.989.03	55,642.98	29,752.30	248,756	11,169.14	460,961	58,219.37	.....	.....	105,129.84
Lake	57,215.569	1.182,645.81	3,045,312.37	1,628,328.52	12,728,195	571,495.96	3,749,721	473,589.76	41,757,155	2,250,710.71	6,106,770.76
La Plata	18,953.330	391,765.23	142,167.34	76,016.88	373	12.26	152	19.20	.....	.....	467,813.57
Mineral	5,634.123	116,457.32	769,442.38	411,420.84	8,131,421	365,100.80	25,520	3,223.18	3,129,157	168,661.56	1,064,863.70
Montezuma	422.241	8,727.72	214.57	114.75			217	27.41	.....	.....	8,869.86
Ouray	107,007.180	2,211,838.41	417,980.04	223,493.93	4,043,070	181,533.84	654,295	82,637.46	.....	.....	2,699,503.64
.....	12,838.681	265,375.54	116,939.80	62,527.71	2,051,812	92,126.36	86,254	10,893.88	940,760	50,706.96	481,630.45

Pitkin	31.436	649.78	472,597.05	252,697.64	13,407,805	602,010.44	24,426	3,085.00	.....	.....	858,442.86
Rio Grande	63.188	1,306.10	61.19	32.72	246	11.04	89	11.24	.....	.....	1,361.10
Routt	254.096	5,252.16	35.64	19.06	.....	.....	.....	.....	.....	.....	5,271.22
Saguache	52.263	1,080.28	6,296.83	3,366.92	193,823	8,702.65	7,429	938.28	.....	.....	14,088.13
San Juan	33,447.194	691,353.50	756,234.87	404,358.78	10,887,752	488,860.06	1,146,134	144,756.72	5,161,542	278,207.11	2,007,536.17
San Miguel	120,716.816	2,495,216.58	1,156,663.27	618,467.85	7,431,312	323,665.91	538,158	67,969.36	1,762,879	95,019.18	3,600,338.88
Summit	18,078.218	373,676.77	172,857.71	92,427.02	6,154,629	276,342.84	25,426	3,211.30	4,808,508	259,178.58	1,004,836.51
Teller	530,453.204	10,964,467.73	56,269.42	30,087.26	3,421	153.60	.....	.....	.....	.....	10,994,708.59
Total	981,980.440	$20,297,535.69	8,215,327.71	$4,392,735.72	70,565,369	$3,158,380.54	8,304,312 Boulder Co	$1,048,834.60 unty's productio	62,475,647 n of Tungsten	$3,366,437.41 for 1910.....	$32,263,923.74 $736,700.00
											$33,000,623.74

NOTE.—In the above table the calculations are made on the average price of the mineral for the year.
Gold, 20.67; silver, .5347; lead, .0449; copper, .1263; zinc, .0539. The zinc figured on actual spelter recovered

PRODUCTION OF

PRECIOUS METAL

To December 31, 1910

THE BUREAU OF MINES OF THE STATE OF COLORADO.

PRECIOUS METAL PRODUCTION OF COLORADO TO DECEMBER 31, 1910.

YEAR	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Previous to 1870	1,316,550	$27,213,081.00	250,000	$ 330,000.00	.....	.....	200,000	$ 40,000.00	.....	.....	$ 27,583,081.00
1870	145,864	3,015,000.00	500,000	660,000.00	.....	.....	97,088	20,000.00	.....	.....	3,695,000.00
1871	175,808	3,633,951.00	779,590	1,029,058.00	.....	.....	90,909	30,000.00	.....	.....	4,693,009.00
1872	128,034	2,646,463.00	1,524,207	2,015,001.00	80,000	$ 5,000.00	155,172	45,000.00	.....	.....	4,711,464.00
1873	88,788	1,835,248.00	1,683,370	2,185 014.00	112,000	7,078.40	28,172	65,000.00	.....	.....	4,092,340.40
1874	99 932	2.065 595.00	2,415,435	3.086,926.00	624,000	37,502.40	400,876	90,197.00	.....	.....	5,280,220.40
1875	112,291	2,321,055.00	2,306,253	2,873,591.00	1,636,000	95,706.00	428,571	90,000.00	.....	.....	5,380,352.00
1876	131,897	2,726.311.00	2,552,125	2,950,256.00	1,334,000	81.774.20	376,244	70,000.00	.....	.....	5,828,341.20
1877	145.138	3,000,000.00	3,480,548	4,180,138.00	1,794,000	98,490.60	504,283	93,796.64	.....	.....	7,372,425.24
1878	162,864	3,366,404 00	4.172,744	4 807,001.00	13,338,000	481,501.80	539,393	89,000.00	.....	.....	8,743,906.80
1879	156.023	3,225,000.00	9,049,424	10,162,503.00	47,348,000	1,960,207.20	766,082	131,000 00	.....	.....	15,478,710.20
1880	154,814	3,200,000.00	13,148.735	15,055,302.00	71,348,000	3,595,939.20	915,422	184,000.00	.....	.....	22,035,241.20
1881	159,652	3.300,000.00	13.272,488	15,104,092.00	81,094,000	3,900,621.40	889,503	161,000.00	.....	.....	22,465,713.40
1882	162,554	3,360,000.00	12,707.866	14,436,136.00	110,000,000	5,401,000.00	1,494,000	276,390.00	.....	.....	23,473,526.00
1883	198.355	4,100,000.00	13,434 915	14,912,756.00	141,114,000	6,096,124.80	1,153,000	182,750.50	.....	.....	25,291,631.30
1884	205,612	4.250,000.00	12,375,280	13,984,066.00	126,330,000	4,724,742.00	2,013,000	278,800.50	.....	.....	23,237,608.50
1885	203,193	4,200,000.00	12,220,589	13,014,927.00	111,000,000	4,345,000.00	1,146,000	127,435.20	.....	.....	21,687,362.20
1886	215,288	4,450,000.00	12.375,280	12,313 404.00	118,000,000	5,463,400.00	409,000	44,990.00	.....	.....	22,271,794.00

