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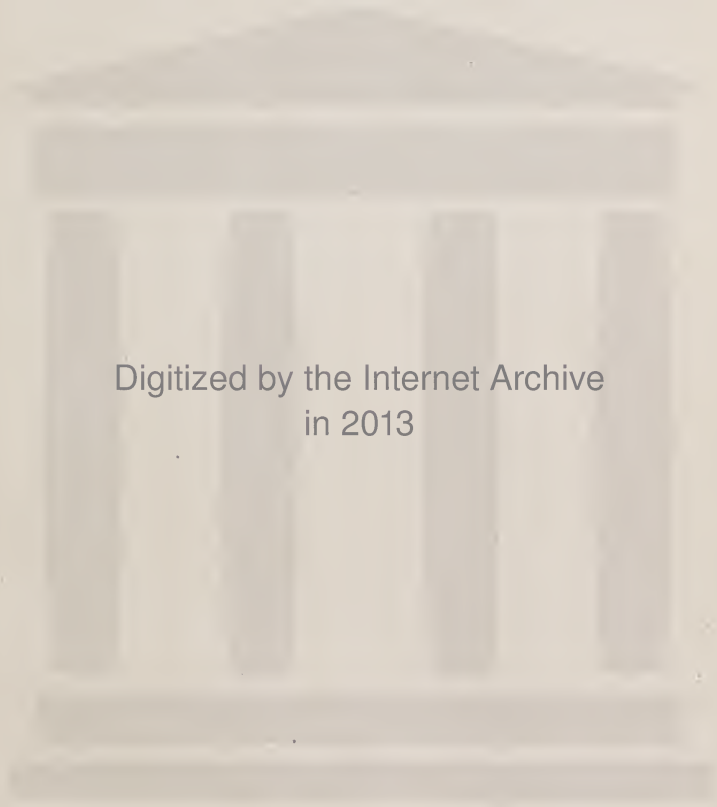


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REPORT
OF THE
State Bureau of Mines
COLORADO

1907-1908

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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 1907-8

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LETTER OF TRANSMITTAL.

Office of the Bureau of Mines,
State of Colorado.

To His Excellency,

HENRY A. BUCHEL,
Governor of Colorado.

Sir—I herewith submit to you and the Seventeenth General Assembly the official report of the Bureau of Mines for the fiscal years 1907 and 1908.

Very respectfully,

T. J. DALZELL,
Commissioner of Mines.

January 1, 1909.

In connection with this report, I desire to heartily and gratefully express my appreciation of the faithfulness to duty of inspectors, Messrs. M. J. McCarthy, J. R. Wood and P. T. Buckel. To the energetic and untiring work of these gentlemen in their official capacity, is largely due whatever of success may be credited to this department.

I also wish to especially thank mine managers and superintendents generally for prompt attention to recommendations issued and compliance therewith.

While many managers cheerfully make such reports to the department as is required annually, we find some difficulty in securing reports from all mines and mining companies, hence possible inaccuracy of statistics.

There has been a steady decrease of accidents, fatal and non-fatal, both in number and percentage of men employed, which is largely due to better mine methods and more ready compliance with the provisions of the mining laws.

A large number of printed copies of the mining law have been distributed, not only among the mine superintendents and managers, but also to the mine foremen, engineers and miners.

The more familiar the miners become with the State law, the greater care they will exercise and fewer accidents will occur.

I also desire to acknowledge my appreciation to the various newspapers throughout the State, for the help they have given this bureau in publishing notices and other items, all of which has greatly assisted in making our work count for the greatest results.

The general public has taken advantage of the opportunity to inspect the splendid collection of minerals and ores in connection with this bureau, located in the State House. Every year demonstrates to an added extent the great value of this collection to the mining interests of the State.

T. J. DALZELL,
Commissioner of Mines.

COLORADO'S MINERAL RESOURCES.

The annexed tables, giving conservative figures, show the mineral output of Colorado for the past year to be \$33,283,010.91. Of this amount, \$22,695,575.75 was gold; \$4,975,428.05, silver; \$2,429,670.90, lead; \$1,383,732.87, copper; and \$1,798,603.33 zinc. The total output of these minerals in the history of the State to December 31, 1908, gives a grand total of \$1,052,303,180.36.

From this compilation it is interesting to learn that zinc alone made a total for seven years of \$27,359,125.42. Prior to 1902 zinc was not included in the mineral production of the State.

A careful analysis of the mining conditions which now exist in Colorado emphasizes the fact that no other State offers such advantages for the exploitation of capital, where returns are so sure and where operations are conducted upon fixed principles. These figures indicate the fact that Colorado has been removed entirely from the realm of experiment, and that the mineral wealth, under intelligent exploitation, can be depended upon for profitable returns. This condition should appeal to the investor especially at this time, when there is so much experiment in contiguous states. Colorado has passed that stage, and can now be safely included among the older communities, where mining operations are conducted upon a permanent business basis. It is realized that in the early stages this industry is credited with enormous returns, but to all familiar with these conditions it is known that the wealth thus accumulated does not arise from legitimate mining. This is essentially a feature of the speculative era, which precedes mineral development in any section, and which was true of Colorado in the early period, and is now true of newly-discovered mineral sections in adjoining states. Happily, Colorado has passed this period, and has, as the figures quoted above clearly indicate, arrived at a condition which may well afford cause for congratulation.

In the matter of production of gold, for instance, we have only to refer to the Cripple Creek district, which stands to-day a marvel to the mining world. Amidst all the fluctuations which have beset investment in other states this wonderful camp has proceeded with uninterrupted flow, adding her millions to the nation's wealth. The speculative fever in this district has subsided for a long time, but the tonnage is as large, if not larger, than in the early days of its history, and with improved proc-

esses of treatment, promises to continue for many years a conspicuous example of what the industry of mining is capable under regular industrial conditions. The achievements of Leadville, Creede, Telluride, Ouray, Silverton, Rico, Breckenridge, Aspen, Gilpin, Clear Creek, Boulder, and other mineral-producing centers, are familiar to all, and, with the coming of cheaper methods of production and enlarged transportation facilities, all sections give promise of continued prosperity in this particular field of activity.

CRIPPLE CREEK, ITS MILLING FACILITIES, WITH ESPECIAL REFERENCE TO THE TREATMENT OF LOW-GRADE ORES.

While the production of the Cripple Creek district shows a substantial increase over 1907, it was not so great as it would have been were it not that the water in the lowest levels of the deeper mines prevented exploration of lower horizons. Both the smelting and milling capacity of the treatment plants have been affected and curtailed, some of the milling plants having been idle the entire year.

On the other hand, the successful treatment of lower grade ore has made a progress not before known, and many thousands of tons of ore, of a value between \$2.50 and \$10 per ton, have been profitably milled. The addition from this source to the total production of the district is approximately 100,000 tons, producing about \$500,000, and has a greater relative importance than would at first glance appear. It has not only given employment to labor not heretofore used in the mining and milling industry, but it constitutes a guarantee of greater development of the low-grade milling processes for the year 1909. The supply of ore for this newer production of value will come not only from increased tonnage from the ore dumps, of known low-grade value, which was during the past few years distinctly segregated by the larger mines for this particular purpose, but this tonnage will be greatly added to from two other sources—first, the low-grade ore that can now be profitably mined from the already opened levels and stopes of the larger mines; second, from the deeper zones, to be unwatered by the Roosevelt drainage tunnel. The immediate extension of the treatment of low-grade ores by cyanidation will, however, be mainly confined to the product to be derived from mining such ores, out of the stopes, which have heretofore provided the high-grade ores of the district, and not from the dumps saved by the various mines.

When the drainage tunnel benefits begin to be realized there will dawn a new era of tonnage and gold production throughout the entire district.

From the success shown in the treatment of such grades of ore, and that which heretofore went to the waste ore dump, it is not too much to anticipate a most important and permanent addition to the industry and production of the camp, and one which will not only greatly add to the profit of the mines, but which will also extend the period of their profitable production.

The Roosevelt drainage tunnel, projected for a total length of 14,000 feet, has been advanced a distance of one mile, and now is being driven from three working headings. It will not be necessary that the tunnel shall be completed before its benefits are experienced. Long before the objective end has been reached the water level will begin to lower in the mines nearest the course of the tunnel, and the sinking of main shafts will be resumed. Seven hundred vertical feet of new mining ground will be ultimately opened and unwatered by the completed tunnel. This will give the present large mines a total possible depth varying between 1,600 and 2,300 feet.

Whether or not present ore bodies will continue payable to that increased depth, by reason of proving further enrichment to exist, remains yet to be generally shown. There is, however, much well-founded expectation that such will prove the case; at least one mine, and that one of the largest in the district, has already discovered the gold tellurides in a new zone below 1,500 feet, and below the point of any present productive ore bodies. With this already known connecting link it would seem practically assured that the past production from some of the larger mines, of ore of fair average payable value for a long period past, and down to the present lowest depth or water level, affords a firm basis for the confident expectation that conditions with respect to value will continue unchanged for at least several hundreds of feet of additional depth.

For these reasons, therefore, we may be certain that the tonnage of the Cripple Creek district will increase, and that both the present and the future ore treatment plants will be furnished with an ample supply of ore so they may successfully operate.

Chief among the plants now in operation is the Golden Cycle mill, located at Colorado City. This plant was destroyed by fire in the month of August, 1907, and though the utmost industry was applied to its complete reconstruction, with a larger daily capacity than before, it was not until about March 1, 1908, that the plant was again in good operation. Hence, quite 16 to 20 per cent. of the year's work was lost to the company.

The Golden Cycle Company has been pre-eminently successful in demonstrating the practical and metallurgical success of low costs per ton with high extraction of value in the cyanidation of the ores of Cripple Creek. Fine grinding, with cyanide treatment, and the subsequent manipulation of slimes and sands, constitute the metallurgical practice applied to the ores, with much mechanical skill, and with the use of well chosen automatic aids. The plant of the Golden Cycle Company has had exceptionally able technical and business management, and the Cripple Creek district producers owe much to the work of this company in accomplishing low costs of operation, with accompanying metallurgical results that have permitted the establish-

ment of lower scales of charges for the treatment of the product of their mines.

Only a short time ago the possibility of shipment out of the district of gold ore carrying but \$8.00 per ton would not have been believed. Now it is a realized fact, due entirely to the successful extraction at the Golden Cycle mill of a percentage of values much in excess of 90 per cent. Naturally, considerably higher percentage extractions are made on ores of greater value than the above, even 98 per cent. recovery having been frequently obtained on \$15.00 to \$20.00 ore.

