Thirteenth Biennial Report

OF THE

State Coal Mine Inspector

1907-1908

DENVER, COLORADO
THE SMITH-BROOKS PRINTING CO., STATE PRINTERS
1909

Compliments of

JOHN D. JONES

State Inspector of Coal Mines, Colorado

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LETTER OF TRANSMITTAL.

Department of Coal Mines, Dec. 31st, 1908.

HON. HENRY A. BUCHTEL,
Governor of Colorado, Denver.

Sir—In compliance with section 17 of an act entitled "Coal Mines" I have the honor to submit to you herewith the thirteenth biennial report of the Department of Coal Mines, covering a period beginning with Jan. 1st, 1907, and ending Dec. 31st, 1908. The report gives the monthly and yearly production of every mine, a list of fatalities which have occurred, descriptions of new mines, and improvements made in old mines, together with articles relating to the coal industry of Colorado. Also recommendations for the changing and amending of the present coal mining law are offered.

Respectfully submitted,

JOHN D. JONES,
State Inspector of Coal Mines.

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ERRATA.

Page 3, fourth line from top, should read, "industry in Colorado."

Page 4, paragraph 2, fifth line from top, should be "annual."

Page 145, sixth line from bottom, should read, "characterized as anthracite."

Page 153, paragraph 1, ninth line from top, should read, "light gray."

Page 153, paragraph 2, ninth line from top, should read, "above the town."

Page 156, paragraph 3, first line from top, should read, "by mule."

Page 288 should contain, "J. W. Canty, Division Superintendent Rocky Mountain Fuel Co."

classes and grades of coals was probably the steadiest and best the State has ever known and the prices were exceptionally good. The warning sent out from Washington and by the various railroad companies early in the year to the public, recommending the laying in of supplies of coal while it was easily obtained, together with the tide of prosperity increasing the business of all the other industries requiring fuel at that time, was responsible for the unusual activity. The winter of 1907-'08 was exceptionally mild and the coal stored in the summer months was not all used up, and in addition thereto in the latter part of 1907 there came a decided depression in the demand for all grades of coal. Shortly after the money disturbance started in October, the effects were felt by the cancelling of many orders. It was estimated that at one time there were 1,500 cars of coal in transit for Nebraska, Kansas, Oklahoma and Texas markets, of which the greater number was from the Colorado fields, and for which there was no longer a demand excepting at prices which meant a loss to the operator. The closing down of

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INTRODUCTION.

Reviewing the trend of the coal industry of the last two years, which the thirteenth biennial report covers, and which is herewith published, many phases developed making it the most notable period known to the industry of Colorado. In 1907 there was great activity in all the mines and consequently the production exceeded that of any year before. In 1908 there was a decrease in the output, being 9,773,007 tons, yet the total production of the two years taken together is in excess of that of any preceding biennial period.

The year 1907 was the most flourishing in the history of the coal business, both in the amount of tonnage produced and also in the number of new mines opened and equipped on a scale to meet a large demand for the product; 10,965,640 tons constituted the year's output, and 18 new mines located in the various districts, were developed by a large expenditure of capital.

(See chapter "New Mines" elsewhere in this report.)

During the earlier nine months of 1907 the demand for all classes and grades of coals was probably the steadiest and best the State has ever known and the prices were exceptionally good. The warning sent out from Washington and by the various railroad companies early in the year to the public, recommending the laying in of supplies of coal while it was easily obtained, together with the tide of prosperity increasing the business of all the other industries requiring fuel at that time, was responsible for the unusual activity. The winter of 1907-'08 was exceptionally mild and the coal stored in the summer months was not all used up, and in addition thereto in the latter part of 1907 there came a decided depression in the demand for all grades of coal. Shortly after the money disturbance started in October, the effects were felt by the cancelling of many orders. It was estimated that at one time there were 1,500 cars of coal in transit for Nebraska, Kansas, Oklahoma and Texas markets, of which the greater number was from the Colorado fields, and for which there was no longer a demand excepting at prices which meant a loss to the operator. The closing down of

many metalliferous mines in this State, and the reduction of the producing capacities of others and also the curtailing of the amount of fuel used by the railroads in hauling the ore, created dull conditions, so much so that many coal mines were obliged to close down in January of this year and some did not open for business until September, and very few mines were working to their full capacities. However, nearly all the mines which ceased operations pending better markets have now resumed, and the present demand for the higher grades of coal is satisfactory and it is expected that the markets will improve from now on.

From the fact that many industries which were closed down a year ago have resumed, and new ones starting with millions of dollars ready to be invested, there is every reason to believe that the coal business is approaching a prosperous era which will result in a good anual increase of tonnage continuously for many years to come.

The relation between operators and employes in general has been very harmonious, and no labor trouble has occurred which has in any noticeable way interfered with the total production of coal. At the Leyden mine union miners went out on a strike in October and a controversy is still pending, although the mine is being operated with non-union men.

There was a considerable shortage of miners in the early part of 1907, which seriously curtailed the production of nearly every mine in the State. This situation was reversed in the latter part of the year and the first half of this, and many miners were compelled to seek other fields for work. The supply of labor has been about equal to the demand during the latter part of 1908.

The supply of railroad cars has been unusually regular, although at times there have been some shortages caused more through the inability of the companies to furnish motive power to haul the coal, than to a lack of cars.

In summing up the results of the last two years, perhaps none is more gratifying than the great desire manifested on part of the mine owners and officials to comply with the demands for safety measures to protect life and health of the employes. The statute governing coal mining in Colorado is wholly inadequate to cope with the requirements of mining on the scale it has attained in this State, or in conformity with modern methods. Improvements and rules were made and put into effect voluntarily and for the commendable purpose of increasing the safety and welfare of the mine workers.

Immediately after coal was struck in the different new mines which were opened during the period covered by this report, a circular letter was sent to the superintendent of each mine calling attention to the advantage that would result in not postponing the sinking of the second opening for the time allowed

by the statute. With the exception of four operators, all complied with the recommendation and second openings were started at once and continued to completion. Following is a copy of the letter sent and it will explain its purpose:

"In this State the law governing coal mining does not demand a second opening until 15,000 square yards have been excavated. But when we call to memory the number of accidents and lives lost through tipple and head frame fires, we must desire to do better than the law and protect life by measures not yet made a legal requirement. Whenever I think of a mine with but one opening and a number of men working in it, with surface buildings and head frame above it, I deem it my duty to urge a second opening to be made at once regardless of what the law demands. In 1906 we had two fires started at the engine houses and which destroyed the head frames of two different mines which were well built and with as little chances for fire as your surface equipments, and if there had been no second opening every man in the mine would have perished. Even as it was, it took ingenuity and heroism to get the men out.

"Therefore, I cannot impress too strongly the importance of starting this second opening at once. The cost of making it now will prove an economy in the end; besides, it will furnish better ventilation and permit the men to do better work. Also it is a humane deed to insure and protect life and should be the first aim of every coal operator. I believe you will agree with me and place your mine on as safe a basis as it is possible. I recommend this measure so earnestly, for the danger is always great where there are tipple and shaft houses, and should a fire break out and stop the egress of the miners, there would be no other escape-way and the men would have to perish, with no help being able to reach them. We would then have regrets, but too late.

"I trust you will consider this recommendation favorably and in the spirit in which I make it for the welfare of all concerned in this request.

"An early reply stating your intentions in the matter will be highly appreciated."

In addition to the above quoted letter, personal interviews were sought with the parties in authority in which the importance and advantage of immediately sinking second openings were minutely explained.

There is no law compelling the operator to make this second opening so early in the development of his mine, and all of them could have refused with impunity to comply with this measure of safety for some time at least. In mines under rapid development the expense of making this second opening could have been avoided for a year at least, and the smaller ones several years, and thus exposing continuously the lives of the em-

ployes to the danger resulting should a fire break out at the head frame of the one opening.

Nearly all the larger coal companies and many of the smaller ones operating in the counties of Las Animas, Huerfano, Fremont and the western slope districts have adopted and are enforcing the rule of firing shots when all the employes have withdrawn from the mine, excepting the "shot-firers," and in many cases the coal is undermined to a depth exceeding the depth of the blast holes, thus diminishing the chances for "blown-out" shots. These safeguards are of the utmost importance, for in this manner the mine is kept free from powder smoke while the men are at work, and the opportunities for dust explosions are lessened in the absence of "blown-out" shots. Here also the law is deficient, for no provisions are made requiring "shot-firers." These concessions were made voluntarily and solely for the protection of the underground workers. (See article on "Accidents and Prevention" in another part of this report.)

The sinking of new air shafts nearer the faces of the workings in old mines and thus shortening the air ways and increasing the air currents, enlarging air shafts and installing fans of greater capacities and overcasts for the purpose of placing the mines on a safer basis for the workmen, have been numerous, and made the conditions and equipments of the majority of these mines up to date.

In the latter half of the year 1907 two of the largest operators in the State, viz., The Colorado Fuel and Iron Company and the Victor Fuel Company, each put on a special mine inspector for the protection of the employes at their respective mines. The fact that so many of the companies are enforcing rules of safety at their mines which are not stipulated by the law is an ample argument that the law needs some revising and changing.

The Sixteenth General Assembly passed a bill authorizing the appointment of two more deputy inspectors, but made no provisions for salaries and expenses, consequently they were not appointed.

In 1907 there were 99 fatalities. This number was a little larger than usual. The explosion at the Primero mine on Jan. 23rd, killing twenty-four persons, and the suffocation of five from noxious gases from a mine fire at Engleville, were factors in swelling the list. (See "Fatal Accidents" in this report.)

In 1908 it is gratifying to report that the number of fatalities did not run as high, being 61, or 38.4 per cent. less than the preceding year. No catastrophe of any magnitude occurred and no mine accident at which more than one man was killed. This encouraging decrease of accidents is due chiefly to the foregoing stated additional precautionary measures taken by the op-

erators and to the fact that the men are becoming more competent to safeguard themselves.

I have been ably assisted in fulfilling the duties of the department by Mr. D. J. Griffiths, Deputy State Coal Mine Inspector, and I hereby wish to thank him for his faithful services and for the good judgment he displayed at all times.

COAL MINE ACCIDENTS—CAUSES AND PREVENTION.

The chief duty of the State Coal Mine Inspector in carrying out the purpose of the act creating the office is the concentration of all his efforts to reduce and eliminate as much as possible the causes which contribute towards injuries and fatalities, and to see that the mines are kept in a sanitary condition. This constitutes the main work of the department and is one that requires constant vigilance and convincing powers of persuasion. Many of the operators and miners have to be shown their duties in the premises. The Colorado operators are rapidly realizing that a mine conducted on the safest and most sanitary basis is also the most economical to operate.

In looking over the list of fatalities of the last four years it will be noted that the greatest percentage of any one class of accidents occurred through falls of rock and coal. The number killed in the given period through various causes are as follows:

Cause	1905	1906	1907	1908
Fall of rock and coal	41	44	52	39
Dust and gas explosion	.....	35	25	5
Motors and mine cars	8	3	9	10
Suffocation	1	.....	8	1
Miscellaneous	10	6	5	6
Total	60	88	99	61
Number of employes each year	11,891	12,030	12,900	14,354
Tons of coal produced each year	8,989,631	10,308,421	10,965,640	9,773,007

The accidents grouped under the head of miscellaneous occurred in various ways, as by falling down shafts, by shaft cages, premature and delayed shots, electrocution by trolley wires, etc. The reports of all the accidents which are on record in this office and which were made after a careful and thorough investigation into their causes, show that a large majority of them were due to either the carelessness, ignorance or inability to detect and realize the dangers incident to mining, by the victims themselves, or their co-workers, and largely happened in those districts where miners foreign to the English-speaking countries were employed.

CAUSES AND CONDITIONS CONTRIBUTING TOWARD ACCIDENTS BY FALLS OF ROOF AND COAL.

(1) "Bad roof," or that which is tender and brittle and lacking the adhesive qualities to sustain its own weight over com-

paratively small areas. A roof of any character which is frequently penetrated by well-defined cleats and slips, characterized as treacherous roof.

(2) "Thick coal Beds," the more distant the roof is from the worker, the more difficult it is to examine and detect any sudden changes that may unexpectedly occur in its physical condition. Where long props are used, the timbering is not as rigid and solid as where short ones are used, and hence less efficient in the capacity which they are to serve. The greater the height of the roof, the more destructive is the force of the rock and coal when it falls. Coal falling from a thick face naturally covers more ground and thus lessens the miner's chances to get away safely.

(3) Carelessness on the part of the companymen in allowing loose rock to hang overhead in the traveling and haulage-ways that should be taken down or timbered, and also permitting old timber and cross-bars to reach a complete state of decay before replacing by new ones.

(4) "Blasting off the solid." When the coal is worked by blasting the jarring and cutting effect of the explosives damages the roof sometimes to a considerable extent, and flying coal from shots often displace props already set and thus allows the roof to fall. These dangerous occurrences can in a great measure be removed by undercutting the coal so that the direction of the "throw" of the shots is downward, and the charges of powder used reduced to the lowest possible minimum.

(5) Powder smoke or a gloomy atmosphere from fumes generated through various sources renders the senses of hearing and seeing less acute to the warnings of danger. This trouble can be minimized by good ventilation in keeping the air of a mine as clear as possible.

(6) *Men inexperienced and careless*: This is one of the main causes of most of the accidents. In mining as well as in any other occupations, there are as many grades of workers as there are men employed. However, in general the miners can be classified into three distinct groups, to wit: The experienced and careful; the experienced and reckless; and the inexperienced and incompetent. The accidents which the former class usually meet with occur through the carelessness of their co-workers or others, and also those accidents which are termed "unforeseen," such as falling roof, which previously gave evidence of being absolutely sound and safe, but released by invisible slips and by the bursting out of bodies of coal or rocks, by occluded gases in the form of heavy "blowers," etc.

The competent but careless miner often takes desperate chances against the danger of partially loose coal or roof by neglecting to timber the roof, or "sprag the coal," which he considers a more remunerative method than by first doing the necessary timbering for his safety.

The inexperienced: Owing to the scarcity of skilled labor, the mines of this State employ annually hundreds of men who never saw the inside of a coal mine before taking up the occupation here. The majority of this class are men who come from Mexico and the different countries of Continental Europe and Asia, and are entirely unable to speak or understand the English language. Naturally these men are greatly handicapped when it comes to the question of protecting themselves against the multitude of dangers from roof and coal, or mine cars and "trips" of any kind, as they are not familiar with these phases of danger and therefore are not watchful, and even were they, cannot detect them when apparent. This class could be considerably assisted and the accidents resulting from their ignorance minimized, by the superintendents of the mines establishing and enforcing a rule forbidding two incompetent miners to work together, by arranging so that every green miner employed would be paired off with an experienced man until he had acquired sufficient skill and knowledge to at least protect himself and others in a mine. Of course, the skilled miner will offer some objections to this rule from the fact that the novice could not perform in full his share of the work, rather he would retard the efforts of the skilled worker, but this could be adjusted by allowing a difference in their payments equal to the difference in their efficiency. Should conditions be such that all the green men could not be paired off in the manner stated above, then any place worked exclusively by them should be governed by a strict rule of systematic timbering and spragging, that is, to see that props are put up in their working places a certain number of feet apart and within a specified distance from the faces, regardless of the good or bad condition of the roof.