1887	193,517	4,000,000.00	11,600.826	11,345,608.00	126,000,000	5,670 000.00	2,012,000	226,350.00	.....	.....	21,241,958.00
1888	181,809	3,758,000.00	14,695,645	13,813,906.00	131,000,000	5,790,200.00	1,621 000	270,058.60	.....	.....	23,632,164.60
1889	187,898	3,833,859.00	18,375,519	17.199,486.00	138,000,000	5,423,400.00	3,100,000	426,250.00	.....	.....	26,932,995.00
1890	200,774	4,150,000.00	18,800,425	19,665,245.00	109,000,000	4,883,200.00	6,000,000	945.000.00	.....	.....	29,643,445.00
1891	222,545	4,600,000.00	21,160,480	20,906,554.00	128,000,000	5,568,000.00	7,000,000	883,400.00	.....	.....	31,957,954.00
1892	256,410	5,300,000.00	26,350,000	23,082,600.00	123,000,000	5,030,700.00	7,250,000	837,375.00	.....	.....	34,250,675.00
1893	364,151	7,527,000.00	25,838,600	20,205,785.00	84,396,000	3,147,970.80	7,121,157	765,535.13	.....	.....	31,646,290.93
1894	462,009	9,549,731.00	23,236,025	14,638,696.00	97,264,000	3,200,000.00	6,528,214	624,097.26	.....	.....	28,012,524.26
1895	656,021	13,559,954.00	17.891,626	11,683,232.00	91,477,214	2,954,714.00	6,125,000	659,050.00	.....	.....	28,856,950.00
1896	738,618	15,267,234.00	21,547,743	14,458,536.00	82,018,000	2,321,109.30	7,539,245	820,269.86	.....	.....	32,867,149.26
1897	947,249	19,579,637.00	21,278,202	12,692,448.00	80,799,778	2,731,032.49	9,151,592	960,917.13	.....	.....	35,964,034.62
1898	1,138,584	23,534,531.28	23,502,601	13,690,265.15	113,417,168	4,117,043.24	10,870,869	1,304,504.28	.....	.....	42,646,343.95
1899	1,282,471	26,508,675.57	23,114,688	13,771,731.10	138,048,446	6,170,765.53	7,357,245	1,295,610.85	.....	.....	47,746,783.05
1900	1,391,487	28,762,036.29	20,336,712	12,488,774.84	164,274,762	7,770,196.24	7,826,949	1,293,011.98	.....	.....	50,314,019.35
1901	1,339,112	27,679 445.04	18,492,563	10,901,365.89	148,111,020	6,419,131.61	7,872,529	1,303,297.17	.....	.....	46,303,239.71
1902	1,379,638	28,517,117.46	15,941 703	8,315,192.29	106,303,374	4,325.484.29	8,463,938	1,006,108.31	52,582,510	2,544,993.48	44,708,895.83
1903	1 045,252	21,605,358.84	13,245,483	7,079,710.66	101,513,414	4,301,123.35	7.809,920	1,033,642.90	80,616,000	4,353,264.00	38,373,099.75
1904	1,171,892	24,223,007.64	12,960,777	7,416,156.60	107,546,854	4,624,514.73	9,401,913	1,205,607.31	64,976,235	3,313,787.97	40,783,074.25
1905	1,237,443	25,577,946.81	12,831,348	7,743,718.51	115,712,908	5,438,506.67	9,854,176	1,536,266.04	81,198,941	4,774,497.91	45,070,935.94
1906	1,092,827	22,588,734.09	12,725,882	8,499,734.83	105,984,540	5,666,993.36	9,565,319	1,844,002.19	85,488,901	5,298,602.09	43,898,075.56
1907	990,398	20,471,526.66	12,059,202	7,886,736.17	92,987,235	4,965,517.10	11,256,291	2,251,258.20	85,018,157	5,275,376.64	40,847,834.55
1908	1,097,995	22,695,575.75	9,416,025	4,975,428.05	57,711,898	2,429,670.91	10,644,099	1,383,732.87	39,270,815	1,798,603.33	33,283,010.91
1909	1,061,663	21,946,684.13	8,908,045	4,587,643.34	64,720,646	2,765,511.72	10,087,950	1,220,641.95	41,728,107	2,295,045.88	33,211,527.32
1910	981,980	20,297,535.69	8,215,327	4,392,735.72	70,565,369	3,158,380.54	8,304,312	1,048,834.60	62,475,647	3,366,437.41	32,263,923.74
TOTAL	23,584,400	$487,491,998.25	530,774,236	$424,541,469.20	3,403,004,626	$145,167,253.98	194,370,433	$27,164,181.47	593,355,313	$33,020,698.71	$1,117,778,631.42

THE BUREAU OF MINES OF THE STATE OF COLORADO.