The daily tonnage handled at the Golden Cycle mill, now being 900 tons per twenty-four hours, has served to reduce the actual cost of treatment to a low figure per ton. In the near future it is likely that lower freight rates will permit the shipment of still lower grades of ore to this and other plants. In the main, however, local mills will treat in the future, as they have during the past year, the bulk of the extremely low-grade ores from mine and dumps, and the necessary freight and cost of delivery to cars, while comparatively small items, can thus be partially converted into profit per ton.

There are five mills locally situated in the district whose total tonnage in 1908 equaled about 115,000 tons, with a gross value of \$380,000. Much of this was produced at an actual profit per ton, even though the operation was on rather small units. The example of success in such handling, and on such a small scale, together with the demonstration of what has been accomplished in a plant of 100 tons daily capacity and upwards, with respect to realizing low cost of treatment, and the consequent profit of the handling of from \$2.00 to \$5.00 rock, will undoubtedly be reflected in a great growth during the coming years in the local application of cyanidation to Cripple Creek low-grade ores.

The tonnage available is for all purposes, so enormous as to be practically unlimited, and the coming year will see large plants completed and at work at many of the mines.

With past successes, there is excellent reason to expect the application to a great extent of the methods of the Black Hills and Treadwell properties to the Cripple Creek district.

Thus enterprising capital will secure on a safe investment the return of a sure profit, though small, per ton, on many tons handled daily and cheaply and automatically.

During the year 1909 we should realize from this source the addition of several millions of dollars to the output of the district, and the employment of hundreds of men not heretofore so occupied.

The United States Reduction & Refining Company, the officers of which have been intimately connected with the develop-

ment of the mines of Cripple Creek as well as the milling industry, and thus have done much for the district, have continuously operated their plant at Colorado City to its full capacity of 450 tons of ore per day.

The milling plant of the Portland Gold Mining Company, near Colorado City, operated almost exclusively for the reduction of the immense tonnage of ore from their own mines, is always fully supplied with ore; capacity, 300 tons per 24 hours.

The American Smelting & Refining Company continue to take the higher grade ores, thus handling a fair per cent. of the production.

The leasing system, which has been of such incalculable benefit to the district, will advance this important low-grade ore movement. New ore bodies will be found in ground not heretofore fully explored, and such discoveries will furnish their full quota of low, as well as high, grade ores. In addition to the extension of the ore-producing territory in this way and in the region or the horizons that may be termed present depth zones, there is another and highly important extension which will probably be developed during the coming year; viz., a new zone of ore at increased depth. There are discoveries already made which point to a deeper zone of enrichment than has thus far been developed and explored. It is in the mines which have attained a depth as low as it is practicable to now pump water that such discoveries have been made, and the explorations in every deep mine will proceed just as rapidly as the progress of the drainage tunnel permits.

The questions which have been before the Cripple Creek mine operators in the past few years regarding permanency of ore bodies and the production of new ore in the known horizons, as well as those questions affecting ore treatment facilities and their extension to lower grade ore and profit therefrom, have been answered during the year 1908, if not entirely answered before. The progress toward improvement in both transportation and ore treatment covering larger tonnage has been greater than in any previous year. The limits of the district were defined several years ago. No extension of ore outside of these limits seems likely, and the geological conclusions regarding the probable extent of mineralization have been proven correct in the light of the development of the past years.

DRAINAGE AND TRANSPORTATION TUNNELS.

During the early history of mining in Colorado it was an easy matter to produce a large tonnage of ore by means of comparatively low cost plants for treating surface ores.

As the shafts attained deeper levels, entirely new problems were presented, requiring larger expense in handling ore and water.

Mine after mine was forced to close down, the greatly increased expense being prohibitive of profitable operation, until in some districts work was largely confined to cleaning up old stopes and prospecting surface areas formerly considered unworkable, but now made possible by lower cost of ore treatment.

Over large areas, where an occasional mine was equipped with an expensive plant, an added difficulty was encountered in that the mine water corroded the boilers so badly that it could not be used without constant boiler renewal, although all kinds of methods were tried to sweeten it, some of them helpful, but none conclusive.

The one solution of the problem gradually became evident; namely, the veins must be intersected by deep drainage tunnels.

The deep cut canon of South Clear creek at once attracted attention as affording one of the most favorable opportunities for such a test in northern Colorado. Running through the well proved mineral bearing districts of Clear Creek county, with the southern portion of Gilpin county, represented by the Russell gulch and Nevadaville districts, in striking distance, the canon, cutting the mountains to a depth of fifteen hundred feet, two thousand feet, and at some points twenty-five hundred feet, offered ideal locations for this character of operation. A large number of cross-cut drainage and transportation tunnels have been started upon either side of this canon, from a point below Idaho Springs to Mt. McClellan, west of Georgetown, a linear distance of twenty-five miles, as the Lucania, Rockford, Honest John, Mt. McClellan, Empire, Marshall-Russell, Doric, Kelly, Capital Prize, Brown, and others in upper Clear creek. Several have been driven a mile or more, as in the case of the Central tunnel, of the Big Five tunnel, Ore Reduction and Transportation Company, now under cover seven thousand one hundred feet, having attained a depth of fourteen hundred feet.

One shift is kept at work in the breast of the tunnel, averaging seventy feet per month. A large number of veins have been intersected, five of which are being operated, four on a

transportation basis and one by the company. As a concrete example of the value of this type of work, mention may be made of the Shafter mine, now operating through this tunnel. Previous to its connection with the tunnel all ore was hoisted to the shaft house on the mountain; all water had to be either pumped or hoisted; it cost one dollar per ton to haul the ore to the mill at Idaho Springs. To-day the tunnel company transports the ore through the tunnel to the bins in the mill for fifty cents per ton, while the mine is drained and ventilated without additional expense.

The chief example of this form of mining, the one that stands far in front of all similar operations in the United States, is the Newhouse Tunnel, located at the lower edge of Idaho Springs, Clear Creek county. It has been driven seventeen thousand five hundred and forty feet, and is steadily forging ahead at the rate of eight feet every twenty-four hours toward its objective point beyond Nevadaville, in Gilpin county, twenty-two thousand feet plus from the portal.

Many veins have been intersected, twelve of which—among them the Gem, Sun and Moon, Saratoga, Old Town, are familiar as among the principal producers of this section—have been tapped from thirteen hundred feet to sixteen hundred feet vertical depth, and are now being operated principally through this tunnel.

Contracts for ninety-nine years' duration are on file between the company and one hundred and fifty owners, representing three hundred mining claims, for drainage and transportation.

The great majority of these mines yielded good returns from surface developments, but for many years have been forced into idleness by the reasons heretofore mentioned. As soon as they are intersected by the tunnel, or laterals therefrom, they will again become producers.

The total expense of financing this important proposition has been approximately \$600,000, or a little less than \$35 per foot.

A number of vital questions have been definitely settled by this work.

First. It has been conclusively proven that the veins of this district are true fissures, continuing in depth and value.

Second. That the drainage area of such a tunnel is very large, as wet shafts, whose deepest point is hundreds of feet above the tunnel level and hundreds of feet (in some known cases thousands of feet) from the line of the tunnel, but upon veins which have been intersected, are now dry; as time increases this drainage area becomes more extended.

Third. That it is cheaper to operate the lower levels, both above and below the tunnel, through the tunnel, while, upon the other hand, it may be cheaper, after the tunnel has drained and

ventilated the mine, to operate the upper levels from the surface.

Fourth. By this system the drainage and ventilation of the mines intersected is absolutely settled, and as a result the disease known as miners' consumption, so prevalent where the ventilation is poor, will be largely eliminated.

Fifth. By concentrating the output of a large number of mines at one point, as the portal of a transportation tunnel, mills for the treatment of ore can be operated more economically, and the returns to the mine operators thereby increased.

One of, if not the most important, drainage enterprises in the State is the Roosevelt deep drainage tunnel, at Cripple Creek. Work on this tunnel is being prosecuted under the personal direction of Mr. A. E. Carleton, through whose energies and good judgment in selecting lieutenants and securing the best men obtainable for every detail of the work, the tunnel is progressing at a remarkable rate of speed, breaking all previous tunnel records in like formation.

At Leadville the Yak tunnel has long been recognized as the most important enterprise in that district. The Dinero tunnel, in Sugar Loaf mountain, has successfully reached the objective point.

In the Pitkin and Ohio Creek district, in Gunnison county, there are several important tunnels, among which are the Raymond, the Sandy Hook, the Carter, and two being driven by the Belzora-Bassick Company.

DREDGING.

The first dredging for gold in the United States was done in Colorado, and the earliest dredges built were in the Breckenridge district, but owing to the inferior quality of the material used in their construction, (manganese and other self-hardened steels at that time being unknown), it was not a pronounced success. Had the company confined their operations to dredging, instead of the manipulation of stock, before operating results had been solved, dredging in this State might have taken the lead as it did in California, where there are fifty dredges in operation.

In California at the present time dredging is one of the regular industries and has done more to develop the state and keep up its production of the yellow metal than any other class of mining. Most of the available dredging ground in California has been already equipped, and the life of dredging there is practically known.

In Colorado, on the other hand, the life of dredging is practically unknown, for the reason that vast areas of auriferous gravels remain untouched, and are as yet to be prospected.

In the Breckenridge district there are now four modern dredges which cost large sums of money, and have demonstrated the fact that the Breckenridge gravels can be dredged successfully and at a handsome profit.

During the past winter the Reliance dredge has demonstrated the feasibility and practicability of operating during the entire winter months, and during a winter which might be termed as one of the most severe in the annals of the State.

The success of the dredges in the Breckenridge district and in Routt county should be the means of arousing interest in further development in the rich gravel districts of this State.

In California ground yielding \$5,000 to \$6,000 per acre or ten to eleven cents per cubic yard is considered a safe investment.

Dredging in Colorado at the present time produces from \$15,000 to \$20,000 per acre, or twenty to forty cents per cubic yard, as against a third of the same values in other states which are being boomed and are attracting attention.

There is no other state in the Union where the investor and capitalist would receive larger returns with safety. If the mining men would turn their attention to the development and exploitation of the rich, auriferous gravels they would find better opportunity for lucrative and permanent investment, particularly with the increased advantage of being able to use electricity as against the excessive cost of steam in the by-gone years.

Were the rich values in Colorado obtainable in other states, capital would be seeking investment in dredging enterprises.

TUNGSTEN.