EXPLOSIONS.

These rank second in assisting to swell the list of fatalities, and can be grouped into three general classes, viz.: *Dust, gas, and dust and gas combined.* The force of an explosion is dependent upon the volume and expansive power of the gases taking part in it. The force and extent of a dust explosion depends chiefly upon the inflammability and fineness of the dust, the dryness of the roadways and workings, the quantity of dust available for the explosion to feed upon and the amount suspended in the air. Below is a table of all explosions in which five or more persons were killed and which have occurred in this State since the State Coal Mine Inspection Department has been created:

Date	Name of Mine	Number Killed	Character of Explosions
Jan. 24, 1884	Crested Butte	59	Gas and dust
Jan. 10, 1893	Como	24	Gas and dust
Feb. 18, 1896	Vulcan	49	Gas and dust
Sept. 3, 1897	Sunshine	12	Dust
Sept. 16, 1901	Spring Gulch	6	Dust
Aug. 7, 1902	Bowen	13	Dust
Oct. 25, 1904	Tercio	19	Dust
Feb. 19, 1906	Maitland	14	Gas
Apr. 22, 1906	Cuatro	19	Gas and dust
Jan. 23, 1907	Primero	24	Gas and dust
	Total killed	239	

The four explosions resulting from dust alone occurred in mines considered and regarded perfectly free from explosive gas. Two had their origin from blown-out shots, one from blasting in the apparent absence of a "blown-out" shot, and one from the accidental exploding of a quantity of loose giant powder.

DUST.

The usual and most common mode of origin of dust explosions is from local gas combustions and from blasting of any kind, especially where they result in "blown-out" shots. However, at a certain stage of conditions, a dust explosion can be started through any form of compression of sufficient intensity when combined with the required temperature for ignition. The exploding of a loose quantity of powder, a runaway trip of cars, or fall of roof covering a large area, occurring suddenly, might agitate and compress the dust and air and bring about explosive conditions. Therefore, a mine which is very dusty, and whose dust is of high inflammable nature, is never safe from explosions. To lessen the chances of explosions in such cases to the lowest minimum, it is necessary that all the following rules be put into effect and strictly and continuously obeyed:

(1) All places to be kept free from unnecessary dust accumulations.

(2) All entries, rooms and travelingways to be sprinkled with sufficient water to lay all dust on the floors, sides, timber and roof, and this method further assisted by water sprays of such degree of fineness to permeate the air of the mine to the highest point of saturation and thus purge the air as much as possible of suspended dust.

(3) All shots to be charged and fired by shot-lighters, who are qualified by a thorough practical knowledge in the handling of powder, and able to gauge the charges necessary to remove the load assigned each shot.

(4) Blasting to be prohibited until all employes other than the shot-lighter have left the mine.

(5) All coal to be blasted should be undercut at least eight inches deeper than the hole for the powder.

(6) All holes should be tamped or stemmed with an absolutely non-combustible material.

(7) The size and strength of shots should be regulated so as not to require an amount of powder to exceed a specified maximum charge.

(8) No shots to be fired where there is the least visible quantity of explosive gas present.

(9) The quantity of powder taken into a mine at any one time should be restricted to the lowest possible minimum, and not exceeding the amount needed during the shift.

There are several mines in this State situated so far away from the source of water supplies that sprinkling as profusely and thoroughly as is suggested in rule 2 would incur an expense so nearly equalling the margin of profit that they would be forced to cease operating. At some of these mines even the water for the steam plant is hauled in railroad tanks a distance of six miles, and the water used for sprinkling is then pumped into mine water cars and hoisted up gravity planes into the mines. Nevertheless, in spite of these obstacles, a reasonable degree of safety can be maintained by the strict enforcement of all the other rules and the judicious sprinkling to the maximum extent as such a limited water supply will permit. Where different districts in a mine are connected, the dust and air should be kept thoroughly saturated for a distance of at least 600 feet to prevent the transmission of an explosion.

A system of electric firing of shots would be an additional device of safety to this code of preventatives. With intermittent firing there is more or less commotion existent in the mine's atmosphere throughout the entire process. The finer dust is sometimes raised in thick clouds by the concussion of shots and thus brings about conditions which are imminently dangerous in the event of a "windy" or "blown-out" shot. Considerable carbonic oxide gas, which is highly explosive, is formed by the combustion of powder, and a second or third shot fired in the same room, or entry, could ignite the gas generated by the preceding shot and thus initiate a general dust explosion. With electric firing both the dangers just described would be almost wholly eliminated. A lapse of sufficient time could be given between the ceasing of operations at the end of the "shift" and the firing time, so that practically all dust particles in the air would be brought to a state of complete rest. Then when the shots are fired simultaneously, the flames (if any) created by the blasts waste their energies upon nearly pure air and the temperature falls below the point of ignition before the dust is resuspended. However, the greatest benefit derived from this method of firing is that the

shot-firers as well as the other employes are out of the mine when the blasting takes place.

GAS.

There are numerous ways through which gas explosions can be started. A body of gas can be ignited by an electric spark, or a spark produced by friction of material, naked lights, a defective safety lamp, a flame from a shot or from any burning material. A gas explosion in the total absence of dust naturally is limited to its own particular district, unless the accumulation acted upon is of such volume that the expansion of the burning gases transmit the flame to another body of gas collected in an adjoining district. But when one occurs, where dust is in abundance and being of the delicately inflammable kind the two previously independent factors of energy (gas and dust) join forces, and what was originally a gas explosion is transformed into one of gas and dust combined. If the volume of gas involved is small, and the territory of dust extensive, the energy of the gas is naturally expended before that of the dust, and before all the combustible elements are extinct, dust alone is the feeder of the holocaust. It can readily be seen that the danger due to dust is much greater in gaseous than in non-gaseous mines.

A mine in which firedamp is generated freely, and where naked lights are used, is constantly exposed to the possibility of a local gas explosion. When the ventilating system is intact from intake to outlet with an ample volume of air circulating to cope with the extreme requirements, the gases are diluted and carried away as rapidly as they transpire. However, the tapping of fresh feeders by blasting, etc., an accident to the fan which would retard its speed and thus curtail the quantity of the air entering the mine, a door left open and the air current allowed to return before reaching the faces, a brattice or stopping torn by the concussion of shots, by falls of roof or coal, causing short circuiting of the air, or a fall occurring in an air course and impeding the current; in fact, any condition which might occur and make possible gas accumulations of considerable proportions, would be a source of great danger where naked lights are used. With the use of safety lamps the sudden danger arising through these unexpected causes would be in a great measure obviated. It would give the men an opportunity to discover the gas and retreat to a place of safety until the origin of the trouble could be ascertained and normal conditions restored. Therefore, all mines giving off firedamp to such an extent that they become dangerous in the event of any of the above enumerated emergencies, should be worked *exclusively* with safety lamps.

The chief factor as a preventative against gas explosions is the supply of an ample volume of air distributed in such a manner that the gases will be carried away as fast as they are

generated and keeping the mixture at an absolutely safe margin below the danger line.

CARS.

The accidents under this head are generally due to the runaway cars or trips, the breaking of ropes and couplings, accidental disconnecting of couplings while the trips are in motion. Ropes not properly attached on incline planes, or neglect to coupling trips before pushing them over the knuckle of the slopes. These mishaps can be largely attributed to a lack of discipline on the part of the mine officials and carelessness of the coupler. Also drivers riding on tail chains in front of trips over varying degrees of grades lose their balance and sometimes fall under or become tangled in the chain and are crushed between mules and cars.

The remedy to lessen the chances against these accidents would be in paralleling the mechanical haulageways with travelingways in order that the men could go in and out and not come in contact with any possible runaway. Furthermore, drivers should be furnished with "shafts" instead of chains to pull the loads with, and if they insist on using a chain, then they should be compelled to ride behind the cars, and not in front. Keeping the sides of haulage-ways clean is an important protection for the drivers.

SUFFOCATION.

Accidents from suffocation are caused by fumes from mine fires and powder smoke. In the former instance, it usually happens when men are fighting mine fires and do not take the proper precaution of carrying fresh air along with them, and by first sealing off all possible sources from which deadly gases could issue as they advance. Great care should be taken that fumes never mingle with the air between the point where the men are working and the intake. The non-observance of this precaution can be accounted for by the desire to make a quick advance and not waiting to thoroughly seal and complete the work behind. Suffocation from powder smoke often results where men return too soon after shots have been fired and not allowing the smoke sufficient time to clear away and consequently are overcome by the deadly gases. Also in places where unusually heavy shooting is done and a large number of shots are fired the resultant smoke in passing out is liable to catch a victim who has remained too long in his place after firing commenced and is therefore overtaken by the gases generated and which are moving to the outlet. This danger could be avoided by having all shots fired by shot-lighters, and firing commenced at the place nearest the outlet, and to proceed in successive order against the air current.

ELECTROCUTION.

Men riding on trips sometimes accidentally come in contact with the trolley wires, resulting in death. Keeping traveling-ways for the men and forbidding them riding on the trips, would diminish the possibility of contact with live wires.

MISCELLANEOUS.

Accidents of this class are brought about in various ways, such as men firing a shot in a cross-cut and not notifying the men working on the other side of the pillar where the cross-cut is to go through, and the effects of the shot blown through the pillar injuring or killing any one struck by the flying coal. A notification of the firing given to the men adjacent, so as to give them an opportunity to retreat to a safe distance from any of the flying coal, would of course obviate this danger. Returning too soon to shots hanging fire, under the assumption that they had missed, is often disastrous. Occasionally a man falls down a shaft thinking the cage is standing on the landing when it is at the bottom. This indicates heedlessness and will happen so long as men are not on the alert in moving about a mine. Precaution observed by the men and a strict enforcement of the rule to keep safety gates always closed excepting when the cage is on the landing is a sure safeguard.

Much more might be said on the causes of accidents and their prevention. However, in the aggregate what we need more than safety devices is the enforcement of all known precautionary measures and a general education of the men to protect themselves.

VENTILATION.

From the incipiency of a coal mine to its highest stage of development, and from the country bank to the largest producer, there is no factor which promotes the safety, health and welfare of the employes more, or gives greater aid to its successful and economical operation, than that of good ventilation. No money invested in the opening and equipment of a property yields greater returns than that expended in the establishment and maintenance of a first-class system of ventilation throughout the entire life of the mine.

All coal beds are more or less charged with occluded gases of various kinds, which are injurious to health if breathed in certain quantities and for any length of time. As soon as the air enters a mine, it begins to take up these gases as they issue forth from the pores in the coal, and the percentage of impregnation of the air naturally increases all along its course until the outlet is reached. The air is further contaminated by noxious gases generated by the breathing of men and mules, by the burning of lights, by the combustion of powder and the decomposition of matter through various sources. It is then very obvious how

necessary it is to keep a copious supply of fresh air continuously traveling through a mine.

The table below shows the effects of mine gases of different proportions upon men and lights.

Percentage of Carbon Dioxide Present	Effects on Man	Effects on Lights
3.5	Breathing deeper	Still burns
6.0	Marked panting	Still burns
10.0	Severe distress	Still burns
15.0	Partial loss of consciousness	Extinguished
25.0	Final death	Extinguished

Percentage of Oxygen Present	Percentage of Nitrogen Present	Effects on Man	Effects on Lights
17.3	82.7	Nil	Extinguished
12.0	88.0	Breathing slightly deeper	Extinguished
9.0	91.0	Breathing deeper, more frequent, face bluish	Extinguished
5.0	95.0	Loss of consciousness and final death	Extinguished
0.0	100.0	Death with convulsions	Extinguished

Percentage of Black Damp (Containing 87 per cent. of Nitrogen and 13 per cent. Carbon Dioxide)	Effects on Man	Effects on Lights
16	Nil	Extinguished
28	Breathing slightly deeper	Extinguished
50	Severe panting	Extinguished
66	Life endangered	Extinguished

Percentage of Firedamp Present	Effects on Man	Effects on Lights
1.0	Nil	First indication of a cap
2.0	Nil	Well-formed cap
5.5	Nil	Lamp fires and goes out
45.0	Breathing slightly deeper	Lamp fires and goes out
70.0	Life endangered	

Percentage Carbon Monoxide Present	Effects on Man	Effects on Lights
0.05	After ½ hour or more, slight giddiness on exertion	.....
0.10	After ½ hour or more, inability to walk	.....
0.20	After ½ hour or more, loss of consciousness, and perhaps final death	.....
1.00	After a few minutes, loss of consciousness and final death	..... Cap

Percentage of Afterdamp (Containing 3 per cent. of Carbon Monoxide) Present	Effects on Man	Effects on Lights
2.0	After ½ hour or more, slight giddiness on exertion	..... Nil
3.5	Inability to walk	..... Nil
7.0	Loss of consciousness	..... Nil
10.0	Death	.....Burns rather dimly
16.0	Death	..... Extinguished

INCREASED COST OF PRODUCTION AND EARNINGS OF EMPLOYES RESTRICTED.

When a mine is amply ventilated the gases are diluted and removed before the danger line or a marked degree of injuriousness is reached. But if the volume of air is inadequate and the current too weak to carry away these gases as fast as given off, the air soon becomes sluggish and unfit to breathe. The men become depressed, fatigued and indifferent, losing the desire and ambition to accomplish a good day's work, or of earning a full day's pay. The result is the working capacities of the miners, companymen and mules are considerably lessened. Disintegration of the roof and sides and the decomposing of timber and ties are noticeably hastened in the presence of highly contaminated air, and particularly so when carbon dioxide (blackdamp) exists in large quantities. The falls of roof and sides occur oftener and the decaying of timber is quicker in the return air-ways than in the intakes, which fact is a good illustration to show how destructive the gases are to property, and this is also quite pronounced where the ventilation is weak. Naturally the working parts of a mine, entries and all haulage-ways suffer in like manner as the return air-ways.