AVERAGE MARKET VALUE OF METALS PER ANNUM.

YEAR	Gold per Ounce	Silver per Ounce	Lead per Pound	Copper per Pound	Zinc per Pound
Previous to 1870	$20.67	$1.32	.....	$0.20	.....
1870	20.67	1.32	.....	.206	.....
1871	20.67	1.32	.....	.33	.....
1872	20.67	1.322	$0.0625	.29	.....
1873	20.67	1.298	.0632	.232	.....
1874	20.67	1.278	.0601	.225	.....
1875	20.67	1.246	.0585	.21	.....
1876	20.67	1.156	.0613	.186	.....
1877	20.67	1.201	.0549	.186	.....
1878	20.67	1.152	.0361	.165	.....
1879	20.67	1.123	.0414	.171	.....
1880	20.67	1.145	.0504	.201	.....
1881	20.67	1.138	.0481	.181	.....
1882	20.67	1.136	.0491	.185	.....
1883	20.67	1.11	.0432	.1585	.....
1884	20.67	1.13	.0374	.1385	.....
1885	20.67	1.065	.0395	.1112	.....
1886	20.67	.995	.0463	.11	.....
1887	20.67	.978	.0450	.1125	.....
1888	20.67	.94	.0442	.1666	.....
1889	20.67	.936	.0393	.1375	.....
1890	20.67	1.046	.0448	.1575	.....
1891	20.67	.988	.0435	.1262	.....
1892	20.67	.876	.0409	.1155	.....
1893	20.67	.782	.0373	.1075	.....
1894	20.67	.63	.0329	.0956	.....
1895	20.67	.653	.0323	.1076	.....
1896	20.67	.671	.0283	.1088	.....
1897	20.67	.5965	.0338	.105	.....
1898	20.67	.5825	.0363	.12	.....
1899	20.67	.5958	.0447	.1761	.....
1900	20.67	.6141	.0473	.1652	.....
1901	20.67	.5895	.04334	.16555	.....
1902	20.67	.5216	.01069	.11887	.0484
1903	20.67	.5345	.04237	.13235	.054
1904	20.67	.5722	.043	.12823	.051
1905	20.67	.6035	.047	.1559	.0588
1906	20.67	.66791	.05347	.09278	.06198

THE BUREAU OF MINES OF THE STATE OF COLORADO.

AVERAGE MARKET VALUE OF METALS PER ANNUM—CONCLUDED.

YEAR	Gold per Ounce	Silver per Ounce	Lead per Pound	Copper per Pound	Zinc per Pound
1907	20.67	.654	.0534	.20	.06205
1908	20.67	.5284	.0421	.13	.0458
1909	20.67	.515	.04273	.121	.055
1910	20.67	.5347	.0449	.1263	.0539

MINING LAWS AND REGULATIONS RELATING TO LODE AND PLACER CLAIMS.

RULES AND REGULATIONS OF THE UNITED STATES SURVEYOR GENERAL'S OFFICE AND UNITED STATES LAND OFFICE.

FEES AND PAYMENTS FOR PATENTING.

For lode claim	$30.00
For placer claim	35.00
For millsite	30.00
For millsite included in one survey with a lode claim	20.00
For each lode claim within and included in the survey of a placer claim	20.00
For several lode locations included in one survey, the first location named	30.00
All other locations named, each	25.00
For several placer locations included in one survey, the first location named	35.00
All other locations included, each	30.00
For affidavit of $500 expenditure of improvements after approval of survey	5.00

PUBLIC LANDS OPEN TO PROSPECTORS.

All valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, and the lands in which they are found, to occupation and purchase by citizens of the United States, and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs or rules of miners in the several mining districts, so far as the same are applicable and not inconsistent with the laws of the United States. (Rev. Stat. U. S., Sec. 2319.)

LODE CLAIMS.

No location of a mining claim shall be made until the discovery of the vein or lode within the limits of the claim located

The length of any lode claim may be equal to, but not exceed, 1,500 feet along the vein. The width of lode claims shall

be 150 feet on each side of the center of the vein or crevice. There are a few exceptions, however, wherein local laws have reduced this to 75 feet on each side of the center of the vein.

The discoverer of a lode shall, within three months from the date of discovery, record his claim in the office of the recorder of the county in which such lode is situated, by a location certificate.

Before filing such location certificate the discoverer shall locate his claim: (1) By sinking a discovery shaft upon the lode to the depth of at least ten feet from the lowest part of the rim of such shaft at the surface, or deeper if necessary to show a well-defined crevice. (2) By posting at the point of discovery on the surface a plain sign or notice, containing the name of the lode, the name of the locator and the date of discovery. (3) The discoverer shall have sixty days from the time of uncovering or disclosing a lode to sink a discovery shaft thereon.

On each claim located, and until a patent has been issued therefor, not less than $100.00 worth of labor shall be performed or improvements made during each year. The period within which the work required to be done annually on all unpatented mineral claims shall commence on the first day of January succeeding the date of location of such claim.