BY E. N. HAWKINS.

Several years ago the mining of ores of tungsten in Colorado began to be of importance in the total mineral output of the State. The industry first grew in Boulder county, which still produces most of the metal. Gradually, concentrating mills were built and the facilities for transportation of ores from the mines to the mills were improved. With the growth of the industry, confidence increased and the fund of knowledge bearing upon what constitutes commercially mineable tungsten values was better understood. The concentrated oxide of tungsten, carrying about or in excess of 60 per cent. tungstic acid, first found its market in Germany, and the price paid was \$10.00 per unit or per cent. of the oxide with the requirement that not less than 60 per cent. product should be shipped.

In a short time the natural increase of production stimulated an American demand for tungsten, and this has grown until the product of the State finds most of its market in the United States. The lack of activity in the steel and iron industries the world over affected the market for tungsten concentrates seriously, and in the past year or eighteen months the price fell to \$5.00 and \$6.00 per unit. Correspondingly, the production fell off in 1907 and 1908, both as to tonnage and value, and the industry felt the sluggishness of the market for the metal to the extent that the production in 1908 was little more than 20 per cent. of that for 1907.

Renewed activity in steel manufacturing centers in the East has, in the past two months, resulted in an advance of \$1.00 per unit in the value of tungsten concentrates, and properties that have lain idle in Boulder county, chiefly along Middle Boulder creek, have been re-opened. It now seems likely that the steel mills and manufacturers will require one thousand tons of concentrates in the next three months or thereabouts, and the price of concentrates will therefore doubtless advance to \$10.00 per unit again. It is true that in October and November, 1908, the price fell as low as \$5.00 per unit, but this was due to an entire lack of market demand. Already, activity along Middle Boulder creek and other producing sections in the county has shown itself in the repairing of the plants and the putting into operation of concentrating mills for the full 24 hours on custom ore work. They are nearly all custom mills, buying the mine product direct. Several plants belong to large buyers of tungsten who have their central offices and plants along the Atlantic coast or in Germany. The largest plant in the country is such a one, with their principal works in Pennsylvania, where they reduce not only tungsten ores but those of other comparatively rare metals such as vanadium, molybdenum and uranium. These larger plants are keen to recognize the attractiveness of the fields of Boulder county.

The Colorado production in 1907 was \$500,000.00. In 1908 it fell to a little more than \$100,000.00. A portion of this decrease was however due to the lower unit price paid and not altogether smaller tonnage of concentrates. The State's production last year furnished 60% of the entire output of the United States in ores and concentrates of tungsten. The other producing states were Arizona, California, Nevada, Montana and Idaho. The last named state has but just entered the list of producing states. Colorado will undoubtedly still continue to furnish the major portion of the product.

The minerals from which the supply comes are Wolframite, oxide of tungsten and iron, containing some manganese; Hubnerite, oxide of tungsten and manganese; and Scheelite, tungstate of lime. Of these, the first is the most important producer of the metal, particularly in Colorado. In other states Scheelite has come to be of importance as a commercial tungsten mineral, but in Colorado, Wolframite is the prevailing producer. Concentrates are smelted with iron ores, producing ferro-tungsten varying in percentage from 25% to 70%. The smelting has heretofore usually been done in an electric furnace, but it is certain that in the near future ferro-tungsten will be produced as is ferro-manganese, by direct pig iron blast furnace smelting. While the product may not in this way be as high as 70 per cent., it will still be of sufficient tungsten content to permit of admixture with iron and steel in the manufacture of the useful alloys.

Tungsten in the form of ferro tungsten 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 assist and are usually employed with tungsten, but the latter is the chief factor in the result attained. Another most important recent 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.

In Boulder county, Wolframite occurs in quartz veins which are mainly found intrusive in granite. The vein matter or pay ore will probably not be found to go to great depths. The vein fillings are pegmatic and the fissures have been filled by solutions which at least in part were the result of the cooling of the granite magma. The tungsten ore deposits here as elsewhere are therefore lumpy in character when greatly profitable, as they have frequently proven to be; and they are more likely to be found comparatively close to the surface than at considerable depths. The period of mineralization and deposition is difficult to establish and there is some evidence of secondary action. Whether the actual deposit of tungsten ores occurred in comparatively recent geologic time or whether some portion of it was deposited co-

incident with the fissuring of the granite cannot or has not been yet determined.

The superficial character of most of the deposits yet opened makes mining inexpensive, and the necessity for extensive development to open ore bodies as elsewhere is frequently required, is quite eliminated in the tungsten industry until the extent of the occurrences of ore is fully proven. Hand sorting with mechanical separation and concentration are largely adopted, and thus in large measure they compensate for the absence of continuous large deposits extending to depths. Undoubtedly the granite is the origin of the tungsten ores and minerals, and while, therefore, these metalliferous ores had a deep seated source as other ores have likewise had, the actual zone of deposit has thus far been found to be comparatively shallow and superficial. The vertical extent of the Wolframite mineralization and that of the other tungsten ores and minerals will probably always prove to be a function of the pressure which existed and was acting when the cavity or fissure began to be filled. In several cases secondary action has been observed and some bunchy or cavity deposits of Wolframite have been thus produced. The same conditions prevailing in Boulder county, Colorado, have been generally noted in other states and confirmatory conclusions have thus been possible.

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. 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.

VANADIUM AND URANIUM.

Since the discovery of carnotite, a hydrate oxide of uranium and vanadium, with uncertain accompanying components of potassium and calcium oxides, a desultory search for it has extended in the past ten years, until there have been a number of districts or sections discovered and examined in southwest Colorado. In some of these districts investigations have been carried on, covering not only a detailed history of the occurrences in specified properties and at known localities, but furnishing a record of chemical analyses, giving the content of the ores in oxides of uranium and vanadium.

In Montrose county, deposits have been found in the Naturita district, on the San Miguel river, at Roc creek, near the Dolores river, at Hydraulic, on the Dolores river north of Roc creek a few miles, in McIntyre canon on the Dolores river about twelve miles south of Bed Rock, and in the La Sal Creek district, about six miles westerly from the mouth of the creek, or at the Dolores river. In San Miguel county discoveries were made some ten years ago near Placerville. These last were, in fact, the initial discoveries of uranium and vanadium.

The minerals containing these metals, uranium and vanadium, are, besides carnotite, uraninite, roscoelite and vanadinite, but none but carnotite have yet been found in commercial quantities in these regions of southwestern Colorado. Vanadinite has been found on Roc creek, and uraninite at one or two points, but only small occurrences have been noted. Carnotite occurs in seams, pockets or impregnations in the upper sandstone cliffs or beds, near the capping overlying the La Plata sandstone. In most instances the deposits occur in fault planes and near or next to the clay selvage lying on the shale frequently found above the La Plata sandstone. This last itself is a part of the sandstone series of the Triassic period, and the Dolores sandstone lies below the La Plata. The carnotite is found frequently where any evidence exists of movement in the rock planes, as, for instance, where the beds are not lying flat, but are pitched more or less. All observations go to prove that the deposits are of the most recent character and long since later than even the main disturbances which have cracked and fissured the sandstones, such as the fault fissures that have coursed north and south across and through the great beds.

In several other counties in the State discoveries have been made, but the explorations have not yet reached such ample development as those detailed.

In the McIntyre district, where many discoveries have been made and locations worked, the Rare Metals Mining & Manufacturing Company undertook the metallurgical extraction of the oxides of uranium and vanadium seven or eight years ago. They constructed a leaching plant in which, during a part of 1901, several hundreds of tons of ore were treated. The pre-

liminary experimental plant was located at the La Sal Copper Mines property on La Sal creek. Subsequently the main operating works of the Rare Metals Company was built at the McIntyre deposits. The operation was a concentration by leaching and subsequent precipitation, using sulphuric acid as the solvent. From the ores treated, some ten tons of product in all was shipped, carrying up to 40 per cent. oxide of uranium and 15 per cent. of oxide of vanadium. Most of this product, however, was of much lower content than these percentages. It was all sold in the New York market, which has always been a most active purchaser of these metallic oxides for use in color manufacture in the case of uranium, and for hard and tool steel making in the case of vanadium oxide.

In the past year or two the Dolores Refining Company, which is the successor in the metallurgical field to the Rare Metals Company, has again undertaken the treatment of these ores, using the Engle-Haynes process of extraction by an alkaline carbonate as the solvent and precipitating the uranium and vanadium therefrom and successively by alkaline and alkaline earth hydrates, respectively.

On Roc creek a number of important discoveries have been made. In one location the property has been opened by a tunnel and drifts. The value of the crude ore varies greatly. Where the vein or deposit is several feet thick, the values are usually below one-half per cent. each in oxides, and where the thickness is below twelve inches, the values range from three-fourths of one per cent. to four per cent. in each of the two oxides. From the unit value of these oxides, based on New York delivery prices and the known freight costs, it seems clear that the commercial treatment of these impregnated sandstone veins is possible even with no greater than a 70 per cent. recovery of the existing oxide content.

At Hydraulic the same general conditions exist, with the exception that vanadinite, a chlora vanadate of lead, has been also found.

The carnotite deposits in the La Sal district begin about six miles westerly up La Sal creek, and extend on up the creek three miles. They are found in the planes and fractures in the white sandstones, never in those of more reddish hue. In several known locations the thickness of the deposit is encouraging. In one instance two feet of ore carries between two and three per cent. each in uranium and vanadium oxides. Much high grade selected ore has been mined from this district, and shipments of 20 per cent. oxide of uranium and 16 per cent. oxide of vanadium have been made by the first operating company.

Much exploration has been carried on in the Naturita district, and the promise is that in this section will be found uranium and vanadium oxides of higher percentage content than

elsewhere discovered. The size of the veins or deposits that are workable is also greater.

The only notable discovery of roscoelite, or vanadium mica, is in the La Plata mountains, south of Placerville. Pitchblende, which is the high grade mineral containing uranium, has been rather extensively discovered in Gilpin county. From it, by fractional crystallizations of the compounds made by washing the ore with carbonate of soda, there is obtained all the vanadium.

Uranium oxides are used in the arts chiefly for coloring purposes in the manufacture of glass and porcelains. Vanadium, 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 one per cent. up to one-half of one per cent. gives an enormous strength to steel products, and the increase of elastic limit with this use has been found to be one hundred per cent. The selling price of ferro vanadium is \$5.00 per pound of contained vanadium. For high speed tools, and for the highest grade of tools, this metal will be in increasing demand. Our own country's manufacturers of steel will shortly be purchasers of these valuable ore products necessary for important qualities of high grade steels, and the State of Colorado will have a growing industry in respect to uranium and vanadium ores not, as now, dependent entirely on the demand of the foreign or German market.