From many years of practical experience in the various branches of underground work and under different conditions of sanitation, I feel safe in stating that the strength, speed and dur-

ability of men working under extremely unfavorable conditions of ventilation are impaired to an extent that their normal working capacities are reduced on an average of at least twenty per cent. For example, assuming a mine, operating under extremely adverse circumstances and having a daily output of one thousand tons and requiring an average of fifty companymen, including drivers, timbermen, tracklayers and laborers at $3.00 per day to haul coal and keep the mine in working order. Then if the output is kept up when twenty per cent. of the efficiency of the employes is lost, due to poor ventlation, it can readily be seen that by transforming such a mine into one with first-class ventilation, the change would be accompanied by a reduction in the expense of operating equal to the advantages gained by the improvement.

Par. 1: By raising the normal capacity of the men from eighty to one hundred per cent. by virtue of an improvement in the air, then evidently the total amount of work done by the fifty companymen in handling one thousand tons per day could be performed with equal ease and greater comfort by forty men. The reduction alone of ten men at $3.00 each would be a clear gain of $30.00 per day to the operator.

Par. 2: This same rule applies also to the miners. With an increase of working power at a ratio of eight to ten, the earning capacity of the miners would be correspondingly raised and the working area of the mine would be proportionately reduced, and still the same daily output could be maintained. Therefore, with the limitation of the working territory and increased efficiency, the amount of trackage and timbering to keep up would be cut down, the rooms would be driven and the pillars extracted in shorter time and before the roof reached an advanced stage of deterioration as well as the decay of timber. The air courses would be shortened and consequently fewer stoppings to construct, and the friction against the air and leakages lessened, further diminishing the number of companymen needed for the maintenance of the workings. This, together with the increased preservation of materials resulting from the concentration of area, would be followed by a marked reduction in the cost of operating.

Par. 3: Moreover, the lives of mules would be prolonged and the number required to do the work lessened, and as stated before, the crumbling and falling of roof and sides would be checked and the life of the timber lengthened throughout the mine. These are important features of economy, as the amount of repairing would be curtailed and the number of companymen could be further lowered, besides the danger of accidents due to the unavoidable deteriorating condition of roof and the decay of timber would be largely eliminated.

Par. 4: In a misty mine atmosphere the men cannot see or hear warnings of danger as quickly, and they are not as lively to get out of the way when it approaches, therefore accidents are more frequent under such conditions than when the air is clear and good. Then inasmuch as poor ventilation is a factor

productive of accidents in this manner, it inevitably adds to the cost of production regardless whether the accidents are unavoidable or are caused through the negligence of the officials and thereby subject to indemnity. When a man is injured the output suffers a setback, besides the company is deprived for a time of one man's services until he recovers. If an employe is killed the mine is usually idle two or three days, which fact incurs a loss to the mine of the fixed charges or regular running expenses paid in wages for engineers, pumpmen, timbermen, clerical force and the cost of operating steam plants, feed for stock, etc., all of which have to be kept up just the same as when the mine is running.

Inadequate ventilation and defective conduction of the air currents are the causes which bring about gas explosions. Of course it is possible, as described in the foregoing statement on "Mine Accidents," for a part, or parts of even a well ventilated mine, to be invaded by dangerous accumulations of explosive gas through unforeseen occurrences which would impede or cut off the air current and an explosion ensue. The additional expense thrown upon the mine owners through explosions is sometimes enormous and often exceeds the cost of equipment and maintaining a first-class system of ventilation through the whole life of a property. The extent of the extra cost thus incurred and not considering the indemnities companies are liable to in case of neglect, is dependent upon the degree of damage to the mine, the time the daily tonnage is cut off, the extra force of companymen and the amount of material needed to reopen and restore it into normal condition. It is very often under such circumstances that many of the best men leave camp and months and sometimes years elapse before the mine is restored to its former standard.

Poor ventilation breeds contempt and a general dissatisfaction amongst the men. It creates hard feelings between the employes and the officials and invites agitation and strikes.

Summing up the various items and discarding the heavy expenses under paragraph 4, we find the following difference in the cost of operating, when a mine is changed from the poorest condition of sanitation to the best:

(1)	Due to the first reduction in number of company men.....	$30.00
(2)	Due to saving material and reduction of company men through concentration of work.....	4.00
(3)	Due to limitation of work in attending roof and timber and using fewer mules.....	6.00
	Total saving per day.....	$40.00

A property containing 640 acres with a five-foot bed of coal, if properly mined, would yield 4,680,000 tons. To mine this at the rate of 1,000 tons per day would require 4,680 days, or about fifteen years working full time, excepting Sundays and holidays. Therefore, a careless mode of operating, as illustrated in the

foregoing statement, would incur an extra expenditure upon the company of $12,480.00 per year, or a total loss of $187,200.00 during the life of the mine.

The above figures show the difference in results between the two extreme limits, but I want it further understood that a mine conducted upon any of the various grades of sanitation below the first class is economically affected in its percentage under par. For instance, mines having a sanitary condition 50 and 75 per cent. below the perfect mark would suffer to the extent of $20.00 to $30.00 per day, respectively, etc. Therefore, admitting that the above figures and statements are correct and which any practical mining man must concede, it is conclusive that a mine official who permits such unhealthy conditions to prevail on the plea of economy, is grossly ignorant and robs his master of legitimate profits at the expense of the health and life of the employes under him as well as neglecting the preservation of the property.

THE ACQUIREMENT AND DISTRIBUTION OF AIR.

A plant provided with a good fan discharging a large volume of air into the intake is not always a criterion that a mine is well ventilated. If the air is allowed to leak through stoppings and doors, and thus returns to the outlet before reaching the working faces, the good results expected are not realized, and the wear and tear on the fan and its machinery, and the expenditure of supplying the power to run it, are to a great extent wasted. The main factors to be considered in the proper airing of a mine are:

(1) First the fan should have a capacity to supply an amount of air at least 25 per cent. more than the maximum quantity required under normal conditions. It is easier on the fan and engine when they are not taxed to their utmost limits, besides a higher efficiency is obtained per unit of power used in operating the fan when running at moderate speed. Furthermore, any emergency arising from sudden and unexpected outbursts of gas by strong feeders, and requiring more air, could be easily overcome in this manner.

(2) Air shafts and air courses should be of large areas and as uniform and straight as possible to avoid unnecessary friction.

(3) After having an ample quantity of air entering the mine, the next important feature is its judicious distribution and conduction through the workings. The air volume should be divided through splitting, by means of overcasts so that each district, if deemed necessary, could receive a fresh current of air independently of the others, but great care should be exercised that the splitting is not carried so far as to reduce the velocity too low to remove the impurities in the air at a rapid rate.

(4) Sometimes a main air course is found whose sectional area is smaller from the fan to the first or second split than

from there on in. This is a grave mistake; that is, if the area in the given distance is too small to accommodate the various splits. A ventilating system as to area should be based on very much the same principle as that of a city water works. The fan can be considered as the reservoir and the air-way from there on should be large enough as a main to supply all the different districts drawing from it and this without any difficulty, and the return air-way should be amply capacious to allow the easy passage of the expanded volume from the point of reunition of the splits to the outlet. Falls of roof or sides in an air-way obstructs the air current as the "velocity of the air varies directly as the square root of the area." It happens occasionally in air-ways where the rails have been removed, destroying the conveyance, that the debris from such falls occurring from time to time, are stowed along the sides until the heaps become so large that they retard the flow of air. The longer such obstructions are allowed to stand before being taken away the more expensive it becomes to the operator each day until it is removed. Car tracks should never be taken out of the main air courses, as they facilitate the removal of falls and the conveying of the needed timbers for repairs.

(5) Stoppings in cross cuts between air courses and entries should be constructed of incombustible material, such as concrete or stone or mortar or cement, either of which can be made nearer air tight than wooden stoppings and are, moreover, fireproof.

(6) Sprinkling for the purpose of laying and cleansing the air of its floating dust cools and purifies the mine atmosphere.

(7) Blasting exclusively, after quitting time, greatly improves the ventilation, as the mine during working hours is thus kept free from the noxious gases given off by the combustion of the powder used.

(8) Fire bosses, mine foremen and mine superintendents should be required to stand examinations covering the technical as well as the practical knowledge of all branches connected with mining, particularly on gases and ventilation.

While the tenor of this treatise is principally along lines showing its economical advantages to companies, the chief object in view is the health and safety of the underground workers. The coal miner's calling at the best is hazardous, and he should be protected by all the precautionary measures that human skill can provide.

RECOMMENDATIONS.

(1) The work assigned the Coal Mining Inspection Department has reached such proportions that it will take at least four deputy inspectors, or one additional to the number now provided by law, to comply with the requirements of the statute.

(2) The number of men working in each current of air should be restricted to sixty-five.

(3) Cross cuts between entries and rooms should be made at distances not exceeding seventy feet.

(4) Cross-cut stoppings should be made of incombustible material.

(5) Rooms should not be turned inside of the last cross cuts.

(6) Fans should be kept running continuously day and night when the mine gives off explosive gas.

(7) All air bridges should be constructed with incombustible material.

(8) Pure oils should be used exclusively for illuminating purposes in a mine.

(9) The amount of powder taken into a mine at any one time should be restricted to ten pounds or less.

(10) No shots should be fired in the presence of a discernible quantity of gas.

(11) All shots should be fired by either electricity or by regular "shot lighters," and when all other employes are out of the mine.

(12) All shots should be tamped with non-combustible material.

(13) Ventilating fans should be placed at least 250 feet from the nearest building containing inflammable material.

(14) Second opening should be made immediately after development work is started in the main shaft.

(15) All mines should provide separate man-ways other than the haulage-ways where mechanical power is used to haul the cars.

(16) The carrying of tools or material of any kind on cages with the men should be forbidden.

(17) All shaft and slope openings should be provided with speaking tubes or telephone connections between top and bottom.

(18) A fine should be placed upon all officials receiving money from employes for select places, in a mine, etc.

(19) The fiscal year of the department should end November 30th.

(20) The owner, agent or manager of a mine should give notice to the Inspector of Mines in any or all of the following cases within thirty days time:

(a) Where a change occurs in the name of a mine, or in the name of the owner, agent, manager or superintendent of a mine.

(b) Where any work is commenced for the purpose of opening a mine to which this act applies.

(c) Where a mine is abandoned, or the working thereof is discontinued.

(d) Where the working of a mine is resumed after any abandonment or discontinuance for a period exceeding thirty days.

SUMMARY OF THE COAL PRODUCTION OF COLORADO FOR 1907 AND 1908.

	1907	1908
Number of mines in operation	180	190
Number of new mines opened	18	8
Tons of lignite coal produced	2,062,154	1,991,234
Tons of semi-bituminous coal produced	985,226	818,216
Tons of bituminous coal produced	7,803,147	6,824,117
Tons of anthracite coal produced	45,113	69,440
Tons of unclassified coal produced, estimated	70,000	70,000
Total tonnage produced	10,965,640	9,773,007
Tons of coal mined by hand	9,547,568	8,221,628
Tons of coal mined by machine	1,418,072	1,551,379
Total number of mining machines used	148	195
Total tons of coke produced	1,097,051	854,662
Total number of coke ovens	3,478	2,811
Number of employes in and about the mines	12,900	14,354
Number of employes at the coke ovens	960	1,104
Number of non-fatal accidents	110	115
Number of fatal accidents	99	61
Tons of coal mined for each life lost	110,764	160,213.2
Tons of coal mined for each non-fatal accident	99,687.6	84,982.6
Number of employes for each life lost	130.3	235.3
Number of employes for each non-fatal accident	117.2	124.8

TABLE

SHOWING THE NUMBER OF MEN WORKING IN AND ABOUT THE MINES OF EACH COUNTY DURING THE YEAR 1908.

Counties.	Number of Men.	
Las Animas	6,725	
Huerfano	2,180	
Fremont	1,408	
Boulder	1,311	
Gunnison	493	
Weld	486	
El Paso	386	
Pitkin	345	
La Plata	311	
Jefferson	228	
Garfield	210	
Mesa	119	
Routt	100	
Delta	45	
Montezuma	4	
Douglas	3	
Total number of men		14,354

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Simpson	Mitchell	Acme	Rex No. 1
Thickness of bed	11 ft.	6 ft.	7 ft.	6 and 7 ft.
Kind of opening	Shaft	Shaft	Shaft	Shaft
Character of coal	Lignite	Lignite	Lignite	Lignite
January	30,688	6,155	19,839	20,652
February	25,028	6,098	13,399	14,468
March	10,768	2,773	6,392	6,522
April	8,672	2,434	8,326	8,010
May	11,672	2,784	8,676	6,565
June	7,265	2,493	4,900	4,604
July	11,513	2,927	5,475	4,113
August	16,800	5,171	2,209	7,481
September	18,028	4,851	10,510	13,958
October	24,218	5,650	21,190	19,047
November	25,762	6,836	28,850	18,269
December	24,574	7,518	19,240	16,900
Totals	214,988	55,690	149,006	140,589

BOULDER COUNTY, 1907.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Rex No. 2	Hecla	Gorham	Industrial	Vulcan	Monarch
6 ft.	5 and 6 ft.	6 ft.	6 ft.	6 ft.	6 ft.
Shaft	Shaft	Slope	Shaft	Shaft	Shaft
Lignite	Lignite	Lignite	Lignite	Lignite	Lignite
7,909	10,522	8,555	12,088	.....	12,467
5,972	7,456	6,434	8,072	.....	12,565
3,793	4,018	3,617	4,478	.....	10,018
2,457	4,063	4,607	4,012	.....	8,610
2,223	3,350	4,281	5,141	.....	9,173
1,717	2,485	3,161	2,673	.....	7,511
2,114	2,245	3,023	3,653	724	5,090
2,486	3,783	1,997	3,567	3,639	6,385
3,034	8,201	4,817	8,348	3,816	10,003
4,360	8,465	9,270	12,225	5,728	11,891
5,145	10,787	8,324	10,999	8,255	15,048
3,731	9,316	7,216	9,997	8,805	13,719
41,941	74,691	65,302	85,253	30,967	122,480

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Standard	Strathmore	Fox	Matchless
Thickness of bed	7½ to 8 ft.	9 to 11 ft.	8½ ft.	4½ to 5 ft.
Kind of opening	Shaft	Shaft	Shaft	Shaft
Character of coal	Lignite	Lignite	Lignite	Lignite
January	16,371	5,769	6,776	4,417
February	16,559	5,682	5,265	2,876
March	11,650	3,863	1,921	2,565
April	11,591	3,292	1,757	2,254
May	12,558	2,265	1,725	2,565
June	8,344	2,286	1,293	1,550
July	13,509	2,222	1,046	2,071
August	18,335	2,204	1,780	1,589
September	12,617	3,286	4,206	2,782
October	17,954	3,997	7,947	3,892
November	20,637	3,272	5,854	4,506
December	19,875	3,973	6,005	3,837
Totals	180,000	42,111	45,575	34,904

BOULDER COUNTY, 1907—Continued.