Marking boundaries—Posts, Piles of stones.—Such surface boundaries shall be marked by six substantial posts hewed or marked on the side or sides which are in toward the claim, and sunk in the ground, to wit: one at each corner and one at the center of each side line. Where it is practically impossible on account of bed-rock to sink such posts, they may be placed in a pile of stones, and where in marking the surface boundaries of a claim any one or more of such posts shall fall by right upon precipitous ground, where the proper placing of it is impracticable or dangerous to life or limb, it shall be legal and valid to place any such post at the nearest practicable point, suitably marked, to designate the proper place.

Open cut, cross-cut, tunnel, adit, to hold lode.—Any open cut, cross-cut or tunnel which shall cut a lode at a depth of ten feet below the surface, shall hold such lode, the same as if a discovery shaft were sunk thereon, or an adit of at least ten feet in along the lode from the point where the lode may be in any manner discovered, shall be equivalent to a discovery shaft.

Sixty days to sink discovery shaft.—The discoverer shall have sixty days from the time of uncovering or disclosing a lode to sink a discovery shaft thereon.

What location includes; extra-lateral rights.—The location or location certificate of any lode claim shall be construed to include all surface ground within the surface lines thereof, and all lodes and ledges throughout their entire depth, the top or apex of which lies inside of such lines extended downward, vertically, with such parts of all lodes or ledges as continue by

dip beyond the side lines of the claim, but shall not include any portion of such lodes or ledges beyond the end lines of the claim, or the end lines continued, whether by dip or otherwise, or beyond the side lines in any other manner than by the dip of the lode.

PLACERS.

All placer mining claims shall conform as near as practicable with the United States system of public land surveys, and no such location shall include more than twenty acres for each individual claimant.

Claims usually called "placers," including all forms of deposits, excepting veins of quartz or other rock in place, shall be subject to entry and patent under like circumstances and conditions, and upon similar proceedings as provided for vein or lode claims.

Location certificate; recording; manner of locating.—The discoverer of a placer claim shall, within thirty days from the date of discovery, record his claim in the office of the recorder of the county in which said claim is situated, by a location certificate, which shall contain: first, the name of the claim, designating it as a placer claim; second, the name of the locator; third, the date of location; fourth, the number of acres or feet claimed; and, fifth, a description of the claim, by such reference to natural objects or permanent monuments as shall identify the claim. Before filing such location certificate the discoverer shall locate his claim, first, by posting upon such claim a plain sign or notice, containing the name of the claim, the name of the locator, the date of discovery and the number of acres or feet claimed; second, by marking the surface boundaries with substantial posts, and sunk into the ground, to wit, one at each angle of the claim.

Size of claims.—Legal subdivisions of forty acres may be subdivided into ten-acre tracts; and two or more persons or associations of persons, having contiguous claims of any size, although such claims may be less than ten acres each, may make joint entry thereof; but no location of a placer claim made after the ninth day of July, eighteen hundred and seventy, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States surveys; and nothing in this section contained shall defeat or impair any bona fide pre-emption or homestead claim upon agricultural lands, or authorize the sale of the improvements of any bona fide settler to any purchaser.

Twenty acres to one locator.—Where placer claims are upon surveyed lands, and conform to legal subdivisions, no further survey or plat shall be required, and all placer mining claims located after the tenth day of May, eighteen hundred and seventy-two, shall conform as near as practicable with the United

States system of public land surveys and rectangular subdivisions of such surveys, and no such location shall include more than twenty acres for each individual claimant; but where placer claims cannot be conformed to legal subdivisions, survey and plat shall be made as on unsurveyed lands; and where, by the segregation of mineral land in any legal subdivision, a quantity of agricultural land less than forty acres remains, said fractional portion of agricultural land may be entered by any party qualified by law for homestead or pre-emption purposes.

Claim intersected by lode.—Where the same person, association or corporation is in possession of a placer claim, and also a vein or lode included within the boundaries thereof, application shall be made for a patent for the placer claim, with the statement that it includes such vein or lode, and in such case a patent shall issue for the placer claim, subject to the provisions of this chapter, including such vein or lode, upon the payment of five dollars per acre for such vein or lode claim, and twenty-five feet of surface on each side thereof. The remainder of the placer claim, or any placer claim not embracing any vein or lode claim, shall be paid for at the rate of two dollars and fifty cents per acre, together with all costs of proceedings; and where a vein or lode, such as is described in section 2320, is known to exist within the boundaries of a placer claim, an application for a patent for such placer claim which does not include an application for the vein or lode claim shall be construed as a conclusive declaration that the claimant of the placer claim has no right of possession of the vein or lode claim; but where the existence of a vein or lode in a placer claim is not known, a patent for the placer claim shall convey all valuable mineral and other deposits within the boundaries thereof.

Location and location certificate.—The discoverer of a placer claim shall, within thirty days from the date of discovery, record his claim in the office of the recorder of the county in which said claim is situated, by a Location Certificate which shall contain: first, the name of the claim, designating it as a placer claim; second, the name of the locator; third, the date of location; fourth, the number of acres or feet claimed; and, fifth, a description of the claim by such reference to natural objects or permanent monuments as shall identify the claim.