IRON.

While Colorado is seldom mentioned as a producer of iron ore, yet the United States Geological Survey, in its Mineral Resources, credits the State with a production from 1890, to and including 1907, of manganiferous-iron ore used in the manufacture of spiegeleisen and ferro-manganese with 406,993 long tons and with manganiferous-iron ore used for flux of 2,056,792 long tons.

Although the production of iron ore for 1908 was not as large as had been anticipated, yet the county of Lake shipped 73,200 tons of iron ore for flux, valued at \$279,615.00, and 11,600 tons of manganese-iron ore valued at \$29,000.00.

There was shipped from Eagle county 23,300 tons of manganese-iron ore, valued at \$48,900.00.

The Colorado Fuel & Iron Company produced from their mines at Orient, in Eagle county, over 10,000 tons, making a production from Lake and Eagle counties for 1908 alone, of over one hundred and eighteen thousand tons.

STONE.

Always slow of development in a region so richly endowed with other building materials, the stone industry of Colorado has but repeated the history of that industry under like conditions elsewhere.

Each year, however, finds more capital seeking investment in this line, resulting in a gradual but steady progress.

Probably no other state in the Union has as great resource in high grade building stone.

Her granite, sandstone and marble challenge the quarries of the world for beauty, strength and texture.

The rapid increase in the production of stone in the United States during the last decade, from \$28,635,175.00 in 1898, to \$71,105,805.00 in 1907, an increase of \$42,470,630.00 or 148%, as reported by the U. S. Geological Survey, enables us to recognize that it is only a question of time until this industry shall rank high in Colorado's mineral output.

Owing to the large area and numerous small quarries where the output has not been tabulated, it is impossible to obtain complete statistics; the figures given herein are compiled from all possible available data and are safely within the production.

MARBLE.

Our marble, ranges from a beautiful amber vein, a clouded and black vein to pure statuary white, of a fine texture, harder than the ordinary marble, giving it the advantage of a high, clear velvety polish, making it suitable for all exterior and the highest grade of interior work.

During this biennial period, 1907-1908, work in the marble quarries has been largely confined to equipment and development.

The point of production has now been reached for unlimited supply, both in outside, building and monumental work, also for interior decorations in buildings for electrical work, mosaic work, etc., and is sold by the producers principally as dressed stone.

The production is practically confined to the latter part of 1908.

Output 1908, 12,000 cubic feet; value, \$42,000; added to this, contracts have been signed for 1909 delivery amounting to \$500,000.

GRANITE.

Numerous buildings attest the value of Colorado's granite with a steadily growing demand in the monumental line. The beauty of the many varieties of shadings and general excellence of quality is steadily increasing the sales and number of men employed in both quarry and yard.

The output for 1907 and 1908 is as follows:

	1907.	
Sold in rough.....	\$ 10,516	
Monumental	18,041	
Dressed for building.....	1,400	
Dressed for monumental.....	34,913	
Curbing	2,150	
Total		\$ 67,044
	1908.	
Sold in rough.....	\$ 15,520	
Monumental	20,000	
Dressed for building.....	62,500	
Dressed for monumental.....	16,000	
Total.....		\$114,021

Probably \$150,000 of granite has been used for railroad ballast and concrete during these years.

SANDSTONE.

During this biennial period particular attention has been attracted to Colorado sandstone.

Whenever it has come into competition with sandstone from other portions of the country and rates of transportation made it at all possible, it has been chosen because of its superior beauty and texture.

The rates of transportation have in many cases been prohibitive; one contractor gives the following example, illustrative of the difficulties encountered in the exploitation of this splendid industry: He desired to use Colorado sandstone from a quarry on Turkey creek, Colorado, in a building at Ames, Iowa. The railroad tariff from Cottage Springs, Colorado, to Ames, Iowa, was \$1.56 per cubic foot; the railroad rate for Indiana Bedford sandstone, shipped via Milwaukee, Michigan, with the privilege to unload at the dressing mill at that point, in transit, reload and ship to Ames, Iowa, about the same distance as that traversed by the Colorado stone, was 12 cents per cubic foot.

When Colorado stone is placed upon an equal footing in the railroad tariffs, its use will be greatly extended.

Two factors during this biennial period have greatly affected the output of sandstone. First, the use of concrete and cement in foundations, paving and curbing and the cement blocks in building. Second, the financial depression of 1907-08.

The output is as follows:

1907.

For all purposes, building, rough and dressed, ganister, paving, curbing, flagging, rubble, rip-rap, road making, railroad ballast, concrete, etc., \$299,443. 1908 has probably suffered a decrease of \$50,000.

MINERAL WATERS.

The many mineral springs, for which Colorado is justly famous, and around many of which have grown up fashionable resorts with modern hotels and bath houses that are attracting not only health-seekers from all over the world, but thousands of tourists who visit these springs, spending months at a time enjoying both the waters and the climate, every year bringing largely increased numbers of such visitors to the State.

Bottling and shipping water from some of these springs for medicinal and table use is developing into an important industry.

In 1907 the revenue derived from shipments amounted to \$80,550.00; in 1908, \$85,000.00. Had it not been for the general business depression, the year of 1908 would have shown a much greater increase.

PETROLEUM.

Ranking twelfth in the production of crude petroleum in the United States, Colorado not only supplies all home demands, but ships to surrounding territory.

The output of petroleum products, namely, fuel oil, gasoline, smudge oil, lubricating oil and petroleum wax, is steadily increasing.

There are two recognized oil fields, both of them lying along the east front of the mountains, one at Florence, in the southern field, the other in Boulder county, in the northern field.

Some prospecting has been done in the mountain region, both in the northwest and southwest, the indications being that profitable oil fields will shortly be opened in both sections.

The most notable events during this biennial period in the oil industry consists of the opening of two refineries in the city of Boulder and the striking of a two-hundred-barrel flowing well in the Boulder field.

The production of crude petroleum in Colorado for 1907 was 331,857 barrels; in 1908, 411,836 barrels.

COLORADO SCHOOL OF MINES.

JOHN R. WOOD, Deputy Mine Inspector.

We are told that when General Von Moltke dismounted from his horse at the surrender of the French army of one hundred and seventy-two thousand men at Sedan, he said: "We owe this to Pestalozzi."

When the Germans were so thoroughly defeated in the Napoleonic wars, the rulers ascribed their defeat to the ignorance of the masses of the people; then, for about three generations, great stress was laid upon education for all the people, and strictly enforced by compulsory educational laws. When the Franco-German war came, and victory rested upon the German arms, the credit was given to a well-trained, educated citizenship.

So victory in the mining fields depends upon a corps of thoroughly-trained, educated men.

The day has passed never to return when a "rocker," "long tom," a few sluice boxes or slow drop, 250-pound stamp mill is all the equipment necessary to successful mining.

The electrical dredge, chlorination, cyanidation, concentration, amalgamation mills in highly specialized construction, together with the smelters, operated by men thoroughly trained, is absolutely necessary to successful treatment of our ores; while the best mechanical equipment, high art timbering, skillful sampling, exact engineering, can alone direct the present-day mining in deep shafts and miles of transportation and drainage tunnels necessary to the development of our ore bodies.

The same educated, trained, energetic men are demanded in the non-metallic mineral fields existing in nearly every county of our State; clay, sandstone, granite, lava, marble, onyx, cement shale, gypsum, petroleum, mineral waters, coal.

Thus, the question of a thorough training for the profession of mining or metallurgical engineering is state-wide, and every such man graduated from our School of Mines is a practical investment of State funds at the highest rate of compound interest.

RECOGNITION ABROAD.

In a visit to all the important mining schools in England, France, Belgium, Germany, Austria and Hungary, made by President Victor C. Alderson during the summer of 1908, he reports: "Everywhere they know of the Colorado School of Mines and look upon it as the most progressive and energetic in the

United States, with a standard high enough to meet their commendation."

Our graduates, now engaged as professors in other technical institutions and in universities and colleges, number sixteen.

With an enrollment of 383, thirty are men from other schools taking post-graduate courses; 157 men are from other states in the Union, while Mexico sends five, Japan two, England two, Canada two, Australia, British Columbia and the Philippine Islands each one, while many of our graduates are scattered all over the mining world developing and improving their method of operation and the treatment of their ores.

RESEARCH FUND.

May 22, 1908, Honorable Thomas F. Walsh donated \$1,000 to the Vinson Walsh Research Fund, the special purpose of which is to investigate the rare minerals in Colorado and the probable extent and value of the same, and the uses to which they may be applied. To this was added another \$1,000 by Mrs. and Miss Walsh, to be used as a temporary loan to aid worthy students.

In this connection a unique and highly practical bulletin on rare minerals, showing places of occurrence, raw metal, geology, together with mode of economical treatment, the resultant products and their uses, has recently been arranged by Dr. Herman Fleck, Professor of Chemistry, and is appended to this article.

LOCATION.

No School of Mines is more favorably situated, surrounded upon all sides with the metallic and non-metallic mineral fields. With ready access accorded to professors and students to mines, mills and smelters, the Colorado School of Mines has an ideal location.

It is possible for the students to observe practical mining and ore treatment at any time. The school improves these advantages by requiring many carefully planned and conducted trips of inspection, in which the students are required to make detailed studies and present written reports of processes in operation.

Many students take advantage of the opportunity of working in the mines during the long vacation, thus becoming familiar with methods of operation and adding to the development of the all round mining man.

EQUIPMENT.

The physical equipment consists of some ten buildings devoted to the uses of the several departments, while the State will soon add a much needed metallurgical laboratory built in

units, consisting of, first, a sampling mill; second, an ore dressing plant; third, amalgamation, cyanidation and chlorination; fourth, roasting and smelting. Each unit will be capable of treating a carload of ore in one working day and equipped with machines of commercial size and recognized worth. With this equipment, the Colorado School of Mines will have no peer.

Every miner, mill man or prospector, every mining operator within our State, will find the president and faculty of the School of Mines glad to render them any assistance possible in solving the difficulties which they may encounter in their operations.

RARE METALS.

Outline arranged by Herman Fleck, professor of chemistry.

TUNGSTEN.

Occurrence—

Colorado, Boulder county.
 Arizona.
 Nevada.
 South Dakota.
 Washington.
 Australia.
 Portugal.
 Spain.
 Cornwall.