OF EACH MINE IN TONS OF 2000 POUNDS.

Sunnyside	Centennial	Nonpareil	Irvington	Independent	Electric
4½ to 5 ft.	6 ft.	9 to 10 ft.	5 to 6 ft.	5½ ft.	4 ft. 10 in.
Shaft	Shaft	Shaft	Shaft	Shaft	Shaft
Lignite	Lignite	Lignite	Lignite	Lignite	Lignite
682	3,900	383	3,200	520	.....
630	1,440	761	651	740	.....
938	1,500	1,011	730	570	.....
1,124	2,000	1,059	650	530	.....
1,362	614	867	651	360	160
1,500	400	201	337	620	Idle
1,250	710	943	76	980	42
2,700	2,200	1,219	624	362	520
2,500	1,640	2,028	647	624	676
3,100	3,334	4,353	950	524	1,340
3,450	4,825	4,884	1,000	374	1,680
5,000	4,819	4,247	1,000	220	2,200
24,236	27,382	21,956	10,516	6,424	6,618

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Rosser	New Baker
Thickness of bed	7 ft.	8 ft.
Kind of opening	Slope	Slope
Character of coal	Lignite	Lignite
January	435	129
February	335	144
March	328	131
April	256	119
May	229	228
June	456	80
July	322	115
August	438	129
September	402	215
October	620	356
November	690	297
December	700	290
Totals	5,211	2,233

BOULDER COUNTY, 1907—Concluded.

OF EACH MINE IN TONS OF 2000 POUNDS.

Willoughby	Black Diamond	Shanahan	
5 to 8 ft.	11 ft.	11 ft.	
Shaft	Slope	Slope	Total
Lignite	Lignite	Lignite	Tonnage
223	900	500	173,030
174	800	400	135,949
35	700	200	78,521
42	700	200	76,765
162	650	150	78,411
154	650	300	54,980
103	Closed	Closed	64,266
333	down	down	85,951
211			117,400
25			170,436
410			190,154
423			173,605
2,295	4,400	1,750	1,399,518

PRODUCTION OF DELTA COUNTY, 1907.

SHOWING YEARLY PRODUCTION OF MINE IN TONS OF 2000 POUNDS.

Name of mine	Juanita	
Thickness of bed	9 to 14 ft.	
Kind of opening	Drift	Total
Character of coal	Bituminous	Tonnage
December	15,414	15,414
Totals	15,414	15,414

PRODUCTION OF DOUGLAS COUNTY, 1907.

SHOWING YEARLY PRODUCTION OF MINE IN TONS OF 2000 POUNDS.

Name of mine	Platte Canon	
Thickness of bed	6 ft.	
Kind of opening	Shaft	Total
Character of coal	Lignite	Tonnage
December	632	632
Totals	632	632

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCT

Name of mine	Curtis	Rapson No. 2	Danville	Pikeview
Thickness of bed	17 ft.	7 ft.	10 ft.	12 ft.
Kind of opening	Shaft	Shaft	Slope	Shaft
Character of coal	Lignite	Lignite	Lignite	Lignite
January	6,979	4,795	6,500	6,960
February	5,714	4,888	5,243	5,125
March	4,634	3,694	3,400	3,700
April	5,082	4,078	3,400	3,912
May	5,889	4,955	3,285	3,075
June	5,468	4,922	4,000	2,400
July	5,467	5,185	3,300	1,600
August	4,162	3,011	3,500	3,034
September	5,710	5,074	4,500	4,000
October	5,769	4,942	4,650	3,600
November	6,445	4,455	5,050	3,200
December	6,600	7,365	4,555	5,625
Totals	67,919	57,364	51,383	46,231

EL PASO COUNTY, 1907.

ION OF EACH MINE IN TONS OF 2,000 POUNDS.

Williamsville	Austin Bluffs	Patterson	Tudor	Franceville	
6 to 7 ft.	7 ft.	16 ft.	5 ft. 8 in.	6 ft.	
Slope	Shaft	Slope	Slope	Slope	Total
Lignite	Lignite	Liginte	Lignite	Lignite	Tonnage
2,009	2,107	1,595	830	....	31,775
1,262	1,502	1,640	664	....	26,038
1,482	885	1,175	Closed down	....	18,970
1,711	532	985	....	....	19,700
689	633	1,300	....	....	19,826
321	373	1,097	....	....	18,581
490	679	Repairs	....	....	16,721
506	354	943	....	....	15,510
808	557	1,574	....	....	22,223
910	....	2,079	....	....	21,950
1,615	....	1,681	....	....	22,446
1,178	1,859	2,100	....	1,585	30,867
12,981	9,481	16,169	1,494	1,585	264,607

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTI

Name of mine	Rockvale	Coal Creek	Fremont	Brookside
Thickness of bed	4 ft.	4 ft.	4 ft. 5 in.	5 ft.
Kind of opening	Shaft	Slope	Shaft	Slope
Character of coal	Semi-bit	Semi-bit	Semi-bit	Semi-bit
January	20,621	10,287	5,974	7,738
February	14,868	9,620	7,120	6,549
March	13,438	8,631	6,709	6,647
April	12,898	6,481	7,619	5,597
May	9,186	9,351	7,991	4,181
June	16,140	9,789	7,350	6,149
July	15,611	8,614	7,099	5,819
August	16,480	10,016	6,936	6,366
September	13,807	7,298	6,423	4,141
October	16,480	8,365	6,440	5,391
November	17,377	8,208	6,744	6,023
December	17,879	8,682	7,163	4,580
Totals	184,705	105,342	83,568	69,181

FREMONT COUNTY, 1907.

ON OF EACH MINE IN TONS OF 2,000 POUNDS.

Nonac	Chandler	Radiant	Magnet	Beacon	Royal Gorge
5 to 6½ ft.	4 to 5 ft.	3½ ft.	4½ ft.	3 to 4½ ft.	3⅛ to 9 ft.
Slope	Shaft	Slope	Slope	Shaft	Slope
Semi-bit.	Semi bit.	Semi bit.	Semi-bit.	Semi-bit.	Semi-bit.
5,389	9,844	2,339	5,225	3,820	5,103
5,287	8,622	3,032	3,615	3,446	4,225
5,260	9,641	3,388	4,185	1,909	3,967
4,670	11,152	3,258	3,646	493	2,107
5,294	11,633	2,892	2,780	1,531	2,194
3,296	10,329	2,415	2,997	2,183	2,468
2,507	8,208	2,246	3,381	2,735	2,446
2,987	9,932	2,543	2,893	3,120	3,765
3,037	9,647	2,344	2,524	2,316	4,298
3,400	10,231	2,640	3,944	2,627	4,869
4,106	9,315	3,565	3,564	2,695	5,398
4,705	10,903	4,139	4,519	2,688	2,499
45,938	119,457	34,801	43,273	29,563	43,339

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTI

Name of mine	Florence	Cowan
Thickness of bed	3½ ft.	5 ft.
Kind of opening	Drift	Drift
Character of coal	Semi-bit.	Semi-bit.
January	600	535
February	600	510
March	500	216
April	260	154
May	339	349
June	237	311
July	355	339
August	590	236
September	692	223
October	1,059	389
November	703	342
December	900	325
Totals	6,835	3,929

FREMONT COUNTY, 1907—Concluded.

ON OF EACH MINE IN TONS OF 2,000 POUNDS.

Williamsburg 4 ft. Slope Semi-bit.	Horseshoe 4½ ft. Slope Semi-bit.	Walsh 2½ ft. Slope Semi-bit.	Total Tonnage
540	985	...	79,000
360	294	...	68,148
Idle	274	...	64,765
Idle	432	100	58,867
Idle	202	120	58,043
Idle	167	200	64,031
325	153	200	60,038
240	121	225	66,450
200	285	216	57,451
359	238	275	66,607
373	181	135	68,749
400	17	100	69,479
2,797	3,349	1,491	781,628

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTI

Name of mine	Midland	Pocahontas
Thickness of bed	6 to 7 ft.	8 to 16 ft.
Kind of opening	Drift	Drift
Character of coal	Bituminous	Bituminous
January	4,989	3,505
February	5,814	2,310
March	7,008	2,472
April	7,147	1,149
May	6,262	Closed
June	8,319	down
July	7,733	
August	8,956	
September	7,172	
October	8,419	
November	7,758	
December	7,628	
Totals	87,205	9,436

GARFIELD COUNTY, 1907.

ON OF EACH MINE IN TONS OF 2,000 POUNDS.

Keystone 2 ft. Slope Bituminous	Coryell 13 ft. Drift Bituminous	South Canon 4½ and 17 ft. Drift Bituminous	Diamond 12 and 16 ft. Drift Bituminous	Total Tonnage
650	5,680	6,246	1,496	22,566
590	3,760	5,237	1,628	19,339
525	4,101	4,436	469	19,011
500	4,507	2,329	236	15,868
276	3,582	3,646	25	13,791
399	5,873	4,152	.....	18,743
442	4,515	4,237	23	16,950
291	4,684	1,481	364	15,776
368	3,618	2,971	1,070	15,199
332	3,821	4,756	1,602	18,930
412	3,561	4,570	1,917	18,218
391	5,506	4,566	1,900	19,991
5,176	53,208	48,627	10,730	214,382

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Crested Butte	Floresta	Somerset
Thickness of bed	5 to 13½ ft.	3 to 3½ ft.	22 ft.
Kind of opening	Slope	Drift	Slope
Character of coal	Bituminous	Anthracite	Bituminous
January	16,131	.....	21,009
February	15,063	.....	19,499
March	17,519	.....	22,085
April	18,254	.....	17,793
May	18,768	.....	18,837
June	16,233	.....	19,698
July	13,662	6,091	19,625
August	13,879	7,235	20,279
September	13,219	6,376	18,043
October	.....	4,458	19,645
November	.. .	5,513	20,427
December	.....	5,470	19,256
Totals	142,728	35,143	236,196

GUNNISON COUNTY, 1907.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Alpine	Kubler	Porter	Silver Brook	Bulkley	
5 to 7 ft.		15 ft.	3 ft.	5 ft. 4 in.	
Shaft	Drift	Slope	Drift	Slope	Total
Semi-Bitum.	Semi-Bitum.	Bituminous	Anthracite	Bituminous	Tonnage
7,813	.....	2,396	720	1,931	50,000
626	.....	2,275	581	1,562	39,606
48	.....	3,031	982	2,795	46,460
92	.....	2,410	545	3,190	42,284
884	.....	3,675	682	3,255	46,101
8,769	.....	3,740	800	2,669	51,909
9,075	.....	3,392	961	3,700	56,506
6,612	.....	4,540	1,176	539	54,260
8,161	.....	3,744	670	2,701	52,914
9,293	.....	3,561	945	4,986	42,888
8,017	.....	4,577	1,058	4,116	43,708
9,110	8,983	4,560	850	3,976	52,205
68,500	8,983	41,901	9,970	35,420	578,841

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Pictou	Robinson	Walsen	Rouse
Thickness of bed	12 ft.	7 ft.	6½ ft.	6 ft. 4 in.
Kind of opening	Slope	Slope	Slope	Slope
Character of coal	Bituminous	Bituminous	Bituminous	Bituminous
January	15,864	20,975	16,579	17,979
February	10,960	17,852	14,461	17,270
March	13,114	18,572	15,484	19,880
April	17,096	17,344	15,162	19,652
May	11,921	15,372	14,107	20,870
June	7,640	17,233	14,970	16,865
July	5,954	15,995	13,760	18,176
August	7,695	16,324	15,395	18,149
September	6,312	14,359	14,034	15,402
October	4,175	15,051	15,458	18,245
November	6,408	14,473	13,589	17,276
December	5,171	15,976	13,962	15,238
Totals	111,410	199,526	176,961	215,002

HUERFANO COUNTY, 1907.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Hezron	Cameron	Maitland	Pryor	Champion	Toltec
4 ft. 2 in.	4 ft.	6 ft.	5 ft. to 7 ft.	4 ft. 6 in.	3 ft. to 4 ft.
Drift	Slope	Slope	Slope	Slope	Slope
Bituminous	Bituminous	Bituminous	Bituminous	Bituminous	Bituminous
5,113	....	13,212	10,589	2,260	8,296
4,809	....	13,064	10,350	1,845	8,724
4,992	....	13,398	11,234	523	6,905
5,411	....	11,032	11,610	Closed down	7,610
4,994	....	9,420	11,715	Closed down	7,438
5,320	....	10,425	10,807	Closed down	6,410
5,925	....	9,315	9,370	1,420	5,613
6,407	....	9,854	10,458	1,358	6,147
5,895	....	9,171	9,396	1,376	7,099
6,507	....	8,589	10,912	1,453	6,590
6,271	....	8,889	11,067	1,294	6,496
4,673	3,542	9,800	8,070	1,705	7,462
66,317	3,542	126,160	125,569	13,234	84,790

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Midway	Rugby	Sunnyside	Huerfano
Thickness of bed	6 ft.	4 ft.	7 ft. to 8 ft.	4 ft. to 6 ft.
Kind of opening	Slope	Slope	Slope	Shaft
Character of coal	Bituminous	Bituminous	Bituminous	Bituminous
January	10,704	7,325	6,966	6,367
February	13,255	7,659	4,865	5,739
March	14,227	5,054	8,553	2,618
April	13,093	6,587	6,822	Idle
May	13,166	8,921	6,[illegible]08	5,200
June	12,033	7,026	6,539	5,653
July	10,710	8,562	6,119	4,774
August	10,776	6,240	8,436	4,290
September	10,585	8,766	6,245	4,386
October	5,709	8,186	6,000	4,772
November	4,732	9,220	5,800	4,005
December	6,014	7,725	7,565	4,790
Totals	125,004	91,271	80,818	52,594

HUERFANO COUNTY, 1907—Continued.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Sweet	Pinon	Round Oak	Occidental	Gordon	Tioga
5 ft.	3 ft. to 4 ft.	2 ft. 9 in. to 4½ ft.	6 ft. to 8 ft.	5 ft. 8 in.	5½ ft. to 6½ ft.
Slope	Shaft	Slope	Slope	Slope	Slope
Bituminous	Bituminous	Bituminous	Bituminous	Bituminous	Bituminous
5,900	6,020	....	690	....	....
4,000	6,803	1,600	429	....	....
700	5,309	1,200	683	44	....
Idle	4,941	895	637	126	....
Idle	7,033	1,128	874	225	498
658	7,814	1,264	756	260	846
2,731	8,592	1,299	167	450	319
3,244	9,954	1,102	179	280	396
3,145	11,280	1,100	458	360	452
3,973	9,690	1,812	360	1,250	514
3,653	8,630	2,381	261	1,145	814
3,413	11,041	3,877	68	2,943	2,331
31,417	97,107	17,658	5,562	7,083	6,170

PRODUCTION OF HUERFANO COUNTY, 1907—Concluded.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Oakdale	
Thickness of bed	8 ft.	
Kind of opening	Slope	
Character of coal	Bituminous	Total Tonnage
January	....	154,830
February	....	143,685
March	....	142,490
April	....	138,018
May	....	139,790
June	....	132,519
July	....	128,351
August	....	136,684
September	....	129,821
October	....	129,237
November	1,811	128,215
December	4,199	139,565
Totals	6,010	1,643,205

PRODUCTION OF JEFFERSON COUNTY, 1907.