Before filing such location certificate, the discoverer shall locate his claim: first, by posting upon such claim a plain sign or notice, containing the name of the claim, the name of the locator, the date of discovery, and the number of acres or feet claimed; second, by marking the surface boundaries with substantial posts, and sunk in the ground, to wit, one at each angle of the claim. (1879.)

Annual labor.—On each placer claim of one hundred and sixty acres or more, heretofore or hereafter located, and until a patent has been issued therefor, not less than one hundred

dollars' worth of labor shall be performed or improvements made by the first day of August, 1879, and by the first day of August of each year thereafter. On all placer claims containing less than one hundred and sixty acres the expenditure during each year shall be such proportion of one hundred dollars as the number of acres bears to one hundred and sixty. On all placer claims containing less than twenty acres the expenditures during each year shall not be less than twelve dollars; but when two or more claims lie contiguous, and are owned by the same person, the expenditure hereby required for each claim may be made on any one claim, and upon a failure to comply with these conditions, the claim or claims upon which such failure occurred shall be open to relocation, in the same manner as if no location of the same had ever been made; provided, that the original locators, their heirs, assigns or legal representatives, have not resumed work upon the claim after failure and before such location; provided the aforesaid expenditures may be made in building or repairing ditches to conduct water upon such ground, or in making other mining improvements necessary for the working of such claim.

Upon the failure of any one of several co-owners to contribute his proportion of the expenditures required hereby, the co-owners who have performed the labor, or made the improvements, may at the expiration of the year, to wit, the first of August, 1879, for the locations heretofore made, and one year from the date of locations hereafter made, give such delinquent co-owner personal notice in writing, or, if he be a non-resident of the State, a notice by publication in the newspaper published nearest the claim for at least once a week for ninety days, and mailing him a copy of such newspaper if his address be known, and if at the expiration of ninety days after such notice in writing, or after the first publication of such notice, such delinquent should fail or refuse to contribute his proportion of the expenditure required by this section, his interest in the claim shall become the property of his co-owners who have made the required expenditures. (1879.)

TUNNELS.

Any person or persons engaged in working a tunnel, within the provisions of this chapter, shall be entitled to 250 feet each way from said tunnel, on each lode so discovered; provided, they do not interfere with any vested rights. If it shall appear that claims have been staked off and recorded prior to the record of said tunnel, on the line thereof, so that the required number of feet cannot be taken near said tunnel, they may be taken upon any part thereof where the same may be found vacant; and persons working said tunnel shall have the right of way through all lodes which may lie in its course.

Where a tunnel is run for the development of a vein or lode, or for the discovery of mines, the owners of such tunnel shall have the right of possession of all veins or lodes within 3,000 feet from the face of such tunnel on the line thereof not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface; and locations on the line of such tunnel of veins or lodes not appearing on the surface made by other parties after the commencement of the tunnel, and while the same is being prosecuted with reasonable diligence, shall be invalid; but failure to prosecute the work on the tunnel for six months shall be considered as an abandonment of the right to all undiscovered veins on the line of such tunnel.

Where a person or company has or may run a tunnel for the purpose of developing a lode or lodes owned by said persons or company, the money so expended on said tunnel shall be taken and considered as expended on said lode or lodes, and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same.

AFFIDAVIT OF ANNUAL LABOR—EFFECT OF FILING.

Within six months after any time set or annual period allowed for the performance of labor or making improvements upon any lode claim or placer claim, the person on whose behalf such outlay was made, or some person for him, may make and record in the office of the recorder of the county wherein such claim is situate, an affidavit in substance as follows:

State of Colorado, ... County, ss.

Before me, the subscriber, personally appeared ....., who, being duly sworn, saith that at least ..... dollars' worth of work or improvements were performed or made upon (here describe claim or part of claim), situate in ..... mining district, County of ....., State of Colorado, between the ..... day of ....., A. D. ....., and the ..... day of ....., A. D. ..... Such expenditure was made by or at the expense of ....., owners of said claim, for the purpose of complying with the law, and holding said claim.

Jurat: (Signature) .....

And such affidavit, when so recorded, shall be prima facie evidence of the performance of such labor or the making of such improvements; Provided, That all affidavits of labor or improvements upon placer claims heretofore filed and recorded within the period prescribed in this section, or within the period prescribel in section twenty-four hundred and ten of the General Statutes, which shall contain in substance the requirements of the affidavit prescribed by this section or said section twenty-

four hundred and ten, shall be prima facie evidence of the performance of such labor or the making of such improvements; and the original thereof, or a certified copy of the record of the same, shall be received as evidence accordingly by the courts of this State, and this class of evidence shall be receivable, where relevant or material, in all causes, whether now pending or hereafter brought.

RE-LOCATION BY OWNER—CONDITIONS.

If at any time the locator of any mining claim heretofore or hereafter located, or his assigns, shall apprehend that his original certificate was defective, erroneous, or that the requirements of the law had not been complied with before filing, or shall be desirous of changing his surface boundaries, or of taking in any part of an overlapping claim which has been abandoned, or in case the original certificate was made prior to the passage of this law, and he shall be desirous of securing the benefits of this act, such locator, or his assigns, may file an additional certificate, subject to the provisions of this act; Provided, That such re-location does not interfere with the existing rights of others at the time of such re-location, and no such re-location or other record thereof shall preclude the claimant or claimants from proving any such title or titles as he or they may have held under previous location.