Raw Materials—

Wolframite.
 Scheelite.
 Hubnerite.
 General physical and chemical properties.

Geology—

Boulder county deposits.

Economic Treatment—

Mining.
 Placering.
 Concentration.
 Wet treatment.
 Electromagnetic.
 Reduction.

Products—

Ferro-tungsten.
 Powdered tungsten.
 Sodium tungstate.

Uses—

High-speed tool.
 Ferro-tungsten.
 Powdered tungsten.
 Sodium tungstate.
 Fire proofing.
 Mordant.
 Silk weighting.
 Tungsten lamp.
 Pigments.

Statistics—

Output and values.

MOLYBDENUM.

Occurrence—

New South Wales.
 Washington.
 Arizona.

Raw Materials—

Molybdenite.
 Wulfenite.
 General physical and chemical properties.

Geology—

New South Wales deposits.

Economic Treatment—

Mining.
 Concentration.
 Sorting.
 Electrostatic.
 Flotation.
 Reduction.
 Chemical treatment.
 Electric furnace.

Products—

Ferro-molybdenum.
 Powdered molybdenum.
 Ingot molybdenum.

Uses—

High-speed tool.

Statistics—

Output and values.

VANADIUM.

Occurrence—

Peru and other South American countries.
 Mexico.
 Colorado.
 Utah.
 Sweden.

Raw Materials—

- Patronite (Peruvian Sulphide).
- Vanadinite.
- Descloizite.
- Carnotite.
- Roscoelite.
- Iron slags.
- General physical and chemical properties.

Geology—

- Vanadiferous sedimentaries, Peru.
- Vanadinite and descloizite deposits of Mexico and South America.
- Carnotite, western Colorado.
- Roscoelite, San Miguel, Colorado.
- Ore deposition.

Economic Treatment—

- Mining.
 - Extraction of values.
 - Salt roast method.
 - Acid treatment.
 - From lead ores.
 - Refining.

Products—

- Vanadium.
- Vanadium pentoxide.
- Ferro-vanadium.
 - Electric furnace.
 - Thermite process.
 - Properties.

Uses—

- Vanadium steel.
- Aniline black.
- Inks.

Statistics—

- Output and values.

URANIUM.

Occurrence—

- Bohemia.
- Colorado.
- Utah.

Raw Materials—

- Uraninite.
- Carnotite.
- General chemical and physical properties.

Geology—

- Uraninite regions of Joachimsthal and Gilpin county.
- Carnotite regions of western Colorado and Utah.
- Ore deposition.

Economic Treatment—

Prospecting (radio-activity).

Mining.

Concentration.

Mechanical.

Chemical.

Alkaline method.

Acid method.

Refining—

Uraninite concentrates.

Carnotite concentrates.

Uses—

Glass tinting.

Pigments.

Porcelain coloring.

Gas mantles.

Statistics—

Output and values.

RARE EARTHS.

Thorium, Cerium, Yttria, Zirconium.

Occurrence—

North and South Carolinas.

Brazil.

Texas.

Raw Materials—

Monazite.

Gadolinite and allied minerals.

Zircon.

Geology—

Carolina deposits.

Texas deposits.

Economic Treatment—

Monazite.

Concentration.

Refining to salts.

Gadolinite—

Mining.

Sorting.

Refining to oxides.

Zircon—

Mining.

Sorting.

Refining to oxides.

Uses—

Welsbach mantle.

Nernst lamp.

Statistics—

Output and values.

TANTALUM.

Occurrence—

Finland.
 Connecticut.
 South Dakota.

Raw Materials—

Columbite.
 Tantalite.

Economic Treatment—

Mining.
 Refining.

Separation of tantalum from columbium and titanium.

Product—

Tantalum metal (Von Bolton).

Uses—

Tantalum lamp.
 Pens.

LITHIUM.

Occurrence—

California.
 South Dakota.

Raw Materials—

Ambligonite.
 Lepidolite.
 Spodumene.

Geology—

Distribution and occurrence.

Economic Treatment—

Alkaline fusion method.
 Direct acid treatment.

Uses—

Salts in medicine.

Statistics—

Output and value.

PLATIUM METALS.

Platinum, Iridium, Osmium, Palladium.

Occurrence—

Urals, Russia.
 United States. Black Sands.
 Wyoming.

Raw Materials—

Platinum sands.
 Black magnetic sands.
 Covellite.

Mint by-products.

Economic Treatment—

Placering.
 Refining.

By-products.

Uses and Statistics.

TABLES

Men Employed in Mining, Milling
and Smelting During Years
1900-1908

NUMBER ENGAGED IN MINING, MILLING AND SMELTING.

COUNTY	1900	1901	1902	1903	1904	1905	1906	1907	1908
Arapahoe.....	2,092	1,810	1,615	1,382					
Archuleta.....	6	6	18	7	10	4	6	12	8
Boulder.....	1,597	1,610	1,556	1,310	1,087	975	1,042	1,076	1,050
Chaffee.....	944	792	725	470	680	742	615	820	780
Clear Creek.....	2,012	1,975	2,010	1,748	1,936	1,860	1,985	2,036	2,050
Conejos.....	15	23	18	20	15	6	4	7	8
Costilla.....	44	25	35	30	32	10	14	12	14
Custer.....	419	325	350	566	625	647	521	464	480
Delta.....		5	5	10	12	8	6	9	11
Denver.....					1,175	1,210	1,175	1,060	1,042
Dolores.....	497	415	352	325	378	418	396	337	365
Douglas.....	5	6	7	5	7	3	7	14	12
Eagle.....	302	391	305	240	265	340	376	384	350
El Paso.....	85	162	830	792	742	518	785	797	940
Fremont.....	495	500	725	630	768	610	630	563	586
Garfield.....	6	8	15	12	20	10	15	20	18
Gilpin.....	3,124	2,664	2,322	1,985	1,860	1,990	1,837	1,971	1,940
Grand.....	35	26	75	90	100	36	28	116	145
Gunnison.....	555	450	630	537	687	590	672	642	630
Hinsdale.....	538	516	580	332	420	432	395	408	370
Huerfano.....	37	40	35	10	12	8	12	11	10
Jefferson.....	45	26	85	52	115	185	76	76	84

Lake.....	7,470	6,420	5,772	6,300	6,380	6,425	6,911	5,906	5,836
La Plati.....	307	387	475	525	784	792	642	640	625
Larimer.....	80	74	45	82	85	77	96	125	108
Mineral.....	992	1,075	920	918	1,010	873	964	872	806
Montrose.....	115	204	152	110	132	80	75	76	64
Mesa.....	28	70	65	35	146	168	210	140	162
Montezuma.....	109	85	143	190	185	170	148	135	125
Ouray.....	1,897	1,918	1,609	1,465	1,586	1,626	1,510	1,468	1,430
Pueblo.....	2,084	1,975	1,485	1,500	1,945	1,744	1,867	1,832	1,684
Park.....	374	360	406	420	635	690	682	586	570
Pitkin.....	1,560	1,692	1,355	900	1,252	1,035	1,108	980	916
Rio Blanco.....	6	8	25	12	10	11	15	12	14
Rio Grande.....	75	110	145	110	131	120	94	74	86
Routt.....	115	138	135	200	233	190	217	186	232
Saguache.....	378	425	310	280	385	375	348	274	295
San Juan.....	1,405	1,688	1,595	1,647	1,860	1,740	1,836	1,890	1,756
San Miguel.....	1,723	1,840	1,625	1,250	1,190	1,233	1,320	1,640	1,460
Summit.....	574	532	623	570	814	860	851	580	615
Teller.....	7,920	6,484	5,940	5,200	5,667	5,480	5,196	4,762	4,983
Total.....	40,111	37,260	35,118	32,267	35,376	34,287	34,790	33,014	32,720

EMPLOYES ABOVE AND UNDERGROUND.

	1900	1901	1902	1903	1904	1905	1906	1907	1908
Number of men engaged in mining, milling and smelting.....	40,111	37,260	35,118	32,267	35,376	34,278	34,790	33,014	32,720
Number of men engaged above ground.....	16,040	14,904	14,047	12,907	14,150	13,754	13,916	13,041	12,854
Number of men engaged underground.....	24,071	22,356	21,071	19,360	21,226	20,533	20,874	19,973	19,866

ACCIDENTS.
CAUSE OR ACCIDENTAL.

ABOVE GROUND	1907		1908	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Machinery accidents.....	2	11	2	6
Mill accidents.....	1	4	1	3
Smelter accidents.....			1	3
Overwinding cage or bucket.....				
Falling from gallows frame or staging.....		1		
Gravity tram.....	1	3		2
Tramming or dumping cars.....		4		8
Handling loose rock or ore.....	10	3		4
Falls while carrying tools or material.....				1
Falling down shaft from surface.....				1
Getting on or off Cage or bucket at surface.....		1		
Falls in chute or bin or caught with running ore.....		2		2
Falling into uncovered prospect hole.....				
Operating hydraulic machine.....				
Came in contact with live wires.....				
Miscellaneous.....	3	14	1	15
TOTAL.....	17	43	5	45

SHAFT ACCIDENTS	1907		1908	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Getting on or off cage or bucket in motion at station..		1		
Falls from bucket or cage while being hoisted or lowered	1	5		
Caught in shaft while being hoisted or lowered.....	4	5	2	2
Falls from ladder.....		2		
Material falling from level or side of shaft.....	2	7		1
Struck by descending cage or bucket.....		2	1	
Pushing car into open shaft, going down with same ..				
Falls of rock or earth in shaft.....	1	2		
Falling down shaft from level.....	4	8	1	1
Material falling from overloaded bucket.....				
Cable becoming detached, letting cage down shaft ..		7		
Miscellaneous.....	1	2		3
TOTAL.....	13	41	4	7

ACCIDENTS—Concluded.