SHOWING MONTHLY AND YEARLY PRODUCTION OF THE LEYDEN MINE IN TONS OF 2,000 POUNDS.

Name of mine	Leyden	
Thickness of bed	9 ft.	
Kind of opening	Shaft	Total
Character of coal	Lignite	Tonnage
January	22,217	22,217
February	17,290	17,290
March	17,009	17,009
April	17,739	17,739
May	16,225	16,225
June	14,720	14,720
July	12,421	12,421
August	11,434	11,434
September	12,428	12,428
October	12,076	12,076
November	19,304	19,304
December	20,956	20,956
Totals	193,819	193,819

PRODUCTION OF LA PLATA COUNTY, 1907.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Hesperus	Porter	Perin's Peak	City	Champion	
Thickness of bed	5 ft.	2 ft. 8 in.	5 to 7 ft.	3 ft.	3 ft.	
Kind of opening	Drift	Drift	Drift	Drift	Drift	Total
Character of coal	Semi-Bitum.	Bituminous	Bituminous	Bituminous	Bituminous	Tonnage
January	6,607	4,460	2,977	1,051	1,626	16,721
February	6,305	4,042	2,704	1,235	1,035	15,321
March	6,272	3,650	3,588	1,097	678	15,285
April	4,393	2,815	2,633	1,269	767	11,877
May	4,372	2,298	3,839	1,518	916	12,943
June	3,954	3,712	4,543	1,566	764	14,539
July	5,470	4,194	4,758	1,786	703	16,911
August	4,650	4,840	4,073	1,895	589	16,047
September	5,786	4,288	3,494	1,577	738	15,883
October	5,167	4,177	4,026	1,846	690	15,906
November	6,088	4,321	4,815	2,329	1,217	18,770
December	5,741	4,662	5,186	2,188	1,377	19,154
Totals	64,805	47,459	46,636	19,357	11,100	189,357

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Frederick	Delagua	Hastings	Gray Creek
Thickness of bed	8 ft.	6 ft.	5 to 8 ft.	4 to 5 ft.
Kind of opening	Drift	Drift	Slope	Drift
Character of coal	Bitum.	Bitum.	Bitum.	Bitum.
January	.....	50,046	41,437	14,206
February	.....	49,309	40,253	8,947
March	.....	53,814	41,778	12,521
April	.....	49,776	37,143	12,666
May	.....	60,120	42,498	12,155
June	.....	54,616	35,830	12,078
July	.....	55,072	37,753	11,205
August	.....	52,667	39,572	8,155
September	.....	53,279	36,645	8,020
October	6,346	55,914	39,296	11,067
November	13,674	54,164	32,863	11,848
December	17,257	52,326	35,454	15,021
Totals	37,277	641,103	460,522	137,889

LAS ANIMAS COUNTY, 1907.

OF EACH MINE IN TONS OF 2000 POUNDS.

Bowen	Piedmont	Francisco	LaBelle	Green Canon	Suffield
7 to 8 ft.	4½ to 6 ft.	4 ft.	5 ft.	4½ to 5 ft.	5 to 7 ft.
Drift	Slope	Drift	Drift	Drift & Slope	Slope
Bitum.	Bitum.	Bitum.	Bitum.	Bitum.	Bitum.
19,742	12,416	6,425	4,080	8,135	11,485
21,152	11,132	6,303	3,503	8,930	10,604
24,576	11,350	6,628	3,615	8,655	10,879
23,310	10,840	6,409	4,188	8,976	10,295
25,108	10,521	7,030	4,181	9,229	11,793
23,366	9,091	6,298	4,260	8,910	10,523
23,376	11,042	6,189	4,397	8,543	10,283
20,620	10,570	5,494	4,586	6,075	10,190
22,214	9,477	4,984	3,771	6,697	11,602
23,155	10,585	5,130	4,330	6,297	13,018
22,222	9,018	5,178	4,080	5,489	14,084
23,484	8,083	4,760	3,949	5,714	13,797
272,325	124,125	70,828	48,940	91,650	138,553

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Primero	Berwind	Starkville	Engle
Thickness of bed	6 to 8½ ft.	6 ft.	7 ft.	7 ft.
Kind of opening	Drift	Drift	Drift	Drift
Character of coal	Bitum.	Bitum.	Bitum.	Bitum.
January	34,397	41,381	30,520	18,483
February	20,880	35,984	28,490	16,092
March	30,572	39,918	33,151	17,197
April	33,483	36,719	27,574	9,154
May	38,191	40,519	29,631	8,185
June	39,473	36,972	28,134	10,261
July	42,537	39,331	31,268	14,464
August	40,922	34,502	31,007	14,367
September	35,717	37,355	27,172	13,535
October	38,377	40,986	28,561	16,693
November	36,874	34,077	27,970	15,896
December	34,902	30,829	26,099	21,447
Totals	426,325	448,573	349,577	175,774

LAS ANIMAS COUNTY, 1907—Continued.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Tercio	Sopris	Tobasco	Cuatro	Quinto	Morley
5½ ft.	4 to 4½ ft.	3½ to 4 ft.	4 ft.	6 ft.	8 ft.
Drift	Drift	Slope	Slope	Drift	Slope & Drift
Bitum.	Bitum.	Bitum.	Bitum.	Bitum.	Bitum.
25,181	10,760	9,016	4,745	8,350	.....
21,283	10,086	8,643	3,047	8,439	.....
22,837	11,949	9,965	3,823	9,348	.....
21,612	11,962	8,499	3,062	7,634	8,719
24,784	13,579	9,332	1,753	8,994	12,602
17,915	12,304	6,960	Closed down	8,308	15,451
16,607	12,730	10,068	....	9,367	20,569
15,797	12,539	11,027	....	9,294	19,478
15,105	10,083	10,481	....	9,754	21,676
14,816	10,989	10,788	....	9,812	23,542
12,355	10,864	10,456	....	7,016	20,081
12,562	10,248	11,004	....	7,009	23,604
220,854	138,093	116,239	16,430	103,325	165,722

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Greenville	Black Diamond	Forbes	Brodhead
Thickness of bed	5 ft.	3½ ft.	6 ft.	4 ft.
Kind of opening	Drift	Slope	Drift	Slope
Character of coal	Bitum.	Bitum.	Bitum.	Bitum.
January	8,797	8,089	20,970	8,930
February	7,099	7,101	18,777	5,525
March	5,522	6,373	24,225	5,645
April	5,086	7,479	20,566	5,750
May	5,730	6,775	23,552	6,525
June	5,482	7,259	22,296	6,025
July	6,021	6,911	24,525	5,200
August	4,697	4,465	22,330	4,700
September	6,131	5,212	21,950	5,412
October	6,784	5,336	23,560	6,710
November	5,717	5,365	18,996	6,429
December	7,363	5,166	17,768	6,300
Totals	74,229	75,531	259,515	73,151

LAS ANIMAS COUNTY, 1907—Continued.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Majestic	Primrose	Ludlow	Bloom	Cokedale	Stevens
5½ to 9 ft.	4 ft.	6½ ft.	7 ft.	6 ft.	5½ ft.
Drift	Slope	Drift	Drift	Slope	Drift
Bitum.	Bitum.	Bitum.	Bitum.	Bitum.	Bitum.
6,575	5,807	5,732	3,111	4,344	451
6,000	5,558	5,456	3,347	4,339	471
7,414	3,208	3,564	2,109	4,394	365
4,556	2,108	5,684	1,645	3,249	217
7,954	6,451	5,245	1,651	3,442	502
5,952	5,751	4,953	1,504	2,029	478
5,712	6,249	5,122	1,971	1,204	342
5,300	3,619	5,367	1,955	2,587	349
5,909	7,124	5,431	2,078	3,000	463
6,442	6,873	5,512	2,676	10,004	626
7,184	6,353	6,459	2,801	15,210	698
7,335	8,156	6,319	2,342	16,326	506
76,333	67,257	64,844	27,190	70,128	5,468

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Southwestern	Jewel
Thickness of bed	4½ ft.	4 ft.
Kind of opening	Slope	Slope
Character of coal	Bitum.	Bitum.
January	1,500	800
February	1,210	making repairs
March	1,215	....
April	670	169
May	784	400
June	1,227	256
July	1,144	589
August	829	327
September	989	269
October	1,136	559
November	1,289	981
December	1,433	980
Totals	13,426	5,330

LAS ANIMAS COUNTY, 1907—Concluded.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Baldy	Thomas	Empire	Rapson No. 1	
6 to 7 ft.	3 to 4 ft.	5 ft.	4 ft.	
Drift	Slope	Slope	Slope	Total
Bitum.	Bitum.	Bitum.	Bitum.	Tonnage
835	.....	.....	....	426,546
895	.....	.....	.....	378,855
606	.....	.....	.....	417,216
352	.....	.....	.....	389,552
370	.....	.....	.....	439,586
328	.....	.....	.....	404,290
626	.....	.....	.....	430,417
436	.....	.....	.....	403,823
576	.....	.....	.....	402,111
964	.....	.....	.....	446,884
1,030	.....	.....	.....	426,721
1,170	12,300	10,308	9,134	470,455
8,188	12,300	10,308	9,134	5,036,456

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Cameo	Book Cliff
Thickness of bed		
Kind of opening	Drift	Drift
Character of coal	Semi-Bitum.	Semi-Bitum.
January	3,818	2,319
February	2,435	797
March	1,863	1,023
April	891	637
May	1,387	569
June	1,614	572
July	2,472	1,179
August	3,360	1,081
September	2,473	915
October	2,755	1,214
November	4,992	1,400
December	5,254	1,500
Totals	33,314	13,206

MESA COUNTY, 1907.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Palisade	Stokes	Riverside	Garfield	Wearing	
3 ft. 10 in. to 4 ft.	3 to 8 ft.	2½ ft.		4½ ft.	
Drift.	Drift	Drift	Slope		Total
Semi-Bitum.	Semi-Bitum.	Semi-Bitum.	Semi-Bitum.	Semi-Bitum.	Tonnage
770	240	75	.....	.....	7,222
475	240	54	.....	.....	4,001
420	222	45	.....	.....	3,573
352	246	.....	.....	.....	2,126
355	48	.....	.....	.....	2,359
424	220	.....	.....	.....	2,830
383	315	39	.....	.....	4,388
482	345	39	.....	.....	5,307
616	360	.....	.....	.....	4,364
759	425	132	.....	.....	5,285
905	470	92	.....	.....	7,859
1,027	345	70	2,000	1,800	11,996
6,968	3,476	546	2,000	1,800	61,310

PRODUCTION OF MONTEZUMA COUNTY, 1907.

SHOWING YEARLY PRODUCTION OF THE MINE IN TONS OF 2,000 POUNDS.

Name of mine	Mancos	
Thickness of bed	$2\frac{1}{2}$ ft.	
Kind of opening	Drift	Total
Character of coal	Lignite	Tonnage
December	150	150
Totals	150	150

PRODUCTION OF PITKIN COUNTY, 1907.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2000 POUNDS

Character of coal.....	Bituminous	Bituminous	Bituminous	Bituminous
Name of mine.....	Spring Gulch	Coalbasin	Marion	
Thickness of bed.....	6 ft. to 11 ft.	6½ ft. to 8 ft.	6 ft. to 6½ ft.	
Kind of opening.....	Slope	Slope	Drift	Total
Character of coal.....	Bituminous	Bituminous	Bituminous	Tonnage
January	18,860	10,899	....	29,759
February	16,598	9,827	....	26,425
March	15,044	10,369	....	25,413
April	17,275	11,002	....	28,277
May	17,754	9,131	....	26,885
June	15,825	10,031	....	25,856
July	16,730	10,296	....	27,026
August	14,371	9,221	....	23,592
September	12,707	9,056	....	21,763
October	14,135	10,101	86	24,322
November	16,735	9,399	67	26,201
December	15,640	11,734	None	27,374
Totals	191,674	121,066	153	312,893

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Leigh	Parkdale	Golden Ash	Northwestern
Thickness of bed	5 and 6 ft.	10 ft.	8 ft.	7 ft.
Kind of opening	Shaft	Slope	Shaft	Shaft
Character of coal	Lignite	Lignite	Lignite	Lignite
January	6,077	428	2,062	1,500
February	4,153	560	2,211	2,282
March	2,871	559	1,080	2,613
April	2,360	2,207	932	1,997
May	2,580	2,829	2,004	1,806
June	2,208	3,558	3,292	813
July	2,608	3,807	3,684	593
August	4,125	6,055	4,554	1,339
September	5,804	6,424	4,420	1,450
October	6,451	7,944	6,735	1,642
November	7,583	8,313	7,361	.....
December	6,985	8,174	5,737	.....
Totals	53,805	50,858	44,072	16,035

WELD COUNTY, 1907.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Shamrock	Whitehouse	Reliance	Lister	Washington	McKissick
11 ft.	6 ft.	5 ft.	4 ft.	5 ft.	7½ ft.
Shaft	Slope	Shaft	Shaft	Shaft	Shaft
Lignite	Lignite	Lignite	Lignite	Lignite	Lignite
1,569	802	1,340	1,200	.....	.....
878	437	508	1,268	.....	.....
720	420	590	1,080	.....	.....
528	302	345	Abandoned	.....	.....
745	169	171	.....	.....	.....
602	211	438	.....	.....	.....
388	218	833	.....	.....	.....
1,340	632	Closed	.....	.....	.....
1,712	690	down	.....	.....	.....
1,732	589	.....	.....	.....	.....
1,868	236	.....	.....	.....	.....
1,066	500	.....	.....	2,231	6,000
13,148	5,206	4,225	3,548	2,231	6,000

PRODUCTION OF WELD COUNTY, 1907.—Concluded.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Denslow	Frederick	Evans	Ideal	
Thickness of bed	7 ft.	8 ft.	8 ft.		
Kind of opening	Shaft	Slope	Shaft	Slope	Total
Character of coal	Lignite	Lignite	Lignite	Lignite	Tonnage
January	.....	.....	.....	.....	14,978
February	.....	.....	.....	.....	12,297
March	.....	.....	.....	.....	9,933
April	.....	.....	.....	.....	8,671
May	.....	.....	.....	.....	10,304
June	.....	.....	.....	.....	11,122
August	.....	.....	.....	.....	12,131
September	.....	.....	.....	.....	18,045
October	.....	.....	.....	.....	20,500
November	.....	.....	.....	.....	25,361
December	1,600	1,500	1,000	200	34,993
Totals	1,600	1,500	1,000	200	203,428

PRODUCTION OF THE STATE OF COLORADO, 1907.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH COUNTY. ALL YEARLY REPORTS GROUPED IN THE MONTH OF DECEMBER.