RE-LOCATION OF ABANDONED LODES.

The re-location of abandoned lode claims shall be by sinking a new discovery shaft and fixing new boundaries in the same manner as if it were the location of a new claim; or the re-locator may sink the original discovery shaft ten feet deeper than it was at the time of the abandonment, and erect new or adopt the old boundaries, renewing the posts if removed or destroyed. In either case a new location stake shall be erected. In any case, whether the whole or part of an abandoned claim is taken, location certificate may state that the whole or any part of the new location is located as abandoned property.

PATENT.

A patent for any land claimed and located for valuable deposits may be obtained in the following manner: Any person, association or corporation having claimed and located a piece of land for such purposes, may file in the proper land office an application for a patent, together with a plat and field notes of the claim or claims in common, made by or under the direction of the United States Surveyor-General, and shall thereupon be entitled to a patent for the land in the manner following: The register of the land office, upon the filing of such ap-

plication, shall publish a notice that such application has been made, for the period of sixty days, in a newspaper to be by him designated as published nearest to such claim; and he shall also post such notice in his office for the same period. The claimant shall file with the register a certificate of the United States Surveyor-General that $500.00 worth of labor has been expended or improvements made upon the claim. At the expiration of the sixty days of publication, the applicant is entitled to a patent, upon the payment to the proper officer of $5.00 per acre.

ALTITUDE OF CITIES AND TOWNS IN COLORADO.

NAME	FEET	NAME	FEET
Alamosa	7,536	Greeley	4,652
Alma	10.238	Gunnison	7,673
Anaconda	9,453	Idaho Springs	7,556
Antonito	7,876	Lafayette	5,094
Aspen	7,943	La Junta	4,052
Berthoud	4,962	Lamar	3,610
Black Hawk	8,045	Lake City	8,675
Boulder	5,350	Las Animas	3,884
Breckenridge	9,534	Leadville	10,190
Buena Vista	7,958	Littleton	5,358
Canon City	5,332	Longmont	4,941
Central City	8,516	Loveland	4,986
Colorado City	6,077	Lyons	5,349
Colorado Springs	5,878	Mancos	6,996
Como	9,785	Manitou Springs	6,307
Creede	8,850	Manzanola	4,249
Cripple Creek	9,591	Meeker	6,182
Del Norte	7,868	Monte Vista	7,653
Delta	4,970	Montrose	5,801
Denver	5,184	New Castle	5,552
Dillon	8,849	Ouray	7,710
Dolores	6,945	Pagosa Springs	7,095
Durango	6,508	Palmer Lake	7,224
Fairplay	9,896	Pitkin	9,190
Florence	5,187	Pueblo	4,675
Fort Collins	4,984	Red Cliff	8,598
Georgetown	8,507	Rico	8,725
Glenwood Springs	5,747	Ridgway	6,993
Golden	5,693	Robinson	10,857
Grand Junction	4,573	Rocky Ford	4,176

ALTITUDE OF CITIES AND TOWNS IN COLORADO.—Continued.

NAME	FEET	NAME	FEET
Saguache	7,745	Sterling	3,932
Salida	7,038	Telluride	8,744
San Luis	7,946	Trinidad	5,985
Silver Plume	9,189	Victor	9,728
Silverton	9,288	Walsenburg	6,187
Starkville	6,337	Wray	3,531
Steamboat Springs	6,781	Yuma	4,147

ELEVATION OF MOUNTAIN PEAKS AND PASSES IN COLORADO.

NAME	FEET	NAME	FEET
Agency Knob	12,274	Boreas	11,480
Alpine Tunnel	11,606	Boulder Pass	11,670
Anchor Mountain	12,092	Boulder Peak	12,417
Antelope Pass	8,050	Breckenridge Pass	11,503
Antero Mount	14,245	Buckeye Peak	12,873
Arapahoe Peak	13,520	Buckskin Mountain	14,296
Argentine Pass	13,286	Buffalo Peak	13,541
Arkansas, Mount	13 807	Calico Peak	12 056
Augusta Mountain	12,615	Cameron Cone	10,685
Avery Peak	12,659	Canby, Mount	13,466
Axtell Mountain	12,012	Capitol Mountain	13,997
Bald Mountain, Boulder Co	11,493	Carbon Mountain	12,000
Bald Mountain, Larimer Co	11,270	Cascade	11,707
Bald Mountain, Summit Co	13,974	Castle Peak	14,259
Bald Mountain, San Miguel Co	11,700	Cement Mountain	12,212
Baldy, Mount	12,809	Chama Peak	12,248
Banded Peak	12,860	Cheyenne	9,407
Battlement Mesa, Mean	12,000	Chicago Lake	11,500
Basalt Peak	11,906	Chief Mountain	11,710
Bear Mountain	12,950	Clark's Peak	13,167
Beckwith Mountain	12,371	Cochetopa Dome	10,000
Belle View	12,673	Conejos Mountain	13,183
Bellven	12,350	Corral Peak	11,533
Berthoud Pass	....	Crested Butte	12,172
Beson Peak	12,426	Crestone Peak	14,233
Blackhawk	12,677	Culebra Peak	14,069
Blackhead	12,514	Cunningham Pass	12,090
Blaine Mount	14,249	Daly, Mount	13,193
Blanca Peak	14,390	Del Norte	13,084

ELEVATION OF MOUNTAIN PEAKS AND PASSES IN COLORADO.—Continued.