UNDERGROUND ACCIDENTS	1907		1908	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Falls of rock.....	15	87	17	121
Falls of timber while timbering.....	2	10	.....	11
Falls from ladder.....	1	3	3	2
Falls from overloaded staging.....	.....	8	2	17
Falls in chute, winze, upraise or manway.....	7	6	9	17
Caught in chute with running ore.....	2	2	.....	2
Injured by tram car.....	2	20	1	26
Struck by flying rock or steel from hammer or pick....	.....	2	.....	4
Struck with hammer by helper, or by self.....	.....	1	.....	1
Injured handling loose rock.....	.....	16	.....	3
Falls while carrying tools or material in mine.....	.....	7	.....	2
Suffocation, burning shaft house or tunnel bldg.....	.....	.....	12	.....
Suffocation, bad air or powder smoke.....	4	1	2	.....
Operating machine drill.....	.....	12	.....	8
Miscellaneous.....	1	17	2	16
TOTAL.....	34	192	48	230

EXPLOSIVES	1907		1908	
	Fatal	Non-Fatal	Fatal	Non-Fatal
Thawing powder over candle, in stove, hot water or sand.....	.....	.....	.....	.....
Picking out missed shot.....	.....	1	.....	1
Drilled into hole that missed fire.....	2	9	1	11
Blast exploded while loading.....	4	2	.....	3
Remained too long after lighting fuse.....	3	4	.....	1
Returned before blast exploded.....	.....	.....	.....	2
Struck unexploded powder or caps with pick or shovel while cleaning away muck.....	.....	6	1	7
Hit with flying rock from blast, not being in place of safety.....	4	1	1	6
Explosion, cause unknown.....	.....	1	3	.....
Electricity.....	.....	.....	1	.....
TOTAL.....	13	24	7	31
GRAND TOTAL.....	77	300	64	313

SUMMARY OF ACCIDENTS 1907-1908, INCLUSIVE.

	1900	1901	1902	1903	1904	1905	1906	1907	1908
Number of men engaged in mining, milling and smelting.....	40,111	37,260	35,118	32,267	35,376	34,287	34,790	33,014	32,720
Number of accidents investigated.....	633	754	643	561	640	595	518	377	377
Number of non-fatal accidents.....	526	633	561	494	539	486	436	300	313
Number of fatal accidents.....	107	121	82	67	101	109	82	77	64
Number of non-fatal accidents above ground.....	156	181	106	109	105	103	72	43	45
Number of fatal accidents above ground.....	15	11	13	6	13	11	12	17	5
Number of non-fatal accidents under ground.....	360	452	455	385	434	383	364	257	290
Number of fatal accidents under ground.....	92	110	69	61	88	98	70	60	48
Proportion non-fatal accidents per 1,000 men employed.....	13.11	17.00	15.97	15.31	15.24	14.14	12.53	9.08	9.56
Proportion of fatal accidents per 1,000 men employed.....	2.66	3.24	2.30	2.08	2.86	3.18	2.37	2.33	1.95
Per cent. non-fatal accidents per 1,000 men above ground.....	9.72	12.14	7.55	8.45	7.42	7.49	5.17	3.29	3.50
Per cent. fatal accidents per 1,000 men above ground.....	.93	.74	.92	.47	.92	.8	.86	1.30	.38
Per cent. non-fatal accidents per 1,000 men underground.....	14.95	20.22	21.59	19.88	20.45	18.65	17.44	12.86	11.57
Per cent. of fatal accidents per 1,000 men underground.....	3.82	4.92	3.27	3.15	4.15	4.77	3.35	3.00	2.41

DURING THE FISCAL YEARS OF 1907 AND 1908 THE
FOLLOWING ORDERS WERE ISSUED BY THE
DEPARTMENT.

	1907	1908
Regarding timbers and timbering.....	10	7
Regarding explosives.....	29	58
Regarding amount of powder kept in storage.....	4	7
Use of steel or iron tamping bars.....	11	5
Removing old timbers from mine.....	3	4
Regarding employment of hoisting engineer.....	1	.....
Regarding indicator on hoisting machinery.....	11	27
Posting uniform code of signals.....	10	24
Regarding fire protection.....	10	13
Prohibit riding on skip or cage with tools, or upon loaded bucket.....	6	3
Timber shaft or stope.....	4	14
Partitioning shaft or dividing into compartment.....	8	3
Placing ladders in shaft and repair same.....	10	26
Provide or repair ladders in upraise, winze or manway.....	5	4
Provide connection to surface with suitable ladders.....	13	17
Provide chain ladders in shaft or incline while sinking.....	14	3
Provide shaft collar with cover, bonnet or doors.....	1	.....
Equip cage with safety clutches or repair same.....	2	6
Make passageway around working shaft.....	1	.....
Provide guard rails at shaft stations.....	13	20
Cover winzes or mill holes or surround with guard rails.....	14	8
Leave pillar ground standing on side of shaft.....	1	2
Cover or fence abandoned mine, shaft or pits.....	2	8
Notice of number of men permitted to ride upon cage, skip or bucket.....	8	5
Repair, replace or test cable.....	10	6
Repair machinery.....	3	1
Place fire doors at mouth of tunnel.....	8	6
Sanitary and ventilation.....	6	7
Provide chairs or overwinding device.....	4	2
Miscellaneous.....	12	8

APPOINTMENTS.

M. J. McCarthy was re-appointed mine inspector for a term of two years, beginning June 1, 1907.

P. T. Buckel was appointed mine inspector for a term of two years, beginning June 1, 1907.

John R. Wood was appointed mine inspector for a term of two years, beginning June 1, 1907.

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 1907-1908.

Appropriation.....		\$27,000.00
Commissioner of Mines T. J. Dalzell, salary	\$ 5,000.00	
Commissioner of Mines T. J. Dalzell, expense account	1,737.20	
Inspector M. J. McCarthy, salary.....	3,000.00	
Inspector M. J. McCarthy, expense account.....	2,004.80	
Inspector P. T. Buckel, salary.....	3,000.00	
Inspector P. T. Buckel, expense account.....	1,838.35	
Inspector Jno. R. Wood, salary.....	3,000.00	
Inspector Jno. R. Wood, expense account.....	1,742.83	
Clerk and Asst. Curator, Fenno Wakeman, salary.....	3,000.00	
Stenographer, A. M. Nickerson, salary.....	2,000.00	
Balance.....	676.82	
	\$27,000.00	\$27,000.00

ANNUAL PRODUCTION

By Counties

of Gold, Silver, Lead, Copper and Zinc

1897--1908

Inclusive

THE BUREAU OF MINES OF THE STATE OF COLORADO.
PRECIOUS METAL PRODUCTION BY COUNTIES FOR THE YEAR 1897.

COLORADO	GOLD		SILVER		LEAD		COPPER		TOTAL
	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Arapahoe.....	102	\$ 2,108.34	14	\$ 8.35					\$ 2,116.69
Archuleta.....	34	702.78	348	207.58					910.36
Boulder.....	24,802	512,657.34	138,715	82,743.50	309,115	\$ 10,448.09	58,474	\$ 6,139.77	611,988.70
Chaffee.....	10,979	226,935.93	53,859	32,126.89	1,686,391	57,000.02	172,891	18,153.55	334,216.39
Clear Creek.....	37,864	782,648.88	1,442,563	860,500.76	5,263,116	177,893.32	516,034	54,183.57	1,875,226.53
Conejos.....	51	1,054.17	98	58.46					1,112.63
Costilla.....	262	5,415.54	482	287.51	50,048	1,691.62	502	52.71	7,447.38
Custer.....	108	2,129.01	26,842	16,011.25	2,101,041	71,015.19	874	91.77	89,247.22
Delta.....	14	289.38							289.38
Dobores.....	2,103	43,469.01	179,901	107,310.95	1,093,840	36,971.79	39,654	4,163.67	191,915.42
Douglas.....	23	475.41	10	5.96					481.37
Eagle.....	1,682	34,766.94	46,046	27,466.44	1,144,013	38,667.64	2,200	231.00	101,132.02
El Paso.....	490,172	10,131,855.24	59,879	35,717.82	5,492	185.63	1,625	170.58	10,167,929.27
Fremont.....	623	12,877.41	1,525	909.66					13,787.07
Garfield.....	15	310.05	42	25.05					335.10
Gilpin.....	100,942	2,086,471.14	374,417	223,339.74	2,007,698	67,800.19	1,018,565	106,652.48	2,484,623.55
Grand.....	94	1,942.98	85	50.70					1,993.68
Gunnison.....	1,972	40,761.24	103,941	62,000.81	1,013,114	34,243.25	2,770	290.85	137,296.15

Hinsdale.....	8,136	168,171.12	243,437	145,210.17	5,550,058	187,501.96	8,085	848.93	501,822.18
Huerfano.....	35	723.45	167	99.62	1,067	36.06	92	9.66	868.79
Jefferson.....	399	8,247.33	1,614	962.75	10,093	341.14	1,602	168.21	9,719.43
Lake.....	99,848	2,063,858.16	5,451,317	3,251,710.59	23,700,908	801,000.69	3,146,802	330,414.21	6,447,073.65
La Plata.....	1,426	29,475.42	1,409	840.47	857	28.97	420	44.10	30,388.96
Larimer.....	144	2,976.48	97	57.86	.....	.....	.....	.....	3,034.34
Las Animas.....	31	640.77	9	5.37	.....	.....	.....	.....	646.14
Mineral.....	2,967	61,327.89	3,070,576	1,831,598.58	6,080,673	205,526.75	1,500	157.50	2,098,610.72
Montrose.....	317	6,552.39	851	507.62	.....	.....	.....	.....	7,040.01
Mesa.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Montezuma.....	371	7,468.57	105	62.63	.....	.....	.....	.....	7,731.20
Ouray.....	26,746	552,839.82	2,776,394	1,656,119.02	7,784,212	263,106.37	2,185,084	229,433.82	2,701,499.03
Park.....	7,432	153,619.44	199,945	119,267.19	4,517,614	152,695.35	58,002	6,090.21	431,672.19
Pitkin.....	7,955	164,429.85	4,599,946	2,743,867.79	4,456,478	150,628.96	8,360	877.80	3,059,804.40
Rio Grande.....	1,093	22,592.31	8,168	4,872.21	12,006	405.80	627	65.84	27,936.16
Routt.....	473	9,776.91	7,805	4,655.68	88,736	2,999.28	958	100.59	17,532.46
Saguache.....	665	13,745.55	2,482	1,480.51	9,266	313.19	2,975	312.38	15,851.63
San Juan.....	33,591	694,325.97	1,101,907	657,287.53	8,021,414	271,123.79	1,435,203	150,696.32	1,778,433.61
San Miguel.....	70,544	1,458,144.48	869,079	518,405.62	4,143,767	140,059.32	354,781	37,252.00	2,153,801.42
Summit.....	13,239	273,650.13	514,107	306,664.83	1,748,761	59,108.12	133,482	14,015.61	653,438.69
TOTAL.....	947,249	\$19,579,636.83	21,278,202	\$12,692,447.47	80,799,778	\$2,731,032.49	9,151,592	\$ 960,917.13	\$35,964,033.92