Counties	Boulder	Delta	Douglas	El Paso
January	173,080	.....	.....	31,775
February	135,949	.....	.....	26,038
March	78,521	.....	.....	18,970
April	76,765	.....	.....	19,700
May	78,411	.....	.....	19,826
June	54,980	.....	.....	18,581
July	64,266	.....	.....	16,721
August	85,951	.....	.....	15,510
September	117,400	.....	.....	22,223
October	170,436	.....	.....	21,950
November	190,154	.....	.....	22,446
December	173,605	15,414	632	30,867
Totals	1,399,518	15,414	632	264,607

PRODUCTION OF THE STATE OF COLORADO, 1907. —Continued.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH COUNTY. ALL YEARLY REPORTS GROUPED IN THE MONTH OF DECEMBER.

Counties	Fremont	Garfield	Gunnison	Huerfano
January	79,000	22,566	50,000	154,830
February	68,148	19,339	39,606	143,685
March	64,765	19,011	46,460	142,490
April	58,867	15,868	42,284	138,018
May	58,043	13,791	46,101	139,790
June	64,031	18,743	51,909	132,519
July	60,038	16,950	56,506	128,351
August	66,450	15,776	54,260	136,684
September	57,451	15,199	52,914	129,821
October	66,607	18,930	42,888	129,237
November	68,749	18,218	43,708	128,215
December	69,479	19,991	52,205	139,565
Total	781,628	214,382	578,841	1,643,205

PRODUCTION OF THE STATE OF COLORADO, 1907. —Continued.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH COUNTY. ALL YEARLY REPORTS GROUPED IN THE MONTH OF DECEMBER.

Counties	Jefferson	Las Animas	La Plata	Mesa
January	22,217	426,546	16,721	7,222
February	17,290	378,855	15,321	4,001
March	17,009	417,216	15,285	3,573
April	17,739	389,552	11,877	2,126
May	16,225	439,586	12,943	2,359
June	14,720	404,290	14,539	2,830
July	12,421	430,417	16,911	4,388
August	11,434	403,823	16,047	5,307
September	12,428	402,111	15,883	4,364
October	12,076	446,884	15,906	5,285
November	19,304	426,721	18,770	7,859
December	20,956	470,455	19,154	11,996
Totals	193.819	5,036,456	189,357	61,310

PRODUCTION OF THE STATE OF COLORADO, 1907. —Concluded.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH COUNTY. ALL YEARLY REPORTS GROUPED IN THE MONTH OF DECEMBER.

Counties	Montezuma	Pitkin	Weld	Total Tonnage
January	.....	29,759	14,978	1,028,694
February	.....	26,425	12,297	886,954
March	.....	25,413	9,933	858,646
April	.....	28,277	8,671	809,744
May	.....	26,885	10,304	864,264
June	.....	25,856	11,122	814,120
July	.....	27,026	12,131	846,126
August	.....	23,592	18,045	852,879
September	.....	21,763	20,500	872,057
October	.....	24,322	25,093	979,614
November	.....	26,201	25,361	995,706
December	150	27,374	34,993	1,086,836
Totals	150	312,893	203,428	10,895,640
Production from mines not reporting, estimated				70,000
Grand total				10,965,640

PRODUCTION BY COUNTIES.

SHOWING INCREASE AND DECREASE.

Counties	1906	1907	Increase	Decrease
Boulder	1,135,028	1,399,518	264,490	.....
Delta	1,049	15,414	14,365	.....
Douglas	1,614	632	.....	982
El Paso	204,154	264,607	60,453	.....
Fremont	701,876	781,628	79,752	.....
Garfield	194,956	214,382	19,426	.....
Gunnison	586,844	578,841	.....	8,003
Huerfano	1,649,075	1,643,205	.....	5,870
Jefferson	213,723	193,819	.....	19,904
Las Animas	4,854,606	5,036,456	181,850	.....
La Plata	179,531	189,357	9,826	.....
Mesa	42,552	61,310	18,758	.....
Montezuma	729	150	.....	579
Pitkin	317,888	312,893	.....	4,995
Weld	114,796	203,428	88,632	.....
Mines not reporting product estimated	110,000	70,000	.....	40,000
Total tonnage	10,308,421	10,965,640	657,219	

Increase for 1907, 657,219 tons.

PRODUCTION OF THE STATE OF COLORADO, 1907.

SHOWING MONTHLY AND YEARLY PRODUCTION OF THE DIFFERENT VARIETIES.

Months	Lignite	Semi-bituminous	Bituminous	Anthracite	Total Tonnage
January	242,050	100,642	685,282	720	1,028,694
February	191,574	79,080	615,719	581	886,954
March	124,433	74,658	658,573	982	858,646
April	122,875	65,478	620,846	545	809,744
May	124,766	65,658	773,158	682	864,264
June	99,403	79,584	634,333	800	814,120
July	105,539	78,971	654,564	7,052	846,126
August	130,940	83,019	630,509	8,411	852,879
September	172,551	75,762	616,698	7,046	872,057
October	229,555	86,352	658,304	5,403	979,614
November	257,265	90,713	641,157	6,571	995,706
December	261,203	105,309	714,004	6,320	1,086,836
Totals	2,062,154	985,226	7,803,147	45,113	10,895,640
Unclassified coal estimated					70,000
					10,965,640

TABLE

SHOWING THE TOTAL PRODUCTION OF DIFFERENT COMPANIES OPERATING TWO OR MORE MINES FOR THE YEAR 1907.

Character of Coal and Number of Mines.

Name of Company	No. of Mines	Bituminous or Coking	No. of Mines	Semi-Bituminous or Non-Coking	No. of Mines	Anthracite	No. of Mines	Lignite	Total in Tons of 2,000 lbs.
Colorado Fuel & Iron Co.....	21	3,426,568	5	492,794	1	35,143	..	.....	3,954,505
Victor Fuel Co.....	5	1,637,999	2	154,258	..	.....	..	.....	1,792,257
Northern Coal & Coke Co.....	4	113,854	..	.....	..	.....	10	915,232	1,029,086
Rocky Mountain Fuel Co.....	7	442,817	3	120,756	..	.....	..	.....	563,573
Green Canon Coal Co.....	2	230,203	..	.....	..	.....	..	.....	230,203
Cedar Hill Coal & Coke Co.....	2	149,760	..	.....	..	.....	..	.....	149,760
Union Coal & Coke Co.....	2	138,803	..	.....	..	.....	..	.....	138,803
Continental Fuel Co.....	1	76,333	..	.....	..	.....	1	41,111	118,444
Huerfano Coal Co.....	2	117,393	..	.....	..	.....	..	.....	117,393
Porter Fuel Co.....	1	47,459	..	.....	..	.....	..	.....	112,264
Pike's Peak Fuel Co.....	..	.....	..	.....	..	.....	2	97,614	97,614
Rapson Coal Mining Co.....	1	9,134	..	.....	..	.....	1	57,364	66,498

COKE PRODUCTION, 1907.

Name of Operator	Location of ovens	County	No. of ovens	Tonnage
Colorado Fuel & Iron Co.	Cardiff	Garfield	167	68,925
Colorado Fuel & Iron Co.	Crested Butte	Gunnison	154	43,210
Colorado Fuel & Iron Co.	Segundo	Las Animas	800	272,552
Colorado Fuel & Iron Co.	Starkville	Las Animas	190	98,141
Colorado Fuel & Iron Co.	El Moro	Las Animas	235	83,085
Colorado Fuel & Iron Co.	Sopris	Las Animas	272	156,715
Colorado Fuel & Iron Co.	Tercio	Las Animas	600	97,625
Colorado Fuel & Iron Co.	Tobasco	Las Animas	302	121,307
Colorado Fuel & Iron Co.	Redstone	Pitkin	249	36,356
Victor Fuel Co.	Hastings	Las Animas	189	72,978
Victor Fuel Co.	Gray Creek	Las Animas	96	13,496
Carbon Coal & Coke Co.	Cokedale	Las Animas	190	19,558
American Smelting and Refining Co.	Durango	La Plata.	34	13,103
			3,478	1,097,051

REMARKS.

Not all the above enumerated ovens were in operation.
The Cardiff ovens are supplied by the Spring Gulch mine.
The Redstone ovens are supplied by the Coalbasin mine.
The Segundo ovens are supplied by the Primero mine.
The El Moro ovens are supplied by the Engle mine.
The Durango ovens are supplied by the Porter mine.
The coal of Huerfano is classed as bituminous, but is non-coking coal

COKE PRODUCTION, 1907.

BY COMPANIES AND COUNTIES.

Companies	Total Number of ovens	Total Tonnage
Colorado Fuel & Iron Co.	2,969	977,916
Victor Fuel Co.	285	86,474
Carbon Coal & Coke Co.	190	19,558
American Smelting & Refining Co.	34	13,103
	3,478	1,097,051

Counties	Total Number of ovens	Total Tonnage
Las Animas	2,874	935,457
Garfield	167	68,925
Gunnison	154	43,210
Pitkin	249	36,356
La Plata	34	13,103
	3,478	1,097,051

List of Fatal Accidents for 1907

FATAL ACCIDENTS IN 1907.

UNDERGROUND.

Date	Name of Person	Nationality	Occupation	Age	Single or Married	Name of Mine	County	Cause of Accident
Jan. 5	John Forine	Swede	Miner	54	Single	South Canon	Garfield	Fall of coal
Jan. 13	Stewart Smith	Scotch	Trip-rider	20	Single	Coalbasin	Pitkin	Struck by a runaway trip
Jan. 15	Geo. Trew	American	Miner	35	Single	Maltby	Las Animas	Fall of roof
Jan. 23	See report on the Primero explosion.							
Jan. 29	Joe Velme	Italian	Miner	35	Married	Rex No. 1	Boulder	Fall of bone
Jan. 31	Claud Ronchietta	Italian	Miner	29	Married	Pryor	Huerfano	Fall of rock
Jan. 31	Charles Akers	American	Miner	33	Married	Somerset	Gunnison	Fall of coal
Feb. 6	John Rhomsick	Austrian	Miner	44	Married	Sopris	Las Animas	Fall of roof
Feb. 11	Domenic Basso	Italian	Miner	26	Single	Pictou	Huerfano	Fall of slate
Feb. 15	Joe Casteline	Italian	Miner	48	Single	Brodhead	Las Animas	Suffocation by gas from gob fire
Feb. 15	John Rossi	Italian	Miner	..	Single	Brodhead	Las Animas	Suffocation by gas from gob fire
Mch. 1	Jank Gregoric	Austrian	Miner	45	Married	Rugby	Huerfano	Fall of roof
Mch. 4	Charles Megasaki	Japanese	Miner	32	Single	Primero	Las Animas	Struck by a runaway trip
Mch. 13	Pete Melkjo	Italian	Miner	26	Single	Pinon	Huerfano	Fall of rock
Mch. 16	John Moneghine	Italian	Miner	23	Single	Primero	Las Animas	Fall of rock
Mch. 18	Anton Peronio	Austrian	Miner	30	Single	Reilly Canon	Las Animas	Fall of rock
Mch. 20	Andrew Mattis	Austrian	Miner	21	Single	Rapson No. 2	El Paso	Fall of roof
Mch. 28	E. Haraguchi	Japanese	Miner	28	Single	Green Canon	Las Animas	Fall of rock
Mch. 28	K. Kusahara	Japanese	Miner	27	Single	Green Canon	Las Animas	Fall of rock
Apr. 6	Martino Costo	Italian	Miner	27	Single	Hastings	Las Animas	Fall of roof
Apr. 11	Robert Brown	English	Miner	20	Married	Majestic	Las Animas	Fall of rock

Apr. 11	Bernard McChwee	Scotch	Miner	55	Married	Majestic	Las Animas	Fall of rock
Apr. 24	Walter Notman	Scotch	Fire boss	24	Married	Midway	Huerfano	Gas explosion
May 1	Angelo Gatino	Italian	Miner	21	Single	Rex No. 2	Boulder	Fall of rock
May 10	Tony Corrick	Polander	Miner	30	Single	Leyden	Jefferson	Fall of roof
May 16	Ambrose Ferdizzi	Italian	Miner	29	Single	Robinson	Huerfano	Fall of roof
May 17	Joe Smith	Austrian	Miner	33	Single	Black Diamond	Las Animas	Fall of roof
May 19	See report on Engleville fire.							
May 23	Tom Donivich	Austrian	Miner	29	Married	Walsen	Huerfano	Fall of roof
June 4	Dolis Matteo	Italian	Miner	28	Single	Hesperus	La Plata	Fall of roof
June 5	Earle Stevens	American	Driver	22	Single	Leyden	Jefferson	Crushed between car and rib by falling off trip
June 13	Jno. Ferranti	Italian	Miner	35	Married	Berwind	Las Animas	Fall of roof
June 29	Wm. Cox	American	Company man	37	Married	Gorham	Boulder	Fall of rock
July 1	Batist Crescentia	Italian	Miner	57	Married	Berwind	Las Animas	Fall of roof
July 10	Giamaine Imbrozamo	Italian	Miner	34	Married	Delagua	Las Animas	Fall of roof
July 12	Frank Byolette	Italian	Miner	24	Single	Toltec	Huerfano	Fall of roof
July 20	Jno. Storzl	German	Miner	40	Married	Advance	Weld	Fall of roof
July 30	Frank Lackitte	Colored	Miner	31	Single	Piedmont	Las Animas	Delayed shot
Aug. 13	Joe Paternoster	Italian	Miner	45	Married	Starkville	Las Animas	Struck by runaway trip
Aug. 19	C. Menapace	Italian	Miner	55	Married	Majestic	Las Animas	Fall of rock
Aug. 21	James Boni	Italian	Miner	25	Married	Alpine	Gunnison	Fall of rock
Aug. 28	George Rogo	Slavonian	Miner	36	Married	Pinon	Huerfano	Fall of rock
Sept. 2	S. Makamoto	Japanese	Miner	25	Single	Green Canon	Las Animas	Fall of roof
Sept. 4	Louis Luggi	Slavonian	Miner	36	Single	Delagua	Las Animas	Fall of drawslate
Sept. 11	David Jones	Welsh	Miner	64	Single	Black Diamond	Las Animas	Fall of rock

FATAL ACCIDENTS IN 1907.—Concluded.