NAME	FEET	NAME	FEET
Double Top Mountain	12,192	Hamilton, Mount	13,800
Eagle Peak	12,105	Hancock Pass	12,263
East Cement Mountain	12,047	Handie's Peak	14,008
East Spanish Peak	12,708	Hanby Peak	10,906
Elbert	14,421	Harvard, Mount	14,375
Elk Mountain	12,718	Hayden Divide	9,182
Engineer Mountain	13,190	Hayden Pass	10,780
Elliott Mountain	12,337	Helmet Peak	11,976
Emmons, Mount	12,414	Hermosa, Mount	12,564
Eolus, Mount	14,079	Hesperus Peak	13,225
Ethel Peak	11,976	Holy Cross, Mount of	14,170
Evans, Mount	14,321	Homestake Peak	13,227
Farnum Peak	11,400	Hoosier Pass	10,309
Flora, Mount	12,878	Horsefly Peak	10,504
Freeman Peak	11,627	Horseshoe Mountain	13,912
Fremont Pass	11,320	Humboldt Peak	14,044
Frustum Mountain	13,893	Hunchback Mountain	13,133
Galena Mountain	13,290	Hunt's Peak	12,446
Garfield, Mount	13,065	Hurricane Peak	13,565
Georgia Pass	11,476	Iron Mountain	10,405
Gibson Peak	13,729	Jacque Peak	13,215
Gilpin Peak	13,682	James Peak	13,283
Glacier Peak	12,654	Johnny Bull Mountain	12,018
Golden Peak	9,650	Jones Mountain	13,851
Gothic Mountain	12,646	Jupiter Peak	13,830
Grand Mesa	10,000	Kendall, Mount	13,480
Grayback Peak	12,387	Kenosha Cone, East	12,350
Gray Head Summit	10,994	Kenosha Cone, West	12,340
Gray's Peak	14,341	Keyes, Mount	13,750
Greenhorn Mountain	12,334	Kit Carson Peak	14,100
Green Mountain	10,530	Lake Creek Pass	12,226
Griffith Mountain	11,427	Lamborn, Mount	11,337
Grizzly Peak, San Juan	13,748	La Plata Peak	14,342
Grizzly Peak, Pitkin	13,956	La Veta Peak	11,000
Gunnison, Mount	12,688	Leavenworth Mountain	10,390
Guyot Mountain	13,565	Leviathan Peak	13,528
Hagerman	11,495	Leon Peak	10,954
Hague	13,832	Lilie Mountain	11,433

ELEVATION OF MOUNTAIN PEAKS AND PASSES IN COLORADO.—Continued.

NAME	FEET	NAME	FEET
Lincoln, Mount	14,297	Pagosa Peak	12,674
Little Lone Cone	12,001	Park Cone	12 021
Lizard Head	13,156	Parrott Peak	11,876
Lone Cone	12,761	Parry Peak	13,133
Long's Peak	14,271	Pass Mountain	11,200
Lookout Peak	13,674	Pearl Mountain	13,484
Lost Park Mountain	11,800	Pearl Pass	12,715
Loveland Pass	11,876	Peeler Peak	12,219
McClellan, Mount	13,423	Pigeon Peak	13,961
McMillan Peak	12,800	Pike's Peak	14,107
Macomb Peak	13,154	Pike's Peak Timberline	11,720
Marcellina, Mount	11,349	Pilot Knob	13,750
Marmot Peak	11,841	Pisgah, Mount	10,322
Maroon Peak	14,126	Plateau Peak	12,030
Marshall Pass	10,846	Pole Creek Mountain	13,400
Marvine, Mount	12,045	Poncha Pass	9,049
Massive, Mount	14,424	Pope's Nose	12,274
Matterhorn Peak	13,589	Potosi Peak	13,763
Mears Peak	13,008	Powell, Mount	13,398
Mesa Peak	12,581	Princeton, Mount	14,196
Mesquite Pass	13,308	Prospect Mountain	12,618
Mineral Creek Pass	11,098	Ptarmigan Hill	12,174
Mineral Point	12,541	Ptarmigan Peak	13,746
Monitor Peak	13,703	Purgatory Peak	13,749
Mosca Pass	9,713	Pyramid Peak	13,885
Mosquito Peak	13,794	Quandary Peak	14,266
Muddy Creek Pass	8,772	Rabbit's Ears Mountains	10,719
Nebo, Mount	13,192	Ragged Mountain	12,481
North Italian Mountain	13,225	Ralston Butte	10,593
North Main	10,973	Raspberry Mountain	10,500
North Sheep Mountain	12,439	Raton Pass	7,893
Ohio Peak	12,251	Red Cloud Peak	14,050
Ohio Pass	10,033	Red Mountain	13,333
Old Baldy	14 176	Republican Mountain	13,393
Ormus Mountain	12,185	Rhyolite Mountain	10,775
Oso, Mount	13,640	Richmond Mountain	12,543
Ouray, Mount	13,956	Rio Grande Pyramid	13,773
Owen, Mount	13,102	Rito Alto	12,989
Pagoda Peak	11,257	Rolling Mountain	13,694

ELEVATION OF MOUNTAIN PEAKS AND PASSES IN COLORADO.—Continued.