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

Huerfano.....	7	144.69	40	23.30	.....	.....	.....	.....	167.99
Jefferson.....	89	1,839.63	102	59.42	.....	.....	.....	.....	1,899.05
Lake.....	100,292	2,073,035.64	7,068,727	4,117,533.48	35,945,006	1,304,803.72	.....	5,543,954	8,100,647.32
La Plata.....	1,470	30,384.90	4,348	2,532.71	.....	.....	.....	2,568	33,225.77
Larimer.....	540	11,161.80	60	34.95	.....	.....	.....	24,484	14,134.83
Las Animas.....	6	124.02	.....	.....	.....	.....	.....	.....	124.02
Mineral.....	2,244	46,383.48	4,177,184	2,433,209.68	5,453,104	197,947.68	.....	14,729	2,679,308.32
Montrose.....	131	2,707.77	6,290	3,663.93	.....	.....	.....	34,064	10,531.38
Mesa.....	8	165.36	20	11.65	.....	.....	.....	.....	177.01
Montezuma.....	400	8,268.00	871	507.36	8,407	305.17	.....	.....	9,080.53
Ouray.....	41,246	852,554.82	1,420,330	827,342.23	2,799,936	101,637.68	.....	1,035,562	1,905,802.17
Park.....	7,716	159,489.72	198,711	115,749.16	1,953,001	70,893.94	.....	20,957	348,047.06
Pitkin.....	3,435	71,001.45	3,977,270	2,316,795.78	15,903,682	577,303.66	.....	4,553	2,965,611.25
Rio Grande.....	180	3,720.60	1,568	913.36	2,393	86.87	.....	9,794	5,896.11
Routt.....	617	12,753.39	2,173	1,265.77	15,477	561.82	.....	600	14,652.98
Saguache.....	952	19,677.84	2,618	1,524.99	132,462	4,808.37	.....	21,711	28,616.52
San Juan.....	54,794	1,132,591.98	1,048,499	610,750.68	14,059,999	532,157.96	.....	2,252,421	2,545,791.14
San Miguel.....	76,085	1,572,676.95	2,129,082	1,240,190.27	6,699,712	243,199.55	.....	360,331	3,099,366.49
Summit.....	16,634	343,824.78	415,087	242,137.68	4,889,204	177,478.11	.....	9,825	764,619.57
TOTAL.....	1,138,584	\$23,534,531.28	23,502,601	\$13,690,265.15	113,417,168	\$4,117,043.24	.....	10,870,862	\$42,646,343.95

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 1899.

COLORADO	GOLD			SILVER		LEAD		COPPER		TOTAL	
	Name of County	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value		
Apache	13	\$	268.71	2	\$	1.19				\$	269.90
Archuleta	5		103.35	43		25.62					128.97
Boulder	26,505		547,858.35	76,371		45,501.84	28,043	\$	1,253.52	\$	608,493.21
Chaffee	10,452		216,662.94	147,339		87,784.58	1,193,074		53,330.41		480,473.14
Clear Creek	26,455		546,824.85	1,502,900		895,427.82	7,216,260		322,566.82		1,816,410.80
Conejos	303		6,263.01	22,987		13,095.65					19,958.66
Costilla	39		806.13	126		76.07					881.20
Custer	51		1,054.17	6,004		3,577.18	836,894		37,409.16		42,203.05
Delta	10		206.70	10		5.96					212.66
Dolores	3,234		66,846.78	257,052		153,151.59	2,046,232		91,466.57		319,302.97
Douglas	4		82.08	24		14.30					96.98
Eagle	2,230		46,094.10	44,393		26,449.35	1,187,930		53,100.47		126,678.68
Huerfano	6		124.02	5		2.98					127.00
Fremont	455		9,404.85	3,974		2,367.70	11,443		511.50		13,463.57
Gilpin	96,568		1,996,060.56	340,652		202,060.46	1,312,312		58,660.35		2,440,371.21
Grand	6		124.02	13		7.75					131.77
Garfield	35		723.45	17		10.13					733.58
Gunnison	3,392		70,112.64	132,983		79,231.27	1,399,336		62,550.32		220,027.58

Hinsdale.....	1,855	38,342.85	155,902	92,886.41	10,572,353	472,684.18	49,676	8,747.94	612,561.38
Jefferson.....	66	1,364.22	351	209.13	770	34.42	254	44.73	1,652.50
Lake.....	106,265	2,196,497.55	7,230,118	4,307,704.30	48,598,720	2,172,362.76	3,202,828	564,018.01	9,240,582.64
La Plata.....	1,242	25,672.14	3,162	1,883.92	3,176	141.97	211	37.16	27,735.19
Larimer.....	100	2,067.00	185	80.43			2,474	435.67	2,583.10
Las Animas.....	10	206.70	3	1.79					208.49
Mineral.....	4,435	91,671.45	3,790,899	2,262,192.42	5,077,162	253,769.14	20,223	3,561.27	2,611,194.28
Montrose.....	35	723.45	46,119	27,477.70			75,006	13,208.56	41,409.71
Mesa.....	6	124.02	4,120	2,454.70			4,650	818.87	3,397.59
Montezuma.....	746	15,419.82	227	135.25					15,555.07
Ouray.....	82,000	1,694,940.00	2,346,194	1,397,862.39	7,556,386	337,770.45	305,177	53,741.67	3,484,314.51
Park.....	7,404	153,040.68	72,137	42,979.22	540,849	24,175.95	7,903	1,391.72	221,587.57
Pitkin.....	2,527	52,233.09	4,158,708	2,477,758.23	25,458,380	1,137,989.59	19,351	3,407.71	3,671,388.62
Rio Grande.....	929	19,202.43	2,718	1,619.38	1,635	73.08	386	59.17	20,954.06
Routt.....	559	11,554.53	1,271	757.26	3,405	152.20			12,463.99
Saguache.....	188	3,885.96	14,306	8,523.51	441,095	19,716.95	35,319	6,219.68	38,346.10
San Juan.....	48,199	996,273.33	1,191,857	710,108.40	16,011,677	715,721.96	1,197,661	210,908.10	2,633,011.79
San Miguel.....	66,604	1,376,704.68	1,208,395	719,961.74	3,918,883	175,174.07	160,239	28,218.09	2,300,058.68
Summit.....	12,606	260,566.02	264,872	157,810.74	4,032,431	180,249.67	65,531	11,540.01	610,166.41
Teller.....	776,902	16,058,564.34	82,299	49,033.74			275	48.43	16,107,646.51
Total.....	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	\$47,746,788.05

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 1900.

COLORADO Name of County	GOLD		SILVER		LEAD		COPPER		TOTAL
	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Arapahoe.....	12	\$ 248.04							\$ 248.04
Archuleta.....	7	144.69	30	\$ 18.43					163.12
Baca.....	5	103.35	102	62.64					1,636.27
Boulder.....	29,307	607,015.89	90,327	55,469.80	76,076	\$ 3,598.39	8,900	\$ 1,470.28	669,449.37
Chaffee.....	8,354	172,677.18	125,330	76,965.15	833,462	39,422.75	753,677	124,507.44	413,572.62
Clear Creek.....	22,518	465,447.06	1,358,143	834,035.02	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	17.08	2,277.51
Custer.....	1,008	20,835.36	82,005	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	1,655,501.04	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	7,984	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	5,280.70	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	1,985,297	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	27,452,290	1,298,491.90	6,082	1,004.75	3,842,501.96
Pueblo.....	12	248.04	9	5.53	.....	.....	.....	.....	253.57
Rio Grand.....	5,207	107,628.69	3,075	1,888.36	26,290	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	15 ^c 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	89,792	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
	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	
Animas	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	\$53,366.30
Chaffee	7,677	158,683.59	76,286	44,970.60	209,708	9,091.35	576,251	95,308.35	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	1,520,969.02
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	103,239.20	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	175,769.64
Hinsdale.....	3,684	76,148.28	152,122	89,675.92	7,588,675	328,803.17	12,53.27	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	298.58	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	2,555.13	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.

Gunnison.....	5,009	103,536.03	123,138	64,228.78	728,935	29,690.37	28,686	3,409.90	131,975	6,857.59	207,222.07
Hinsdale.....	4,758	98,347.86	117,177	61,119.52	6,213,763	252,838.02	8,314	988.29	319,000	15,439.00	428,733.29
Huerfano.....	41	847.47	260	135.62	.....	.....	.....	.....	.....	.....	983.09
Jefferson.....	25	516.75	3	1.56	.....	.....	2,978	353.93	.....	.....	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.....	6,039	124,640.10	7,387	3,833.06	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	49,998	26,063.31	261,046	10,621.96	8,113	984.39	.....	.....	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	.....	.....	2,020,245.32
Rio Grande.....	690	14,292.30	3,171	1,653.99	166	6.75	1,290	149.78	.....	.....	16,072.82
Route.....	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	12,627.04	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	174,888.79	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	1,829,180	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
	Fine Ounces	Value	Fine Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
County											
Arapahoe.....	8	\$ 165.36									\$ 165.36
Archuleta.....	3	62.01									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	55,000	3,002.40	93,911.23
Hinsdale.....	799	16,515.33	33,139	17,712.80	459,462	19,467.40	11,293	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	76,566,000	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	8,000,646	364,409.37	133	17.60	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
Ourray.....	105,056	2,171,507.52	417,343	223,069.83	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	2,569,802	1,373,591.24	33,269,852	1,409,643.63	11,683	1,546.25	2,789,635.22
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	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	363,941.47	3,704,201	156,947.00	466,204	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	439,632.75
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	\$1,033,612.90	\$8,373,099.75

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
	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	\$ 2,070.77	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	180,071.07
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	46,211.95	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	1,032.17			110,823.12
Delta.....	17	351.39	9	5.15							356.54
Dolores.....	2,002	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	81,831.92			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	65,800.55	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.....	6,104	127,409.88	31,033	17,577.08	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	224,557.55	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	1,218,507.42	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	\$40,783,674.25