UNDERGROUND.

Date.	Name of Person.	Nationality.	Occupation	Age	Single or Married	Name of Mine	County	Cause of Accident
Sept. 14	Giovanni Felicia	Italian	Miner	30	Married	Walsen	Huerfano	Run over by a trip of loaded cars
Sept. 16	Steven Lewis	American	Miner	47	Married	Layden	Jefferson	Fall of coal
Oct. 5	Guiseppi Saffonato	Italian	Miner	31	Married	Primero	Las Animas	Fall of roof
Oct. 11	Gasperi Ginario	Italian	Miner	22	Single	Starkville	Las Animas	Fall of coal
Oct. 15	Louis Voshier	French	Miner	33	Married	Curtis	El Paso	Missed shot
Oct. 30	Jacob Luhadol	Austrian	Driver	21	Married	Quinto	Las Animas	Fall of roof
Oct. 30	Angelo Pellegrino	Italian	Miner	24	Single	Quinto	Las Animas	Fall of roof
Oct. 30	Alex. Covi	Italian	Miner	19	Single	Quinto	Las Animas	Fall of roof
Nov. 5	George Theros	Greek	Miner	35	Single	Hastings	Las Animas	Fall of roof
Nov. 6	Leon Surmont	French	Miner	40	Single	Gorham	Boulder	Fall of coal
Nov. 15	Y. M. Swok	Korean	Miner	40	Single	Primero	Las Animas	Fall of roof
Nov. 22	Wm. Dean	Colored	Miner	30	Married	Pinon	Huerfano	Fall of rock
Nov. 22	Jacob Katavish	Slavonian	Miner	49	Married	Hastings	Las Animas	Fall of roof
Nov. 29	J. Movasaki	Japanese	Miner	41	Married	Primero	Las Animas	Fall of rock
Nov. 30	Job O. Taylor	English	Slope repairer	57	Married	Parkdale	Weld	Struck by a runawy trip
Dec. 2	Mike Bardovic	Hungarian	Miner	38	Married	Starkville	Las Animas	Fall of roof
Dec. 2	Charles Yearack	American	Miner	22	Single	Francisco	Las Animas	Fall of rock
Dec. 5	Joe Gasnick	Austrian	Miner	56	Married	Engle	Las Animas	Fall of rock
Dec. 7	Thos. Ritch	Italian	Miner	38	Married	Berwind	Las Animas	Fall of rock
Dec. 13	Jake Thomsick	Slavonian	Miner	25	Single	Ludlow	Las Animas	Fall of roof
Dec. 17	Sam Kagis	Greek	Miner	25	Single	Delagua	Las Animas	Fall of roof

Date	Name of person	Nationality	Occupation	Age	Single or Married	Name of Mine	County	Cause of Accident
Dec. 20	Henry Thomas	Colored	Shot-firer	30	Married	Pictou	Huerfano.	By blown-out shot causing slight dust explosion
Dec. 27	U. Momose	Japanese	Miner	45	Single	Brodhead	Las Animas.	Struck by a trip of cars
Dec. 28	Jacob Shottovish	Slavonian	Miner	43	Married	Green Canon	Las Animas	Fall of rock
Dec. 30	Melford Howard	Mexican	Driver	39	Married	Bowen	Las Animas.	Caught between car and rib
Dec. 30	George Kuzmovic	Slavonian	Pumpman	32	Married	Midway	Huerfano.	Struck by a runaway trip.
Dec. 30	Joe Conders	Slavonian	Miner	19	Single	Maitland	Huerfano	Fall of slate
Dec. 31	Pete Farrell	American	Miner	45	Single	Simpson	Boulder.	Fall of draw slate, died six days later

SURFACE.

Date	Name of person	Nationality	Occupation	Age	Single or Married	Name of Mine	County	Cause of Accident
Jan. 15	Joseph Diomenti	Italian	Timberman	25	Single	Monarch	Boulder	Falling down shaft
May 11	Sam Colombo	Italian		24	Single	Berwind	Las Animas.	Electrocuted on outside pit car track
Sept. 30	Robert E. Olds	American	Blacksmith	59	Married	Huerfano	Huerfano	Struck by cage on top of shaft
Oct. 21	Benny Felino	Italian	Grader on gravity plane	45	Single	South Canon	Garfield	Powder explosion
Oct. 24	William Morris	American	Coal Inspector	45	Single	Bowen	Las Animas.	Run over by railroad cars
Nov. 26	August Risetti	Italian	Company man	26	Single	Acme	Boulder	Falling down shaft
Dec. 3	Andro Archuleta	Mexican	Car Spragger	30	Married	Hastings	Las Animas	Struck by a derailed car on surface

Denver, Colo., March 12, 1907.

HON. HENRY A. BUCHTEL,
Governor of Colorado.

Dear Sir—In compliance with your instructions regarding the explosion which occurred at the Primero mine on January 23, 1907, and resulting in twenty-four persons losing their lives, I beg to state that I made a careful investigation of the workings of the mine and the probable cause of the disaster, and I herewith submit to you my report on the same.

TABLE OF PERSONS KILLED.

Name.	Nationality.	Occupation.	Age.	Married or Single
Angelo Della-Maddalena	Italian	Day man	24	Single
Omobono Muffatti	Italian	Day man	24	Single
Costante Casagrande	Italian	Day man	21	Single
Enrico Stifel	Italian	Day man	28	Single
Modesto Formolli	Hungarian	Day man	24	Single
Arcangelo Piseta	Hungarian	Day man	34	Single
Fortunato Giacomozzi	Hungarian	Day man	52	Married
Domenico Pisetta	Hungarian	Day man	22	Single
Andrea Varga	Hungarian	Miner	40	Married
Gioanni Bozo	Hungarian	Miner	36	Married
Luigi Sipos	Hungarian	Miner	21	Single
Guiseepi Sipes	Hungarian	Miner	20	Single
Gioanni Tokar	Hungarian	Miner	42	Married
Gioanni Toth	Hungarian	Miner	24	Single
Gioanni Hannusek	Hungarian	Miner	28	Single
Giulio Rudolf	Hungarian	Miner	35	Single
Gioanni Fatur	Hungarian	Day man	29	Single
Roberto Fatur	Hungarian	Day man	24	Single
Frank Uralch	Hungarian	Day man	30	Single
Gioanni Sajn	Hungarian	Day man	30	Single
Frank Smaldel	Hungarian	Miner	34	Single
Frank Hubat	Hungarian	Day man	24	Single
Gioanni Paulich	Hungarian	Miner	24	Single
Rees Lumley	Welsh	Fire boss	46	Married

LOCATION AND GEOLOGICAL FEATURES.

The Primero mine is located at the terminus of a three-mile branch, to the north, off the Colorado & Wyoming Railroad 18 miles west of Trinidad, Las Animas county. It is owned and

operated by the Colorado Fuel & Iron Company and the officials in charge are: Messrs. J. T. Kebler, general manager; Robert O'Neil, division superintendent, and Wm. Morgan, local superintendent. The mine is worked through five independent openings, four drifts and one slope and all coal is delivered at one tipple. Development of the property was commenced in June, 1901, and by December of that year it had attained the distinction of being the largest producer in the State, and which supremacy it maintained to the date of the accident now under consideration.

The seam under exploitation belongs to the upper of the three series of workable veins contained in the Laramie cretaceous measures. It has a mean thickness of 7 feet and the coal is of the bituminous coking variety.

DESCRIPTION OF MINE AND MODE OF WORKING.

The explosion occurred in the "Main North," which is the most extensively developed opening of the five, and is equipped for an output of 1,500 tons daily. It is opened by two parallel drifts, haulage way and air course, both entering upon the outcrop of the vein and driven in a direct course until they have reached their present depth of 4,400 feet from the entrance. The drifts run practically level for 1,600 feet, at which point the measures assume a slight forward dip, and the inclination gradually increases from there on to the face, where the pitch is four per cent.

The method of working is double entry room and pillar. There are nine pairs of cross-entries branching off the main, six to the left, which are designated on the accompanying map as "A" entries, and three to the right, called "B" entries, but the present productive workings are embraced within the territory lying from A-6 inward, and all the entries and their tributary rooms lying from A-6 outward, including B-3 and 4, have been worked out and are abandoned. The cross-entries are turned at intervals of 600 to 800 feet apart, and are driven at nearly right angle to the main, and along the strike of the measures. The rooms are 16 feet wide with 24-foot pillars, and mining is done by undercutting and blasting. Giant powder was used in the entries and rooms and black powder in the pillars, and naked lights are used exclusively.

VENTILATION

is effected by a 12-foot direct-connected Capell fan. At the time of this department's last general inspection, previous to the explosion, made on the 4th of November, 1906, by Mr. D. J. Griffiths, deputy inspector, the mine was free from any accumulations of explosive gas, and the total volume of air entering the mine was 108,500 cubic feet per minute at fan revolutions 125. Of this total quantity, 60,700 cubic feet passed in through the main north entry, and was utilized in ventilating the A districts, and the balance of 47,800 entered the first east and was used to ventilate

the workings of B-5 and 6. Final distribution of the air, with the maximum number of men supplied during day shift by each split, was approximately as follows:

Location	No. of cu. ft. per minute	No. of men
A-6	10,000	12
A-7 and 8	25,500	60
A-9 and 10	19,200	30
A-11 and 12 (main entries)	2,000	2
B-5 and 6	47,800	44

In 1904 the officials of the company established a rule to the effect that "all shots are to be fired by shot-lighters, and the firing to be done when all other employes are withdrawn from the mine." This rule, although not a requirement of the mining law, I am informed, was strictly observed by the day shift, but not always followed by the night firers.

HYGROMETRIC CONDITIONS.

As nearly all the water that the mine makes is issuing from the coal, the greatest amount of moisture is found in the advanced workings, yet all the dip rooms and a majority of other rooms, as well as cross entries, that have encountered and passed through local stratigraphical depressions, which occur quite frequently, contain more or less standing water, and the coal loaded from many of the rooms and entries is so saturated with water that the loaded cars are dripping while being hauled out. There are two electric portable pumps used in drainage and these are kept running twelve out of every twenty-four hours, also three syphons are in continuous service to transfer the water from different points to the pump stations. The discharge pipe that conveys the water from the pumps to the surface is laid along the main air course. This pipe is fitted with hydrants located 300 feet apart to which a hose was attached, and the main entry, which is naturally dry from A-9 back, was sprinkled as often as required, and according to the testimony of Mr. William Easton, pumpman, this was done twice a week, and three times when found necessary. Besides, to every rope trip hauled from B-5 and 6 entries, about eight each day, was attached a tank full of water bailed out of the dip rooms in B-6, and when the trip was on its outward run the tank valve was thrown open and the contents allowed to escape along the roadway; thus the floors of the haulage ways were kept in an almost constant condition of humidity.

RESCUING.

The explosion occurred at 4 a. m., mine time, or 3015 standard time, and shortly before the night shift was ready to leave. The concussion created by its tremendous force was such that

it severely shook the entire camp and soon afterwards scores of men gathered at the entrance of the mine. Among the first to arrive was Superintendent Morgan, who instantly realized the extent and seriousness of the catastrophe, and at once directed a corps of men to repair the fan casing, which had been totally disorganized by the force of the explosion. Clouds of smoke were then issuing through the mouth of the main entry, and Morgan, accompanied by Wm. Kilpatrick, Rees Pritchard and others, made an effort to enter through the air course, but soon discovered that both entry and air course were so impregnated with afterdamp that it was impossible to proceed but a short distance. In the meantime a force of men was engaged in rebuilding blown-out stoppings. After three and a half hours of energetic work, the fan was placed in working order and started. At 9 a. m. a third attempt was made by Morgan and his corps to enter by way of the air course and this time they succeeded in getting as far as B-3, where they crossed into the main entry and found the body of Casagrande, driver, who was killed on his way out. At 11 a. m. they reached B-5 pass-by, and found three of the four men that were killed at this point. After getting this far all hope of recovering any of the men alive was given up, although the effort to rescue was vigorously continued until the last body was found. At this time Mr. Robert O'Neil, division superintendent, had arrived and taken full charge of the work.

I was notified of the accident about 9:30 the morning it occurred and instructed Deputy Griffiths to take the first available train for Primero. He arrived there at 10 p. m. the same day. Four bodies had been taken out. Mr. Griffiths rendered all possible assistance rescuing and was present when all the other bodies, excepting that of Lumley, were recovered. Being much engaged in completing some important work of the department which had to be done, I was unable to reach there until the morning of the 26th. At this time the work of rescuing was concentrated in A-7 and 8 in search of Fire Boss Lumley, who at the time of the accident was making his rounds examining the mine preparatory for the day shift.

Immediately after arriving I entered the mine, accompanied by Deputy Griffiths and Mr. Joseph Ball, division superintendent District No. 2, of the Colorado Fuel and Iron Company. In A-7 and 8 I found several groups of men engaged building temporary stoppings in the cross-cuts to restore the ventilation as they advanced into the mine. From the fact that the roof was badly broken and caved and that considerable quantities of fallen rock and timber had been removed, the work was hazardous and the progress slow; the utmost caution and attention had to be exercised for the safety of the men and to avoid further accidents. When we got as far as room No. 52, which point was reached at 11 p. m. Jan. 31st, we found both entries from thereon filled with explosive gas, the air current had be-

come so feeble, due to the many leakages and obstructions from falls, etc., that it was unable to dilute and remove the gas, and this made further advance impossible. It was then decided to suspend the work of rescue and engage in reinforcing the stoppings and try to make a passage over the large fall that blocked the entry near the mouth of A-8 so as to increase the volume of air circulating. A retreat was made and the work outlined begun and in forty-eight hours afterwards the current had sufficiently improved to allow the men to proceed as far as room No. 63 and at 10:30 p. m. Feb. 2nd the body of Lumley was found lying between rooms 62 and 63 on A-7. But it was March 2nd before the entries were sufficiently cleared for me to penetrate far enough into the district to complete my investigation.

DAMAGE TO THE MINE.

The greatest amount of damage to the mine was done in those entries where the "drawslate," which intervenes between the coal and a stratum of sandrock above, had been left standing and was supported by timber. This slate varies from a few inches to eight or ten feet in thickness, and when the timbers were blown out the slate fell and in some places completely filling the passages. Practically all the cross-cut stoppings, overcasts and doors in the mine were blown out and destroyed, and nearly all the sheave-wheels guiding the haulage ropes through the different entries were put out of order.

CAUSE AND ORIGIN OF EXPLOSION.