NAME	FEET	NAME	FEET
Rosa, Mount	11,427	Storm Ridge	11,859
Rosalie, Mount	13,575	Sultan Mountain	13,336
Round Mountain, Elk	10,881	Summit Peak	13,323
Round Mountain, San Juan	13,422	Sunlight Mountain	14,053
Rowtner, Mount	13,750	Sunshine Mountain	12,945
Ruby Peak	12,749	Tarryall Pass	12,456
Saddle Mountain	10,815	Tarryall Peak	11,300
San Bernardo Mountain	11,845	Taylor Peak	13 419
San Francisco Pass	8,560	Telescope Mountain	12,231
Sangre de Cristo Pass	9,459	Ten Mile Peak	12,800
San Luis Peak	14,100	Teocalli Mountain	13,220
Schuylkill Mountain	12,188	Tennessee Pass	....
Searight Mountain	11,333	Tetons Mountain	14,198
Sharano Peak	14,239	Tilton Mountain	12,633
Sheep Mountain, Chaffee Co	12,447	Tomichi Dome	11,384
Sheep Mountain, Elk Mts	13,180	Torrey Peak	14,336
Sheep Mountain, Huerfano Co	10,600	Tower Mountain	13,444
Sheep Mountain, Summit Co	12,380	Trachyle Mountain	10,876
Sheridan Mountain, Park Co	14,038	Treasury Mountain	13,200
Sheridan Mountain, San Juan Co	12,785	Trinchera Mountain	13,546
Sherman Mountain	14,048	Trinity Peaks	13,752 13,804 13,745
Signal Butte	9,300		
Silex, Mount	13,687		
Silver Hill	13,880	Troublesome Peak	11 500
Silver Heels, Mount	13,835	Trout Creek Pass	9,346
Simpson, Mount	14,055	Turret Peak	13,819
Slate Peak	12,989	Twilight Peak	13,153
Sneffels, Mount	14,158	Twin Cones	12,400
Snowmass Mountain	13,970	Twin Sisters	13,438
Sockrider Peak	12,315	Uncompahgre Peak	14,289
Sopris, Mount	12,823	Union Mountain	12,336
South River Peak	13,160	Ute Peak	11 968
Spanish Peaks	13,620, 12,708	Vasquez Peak	12,658
Squaw Mountain, Teller Co	10,376	Velie Peak	13,456
Squaw Mountain, Front Range	13,093	Venado Peak	12,800
Star Peak	13,562	Vermillion Peak	13,870
Stewart Peak	14,032	Vestal Peak	13,846
Stoll Mountain	10,915	Veta Pass	9,378
Stony Mountain	12,677	Virginia Peak	10 600
Storm King	13,742	Vulcan Crest	13,971
Stormy Peak	11,748	Wasatch Mountain	13,551

ELEVATION OF MOUNTAIN PEAKS AND PASSES IN COLORADO.—Concluded.

NAME	FEET	NAME	FEET
Weminuche Pass	10,622	Wilkinson, Mount	11,687
West Elk Peak	12,920	Williams Peak	11,413
Weston Pass	12,109	Willow Creek Pass	9,683
West Spanish Peak	13,623	Wilson, Mount	14,250
Watterhorn	14,092	Windom Mountain	14,084
Wheatstone Mountain	12,548	Wood Mountain	13,640
White Dome	13,607	Yale, Mount	14,187
White Face Peak	11,494	Yampa Peak	8,022
Whitehead Peak	10,817	Yellow Jacket Pass	7,493
Whitehouse Mountain	13,496	Yellow Peak	13,618
White Rock Mountain	13,532	Zenobia Peak	9,297
Wild Horse Peak	13,271	Zirkel, Mount	12,126

ELEVATION OF PARKS AND LAKES.

NAME	FEET	NAME	FEET
Allen Park	8,513	Manitou Park	8,464
Bergen Park	7,543	Middle Park (Mean)	7,500
Big Lake (San Luis Valley)	7,478	North Park (Mean)	8,500
Brennan Lake	10,325	San Cristoval Lake	9,000
Buffalo Springs (South Park)	8,901	San Luis Valley (Mean)	7,500
Chicago Lake	11,500	San Luis Lake	7,592
Columbine Lake	8,788	San Miguel Lake	9,720
Crater Lake	8,877	Sheridan Lake	4,065
Crane Park	10,102	South Park	8,000 to 10,000
Crystal Park	9,317	Trout Lake	9,700
Eagle Park	9,212	Twin Lakes	9,012
Elk Park	8,868	Twin Sister Lake	13,438
Grand Lake	8,153	Union Park	9,655
Hughes Lake	7,453	Weiserhorn Lake	5,238
Jerome Park	8,290	White River Plateau	11,000 to 12,000
Lake Moraine	10,268		

POPULATION OF COLORADO
FROM 1860 TO 1910, BY DECADES.

CENSUS YEARS	POPULATION	INCREASE	
		Number	Per Cent.
1860	34,277	.....	....
1870	39,864	5,587	16.2
1880	194,327	154,463	387.4
1890	412,198	217,871	112.1
1900	539,700	127,502	30.9
1910	799,300	259,600	48.1

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