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 County	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
	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			417,089.27
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	3,252,540	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	32,569.34	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	24,522	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
Laake.....	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	11,290,867.44
La Plata.....	12,096	250,024.32	88,085	53,159.30	610	28.67	425	66.26			303,278.55
Larimer.....	50	1,033.30	35	21.12			4,336	675.98			1,730.60
Los 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							523.30
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	392,942.40	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 County	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
	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	498,522.61	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	407,293	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	110.26							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.....	51,003	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	.....	.....	389,705.11
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	179,249.91	1,988,971.02
Montrose.....	15	310.05	12	8.01	.....	.....	.....	.....	.....	.....	318.06
Mesa.....	103	2,129.01	697	465.53	.....	.....	.....	.....	.....	.....	3,751.22
Montezuma.....	34	* 702.78	10	6.68	.....	.....	6,000	1,156.68	.....	.....	709.46
Ouray.....	47,627	984,450.09	912,099	609,200.04	5,721,599	305,333.90	662,111	127,641.76	54,883	3,401.65	2,030,027.44
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	18,580	3,572.24	71,302	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	.....	.....	3,906,182.27
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	3,090	103.62	.....	.....	.....	.....	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	\$13,898,073.56

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, .06347; Copper, .19278; Zinc, .06198. 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, 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	.....	.....	292.09
Chaffee.....	2,694	55,685.00	34,098	22,300.10	469,452	23,068.74	345,933	69,186.60	2,407.730	\$ 149,389.64	321,640.08
Clear Creek.....	21,558	445,603.88	571,896	374,019.98	3,663,719	193,642.59	175,568	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	32,067.72	48,971	32,027.03	94,913	5,068.35	12,653	2,531.60	38,224	2,371.79	94,065.49
Hinsdale.....	396	8,285.33	46,292	36,274.96	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	693,147.88	12,711	2,542.20	2,691,216	166,989.95	1,820,994.58
Montrose.....	16	330.72	105	107.90	.....	.....	11,222	2,244.40	.....	.....	2,683.02
Montezuma.....	23	475.41	116	75.86	.....	.....	.....	.....	.....	.....	551.27
Ouray.....	118,497	2,449,382.98	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	4,088,693	290,933.40	2,205,023.37
Rio Grande.....	314	6,490.38	6,393	4,181.00	330	17.62	.....	.....	.....	.....	10,089.00
Routl.....	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	\$40,847,584.55

NOTE.—In the above table the calculation is on the average market price of the minerals for the year.
 Gold, .20.67; Silver, .664; Lead, .0634; Copper, .20; Zinc, .06205. 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, 1908.

COLORADO	GOLD		SILVER		LEAD		COPPER		ZINC		TOTAL
	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	12,515	\$1,627.34	.....	.....	\$ 195,420.66
Chaffee.....	1,659.514	34,302.15	19,301.06	10,198.68	416,312	17,826.73	303,170	39,412.10	754,860	34,572.58	136,012.24
Clear Creek.....	20,135.027	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	5,112.28	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	3,000	1.58	.....	.....	.....	.....	.....	.....	242.09
Gilpin.....	53,163.718	1,098,894.05	264,193.75	139,899.97	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	691,956	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	14,335,832	603,664.82	5,334,082	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	1,657,223	75,905.39	989,355.04
Montezuma.....	4,250	87.84	7.25	3.83	.....	.....	.....	.....	.....	.....	91.67
Ouray.....	96,945.575	2,003,565.03	408,469.28	215,835.16	3,033,352	127,699.90	1,189,587	154,616.31	.....	.....	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	1,888,835	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

Production of
PRECIOUS METAL
To December 31, 1908

THE BUREAU OF MINES OF THE STATE OF COLORADO.
PRECIOUS METAL PRODUCTION OF COLORADO TO DECEMBER 31, 1908.

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	145,804	3,015,000.00	500,000	630,000.00			97,088	20,000.00			3,695,000.00
1871	175,808	3,633,951.00	779,590	1,029,058.00			90,969	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	3,396,404.00	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	889,593	161,000.00			22,465,713.40
1882	162,554	3,390,000.00	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	14,912,736.00	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	13,984,096.00	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	215,258	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	3,883,859.00	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	304,151	7,527,000.00	25,838,600	20,205,785.00	84,306,000	3,147,970.80	7,121,157	705,535.13	.....	31,646,290.93
1894	402,009	9,549,731.00	23,236,025	14,638,696.00	97,204,000	3,200,000.00	6,528,214	624,097.26	.....	28,012,524.26
1895	656,021	13,559,954.00	17,891,026	11,683,232.00	91,477,214	2,954,714.00	6,125,000	659,050.00	.....	28,856,950.00
1896	738,618	15,207,234.00	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	44,708,805.83
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	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	40,783,074.25
1905	1,237,443	25,577,946.81	12,831,348	7,743,718.51	115,712,908	5,498,506.67	9,854,176	1,536,266.04	81,198,941	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	43,898,075.56
1907	990,398	20,471,826.66	12,059,202	7,886,736.17	92,987,235	4,965,517.10	11,256,291	2,251,258.20	85,018,157	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	33,283,010.91
TOTAL	21,540,757	\$445,247,473.43	513,650,864	\$415,561,090.14	3,267,718,611	\$139,243,361.72	175,978,171	\$24,894,704.92	489,151,559	1,052,303,180.59

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
1907.....	20.67	.654	.0534	.20	.06205
1908.....	20.67	.5284	.0421	.13	.0458

LEAD AND ZINC.

The total output of lead and zinc in Colorado for 1907 suffered a marked decrease from 1906, and this experience was repeated with greater emphasis in 1908.

The output of lead in Colorado in 1907, as shown by the bulletin issued from this Bureau, compiled with great care and accuracy from all the smelters in the State, was 92,987,235 pounds, valued at \$4,965,517.10, calculated at 5.36 cents as the average market price of this mineral for the year.

In 1908 the output had fallen to 57,711,898 pounds, valued at \$2,429,670.91, calculated at 4.21 cents as the average market price of this mineral during the year.

The loss in production of 1908 over 1907 was 35,275,337 pounds, and \$2,535,846.19, or more than 50 per cent. in value.

What is true of the lead output is also true concerning zinc.

The output of zinc during 1907 was 85,018,157 pounds, valued at \$5,275,376.64, calculated at 6.20 cents as the average market price during that year, while the output of 1908 amounted to 39,270,815 pounds, valued at \$1,798,603.33, calculated at 4.58 cents as the average market price during the year, showing a loss in 1908 over 1907 of 45,747,342 pounds and \$3,476,773.31.

Such a great decline in production and value, divided among twenty-one of our twenty-seven metalliferous mining counties, could not but result in the closing of many mines.

As the lead and zinc values in Colorado are almost wholly obtained from lead-silver, lead-zinc or lead-silver-zinc ore, which are separated usually into silver-lead and zinc products by concentration, the great fall in price and production also resulted in the cessation of work in many such mills, and had its influence upon the falling off in the silver and gold production of the State as well.

LEAD.

Review of the lead output by individual counties for the biennial period, 1907-'08, showing increase and decrease in pounds and values:

In 1907, twenty-one counties produced lead; in 1908, eighteen counties show such production.

COUNTY	1907		1908		INCREASE		DECREASE	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
		\$		\$		\$		\$
Boulder.....	36,286	1,937.67	115,131	4,847.01	78,845	2,908.27		
Chaffee.....	469,452	25,068.54	416,312	17,526.73			53,140	7,542.81
Clear Creek.....	3,663,719	193,642.59	2,410,253	101,471.65			1,253,466	92,170.94
Custer.....	48,127	2,569.98	72,637	3,058.01	24,510	489.03		
Dolores.....	44,403	2,371.12	995,705	41,919.18	951,302	38,548.06		
Eagle.....	346,644	18,510.80	215,237	9,061.47			131,407	9,449.33
Gilpin.....	442,671	23,638.63	573,631	24,149.87	130,960	511.24		
Gunnison.....	94,913	5,068.35	246,843	10,392.09	151,930	5,323.74		
Hinsdale.....	639,855	50,188.26	164,499	6,925.40			775,356	43,262.86
Lake.....	34,064,162	1,819,026.25	14,338,832	603,664.82			19,725,330	1,215,361.43
La Plata.....	444	23.70					444	23.70
Mineral.....	12,980,288	693,147.38	8,238,025	346,820.85			4,742,263	346,326.53
Ouray.....	3,606,699	192,597.72	3,033,352	127,699.90			573,347	64,897.92
Park.....	1,052,113	56,182.83	554,120	23,328.45			497,993	32,854.38
Pitkin.....	13,914,993	743,059.42	7,437,550	313,130.85			6,477,443	429,938.57
Rio Grande.....	330	17.62					330	17.62
Saguache.....	480,150	25,640.01	76,420	3,217.28			403,730	22,322.73
San Juan.....	12,425,828	663,539.21	10,266,101	432,202.85			2,159,727	231,336.36
San Miguel.....	6,499,957	347,097.70	7,135,863	300,419.83	635,906			46,077.87
Summit.....	1,788,247	95,492.38	1,407,610	59,290.38			380,637	36,231.70
Teller.....	87,954	4,696.74					87,954	4,696.74

A brief study of the foregoing table shows that Boulder, Custer, Dolores, Gilpin and Gunnison counties produced more lead in 1908 than in 1907, while San Miguel county produced a larger tonnage but decreased in value.

ZINC.

Review of zinc output by individual counties for the biennial period, 1907-'08, showing increase and decrease in pounds and values. In 1907, nine counties produced zinc; in 1908, twelve counties show a zinc production.

COUNTY	1907		1908		INCREASE		DECREASE	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
		\$		\$				\$
Chaffee...	2,407,730	149,309.64	754,860	34,572.52			1,652,870	114,827.12
Clear Creek...	2,771,960	172,027.83	3,714,309	170,115.35	942,349			1,912.48
Dolores.....			754,860	34,572.58	754,860	34,572.58		
Eagle.....	429,198	26,631.73					29,198	26,631.73
Gilpin.....			810,850	37,136.43	810,850	37,136.43		
Gunnison.....	38,224	2,371.79	694,956	31,828.98	652,732	29,457.19		
Lake.....	67,247,381	4,172,700	23,400,660	1,071,750.22			43,846,721	3,100,947.78
Mineral.....	2,691,216	166,989.95	1,657,323	75,905.39			1,033,890	91,084.56
Park.....			1,883,835	86,279.64	1,883,835	86,279.64		
Pitkin.....	4,688,693	290,933.40	1,887,150	86,431.47			2,801,543	214,501.93
San Juan.....	1,772,764	110,000.00	15,610	114.93			1,757,154	109,885.07
San Miguel.....			1,154,319	52,871.15	1,154,319	52,871.15		
Summit.....	2,970,991	184,350.00	2,542,310	116,424.05			428,681	77,925.95

The decrease in price of lead and zinc during this period explains the decrease in production and value. It has necessarily worked to the disadvantage of a large number of miners and mill men by throwing them out of employment.