As all the men in the mine were killed and no one left to tell how and in what part of the mine the explosion started, or what the existing conditions were immediately prior to its occurrence, the only clue available to assist in trying to determine these facts was the direction in which timbers were strewn and other marks left along the paths invaded by the explosion indicating the course taken by the forces, and the sources from which they issued, and these were both indecisive and conflicting. In several places along some of the cross entries I found evidences indicative of two forces having come in contact with each other, and this manifestation was repeatedly in evidence along the first six hundred feet of A-9 and also in many parts of A-7 and 8. The cause for such an intermixture was due to the energetic action of the coal dust in the adjoining rooms at the time of the explosion. The greatest eruptive force, as was clearly shown by the condition the various places were left in, occurred in A-7 and 8, and A-9 and 10, B-5 and the main entry. The last two acted as the outlets or relieving passages for the pressure generated in the other entries.

DISTRICT A-9 AND 10.

Commencing at the face of A-9 and 10, the only entries, excepting the two in A-12, where mining was being done on this fatal "shift," the direction of the force was as follows:

Outward for the entire length of 10, except that the wall of the overcast at its entrance was blown in, and also 9 as far back as room No. 10, with nearly all cross-cuts blown into 10. From room No. 10 to the mouth of A-9 it was badly mixed, with a slight advantage in favor of an ingoing force. From A-10 it traveled out through the main and also through B-5.

DISTRICT A-7 AND 8.

The wall of the over-cast at the mouth of A-7, a door frame located between first and second south and a trestle supporting the track at a down-throw fault near room No. 50, points located on A-7 2,000 and 400 feet apart, respectively, were blown inward for distances varying from thirty to forty feet. Yet many props which were left standing at the intervening spaces between the points enumerated above leaned outward and some otherwise. A-7 entry was very little disturbed for its first one thousand feet, but was marred by intermittent falls from there to the face. Props and guiding sheave-wheel arrangements at the entrance to A-8 were blown in, but the condition of a trip of loaded cars standing on the "pass-by" 1,400 feet further in, strongly indicated that the force was outward, and the conditions for some distance both in and outside of this "pass-by" were mingled and indecisive. Fire Boss Lumley was the only one in this district at the time of the explosion. Very little damage was done to the rooms, although they were nearly all invaded by intense heat, as was shown by the abundant amount of cokings left adhering to the props and sides. The heaviest cokings were found on the props and cross-cut corners in the pillar workings of A-10, rooms Nos. 40, 41 and 42 A-7 and in the first south. Some coking was found scattered on the entries. Rees Lumley's safety lamp was open, but not the least damaged. The lamp is of the "Wolf" type, fire-boss size. Its sections were separated with the upper frame lying on the south side of the entry and the oil vessel and glass near the center of the roadway, all about eight feet inside of where his body was located. Owing to the lamp being open, some men were of the opinion that this was the iniatory point of the explosion and that its ignition was caused by Lumley. I am informed that the course usually taken by Lumley while making his morning examination was, first to A-6 and through room No. 20 to A-7, then through first and second south, which branch off A-7 at room 45, whence back into A-7 and along this entry as far as room No. 50, at which point an impassable pool of water stood on the entry. From here Lumley's usual route was through a cross-cut into A-8 and along this entry to the face and returning through 7 to where he was found. From the point where Lumley's body lay to the furthest working chambers on A-7 the distance is about 300 feet and the men occupying these places worked there until quitting time (about 5 p. m.) the day before, and they were also visited by shot-lighter

John Franks about 7 p. m., when everything appeared to be at normal condition. Mr. Wm. Easton, pumpman, who was stationed at room No. 36, A-8 and the last to leave the mine prior to the explosion, stated in his testimony at the inquest that "at 2 o'clock, or two hours before it happened, the air current passing along A-8 was the same as usual."

Rees Pritchard, timberman, who was present when Lumley's body was found, testified that he believed Lumley's clothes were burned a little on his shoulders, while all the others who testified as to the condition of the body, stated that he was not burned, his hair and mustache were not even singed. All the others, according to the undertaker's report, were more or less burned, except A. Pesatte, Giacomozzi, Rudolf Bozo, R. Fatur, Toth, Dela-Maddalena and Hubat. The fire-boss' daily record book showed that Lumley had reported gas in room No. 61 A-8 and room No. 6, first south, Jan. 20th.

In all other explosions occurring during the time in which I have been coal mine inspector, I have been able to come to a definite conclusion as to the inception and point of origin. This can usually be determined even in the absence of any testimony of witnesses, by tracing the direction of the forces. I have given above in detail what my deputy and I have found after the explosion. These evidences of conflicting forces make it a most difficult task to come to any absolute conclusion as to the origin of this explosion.

On the day shift preceding the accident there were in the main north at least 175 men working with naked lights distributed throughout the entire portion of the mine wherein the effects of the explosion are shown. Among these were 148 miners who had been working in rooms widely distributed through the same district. After the day shift had left the mine, the shot-lighters passed through practically all the workings with their naked lights and fired the shots of the 148 miners, and then came out about 7 o'clock. The conclusion to be drawn from this condition is that the mine was reasonably safe at 7 o'clock. When the shot-lighters finished their work of firing, the night shift, consisting of twenty-three men, went into the mine and the explosion occurred at 4 o'clock the next morning. The testimony of Mr. Easton, pumpman, as referred to above and who was in the mine until 2 o'clock in the morning and stated that the air was circulating in the usual manner, so that the conditions which brought about the explosion apparently arose shortly before it occurred. The night engineer testified that the fan was continuously in motion at a speed of 115 revolutions per minute until it was disabled by the concussion.

AFTER THE EXPLOSION.

When Mr. Griffiths, deputy inspector, entered A-9 and 10 on the morning of Jan. 24th both these entries had filled with firedamp to a distance of 400 feet back from the face. When the

gas was removed and the faces reached, numberless small "blowers" of gas could be heard buzzing as they issued from the faces and sides, and the water over the road-beds was dotted with bubbles of gas issuing from the floor, showing that the place generated gas quite freely. The same condition was also found at the faces of first and second south and in A-5 and 6. A door left open and the air circuit cut off from such places for a length of time would result in their filling up with gas. The occupants of A-9 and 10 were driving a cross-cut through the pillar to meet each other near the face of their entries. The two who worked in 10 were the shot-lighters for the night shift, and they had already fired their own shots and also those of A-9. Both these rounds had done their work in a satisfactory manner and neither of them showed any sign of having been a "blown-out" or "windy" shot, and this was all the blasting done on that shift. There were several holes already drilled, and one charged in the pillars of 3, 4 and 5 off A-10, but none fired. I found three "blown-out" shots in room No. 22 A-10 and one in the third south off A-7. Had these holes been fired on this memorable shift I would have been inclined to attribute the cause of the explosion to one of them, but these places were not working on the night shift and it was positively proven that they were fired the night before.

I submit in detail these facts for a record of the circumstances surrounding this explosion and that are necessarily essential in determining its cause. Different theories may be advanced to account for such an explosion, but I am not able now and probably never will be able to determine with any degree of certainty its initiatory point or to definitely support any conclusion by reasons concerning the same. However, it is safe to state that the large amount of dust cokings deposited and this found at so widely separated localities proves conclusively that in spite of the wet condition of the road-ways, dust took an important part in augmenting the explosion and I believe that its transmission from the starting point to the other remote districts was wholly due to this same agency. Thus showing that sprinkling of road-beds only, is not an absolute preventative against the exploding of dust and that the roof and sides should be sprinkled as well.

Before this accident my deputy and myself had made several inspections and we had always considered this one of the safest mines in the State. Our inspection is directed to the safety and sanitary condition of the mine, which includes the general workings, together with the ventilation. In this respect the mine was adequately equipped to force the air into all working places. The detail of continuously conducting the air to faces of all the places must, of necessity, be left to the operators. Should this urgent detail be omitted as to a number of places producing explosive gas, then disasters are liable to

occur, notwithstanding the mine may be fully equipped to cope with any directions or instructions I may have given.

Of the twenty-four victims only three showed any signs of having lived any time after the explosion, viz., the two Sipos and Lumley. The former two worked in A-12. Their coats and dinner pails were left at their dining quarters close to their working places, but their bodies were found 300 feet further out on the main entry, which distance they no doubt traveled in their effort to escape and were there overcome by the deadly afterdamp. The entry stood intact along this part and no sign of force or heat was left, except that their tool box had been moved a few feet towards the face, and both bodies were burned. It is also possible that Lumley lived a few seconds, as the position in which he lay with one arm resting on some timber that had been blown by the explosion, and his lamp lay a few feet inside, suggested the probability that he walked some distance after it occurred.

Very respectfully,

JOHN D. JONES,
State Coal Mine Inspector.

VERDICT OF THE JURY.

We, the undersigned Coroner's Jury, duly impaneled and sworn to try the issue of the cause of the death of Angelo Della-Maddalena, Encio Stiffi, C. Casagrande, Robt. Fatur, John Fatur, Genlicio Rudolph, John Tokar, John Bozo, John Toth, Omobono Stuffatti, Modesta Formilli, Fortunato Gacamozi, Angelo Pesseta, Luis Sipos, Jos. Sipos, Frank Hobert, Dominic Pessetta, John Hamecke, John Sine, Frank Urich, Frank Smurdel, John Paulich, find that the said parties came to their death in Primero, said county and State, on the 23rd day of January, A. D. 1907, by an explosion in the Primero mine and that the cause of said explosion is unknown to this jury.

In Testimony Whereof, The said Jurors have set their hands, at Primero, Colorado, this 26th day of January, A. D. 1907.

CHAS. TREW.
SUIS SANTSTAVIN (X, his mark).
FRANCH STATIGNER.
JESSE SHAW.
HENRY BROWN.
CHARLES THOMAS.

JOHN R. GUILFOIL,
Coroner of Las Animas County, Colorado.

An inquisition holden at Primero, in Las Animas county, State of Colorado, on the 7th day of February, A. D. 1907, before John Guilfoil, coroner of said county, upon the body of Rees J. Lumley, there lying dead, by the jurors whose names are hereunto subscribed, said jurors upon their oaths do say that

Rees J. Lumley came to his death by an explosion of gas in the mine of Primero, in said county and State, 23rd day of January, A. D. 1907. Cause of said explosion unknown to this jury and the body found is the body of Rees J. Lumley beyond a doubt.

CHAS. TREW.
FRANCH STAGNER.
SUIS STANTSTAVIN, (X, his mark).
CHARLES THOMAS.
JESSE SHAW.
HENRY BROWN.

JOHN R. GUILFOIL,
Coroner.

On May 19th, 1907, five men, whose names are given below, lost their lives in the Engleville mine by suffocation from inhaling noxious gases generated by fires that had existed in the mine and had necessitated the closing down of its largest producing district for a year.

Name of Victim	Nationality	Occupation	Age	Married or Single
Alex Jacobs	Scotch-Irish	Superintendent	43	Married
Joe Rizzi	Italian	Laborer	38	Married
Frank Ferraro	Italian	Laborer	25	Single
Carl Fulchiero	Italian	Laborer	26	Single
Guiseppi Battu	Italian	Laborer	23	Single

The fire which caused the disaster was started in a crosscut between the main entry and its parallel air course in the vicinity of the 17th east, May 23rd, 1906, and it was believed at that time to have been of incendiary origin. Immediately after the employes were withdrawn from the workings inside an effort was made to extinguish the fire by means of water and removing the burning coal and debris, but the attack was of no avail, as the fire had gained too much headway and the men were forced to retreat and build sealed stoppings on both entry and air course at a convenient point further out to check its progress. Since that time the fire has been fought almost continuously. Thousands of cubic feet of manufactured carbonic acid gas was periodically inserted into the isolated area through pipes and each insertion had a decided effect upon the fire. When the gas process was not in use the fire was fought with water. When this accident occurred the fire had receded and the entries had been reopened to a point beyond the 19th west, which is about 600 feet inside of where it first started. The fan was forcing and the air entered along the air course and returned through the main entry. The 19th and 20th west entries and their tributary workings, which had long since been worked out and abandoned, were broken into the Starkville mine, and some of the air current was escaping through

these places and finding an outlet through the old workings of Starkville. When these entries were reached, which was several weeks before the accident took place, some fire was found a short distance inside of their entrances, and the extinguishing forces worked at it until they thought it was all out. A short distance inside of the 20th the air course was sealed with a stone stopping for the purpose of isolating a fire that was still burning at a point between there and the 21st entry. Here the air current was carried through a cross-cut into the main entry, then forward along the main for about 300 feet, where it was again conducted through a diagonal cross-cut back into the air course at a point nearly opposite the 21st entry and at which location the five men were working on the fatal shaft. From here the air traveled inward for some distance through the air course, then crossed over the main into the 21st east, back through the old east workings and returning into the main at the 19th east. They were working three shifts. Four of the deceased men entered the mine at 3 p. m. on the 19th inst. and later in the evening Superintendent Jacobs went in to see how the men were progressing. The 11 o'clock shift laid off that night. It was nearly 7 o'clock in the morning of the 20th when the news was received that the men, although supposed to be out at 11 the night before, were still in the mine.

Robert McAllister, foreman of the morning shift, and some of his men hastened into the mine to find what had occurred to the missing shift and to render the men assistance if necessary. Upon their arrival at the mouth of the 19th west entry, which I have heretofore mentioned as the point where the air was leaking into the Starkville mine, they discovered that volumes of smoke were issuing from the said 19th west and the same was being carried in by the air to the place where the men had been working. The men now well realized what had happened to the other shift, and Mr. McAllister and some of his men started at once to rescue the bodies. The smoke, being of lighter specific gravity than the air, was thickest along the roof and the rescuers, led by McAllister, at the risk of their lives, crawled on hands and knees under the deadly smoke and when in about half the distance between the 20th and 21st east, on the main entry, they found the body of Superintendent Jacobs and one other lying together. The other three bodies were found about 50 feet further in, all lying on the floor of the entry, where they had fallen while retreating about 100 and 150 feet back from the face. Death was caused from suffocation by breathing the deadly fumes given off by the fire in the 19th west, which they thought they had completely extinguished, but which was afterwards rekindled and the reversing of the current which had up to this time escaped through the old workings of Starkville forced the fumes upon them. The position in which Superintendent Jacobs was found indicated strongly that he made an effort to carry the deceased, who was

found lying with him, out to save his life, but unfortunately he fell in the attempt before reaching fresh air.

JOHN D. JONES.

Denver, Colo., May 25th, 1907.

VERDICT OF THE JURY.

That John Rizzi, Frank Ferraro, Guissippi Battic, Carlo Fulchiero and Alex. Jacobs came to their deaths by inhaling carbon monoxide or white damp while working in the Engleville mine, May 19th, 1907, and that said miners had worked where the said gases existed previous to this date and since the progress of the fire had been checked and were aware of the danger existing, thereby taking their own risk.

F. E. COLE, Foreman.
C. H. GILLEN,
S. T. BURKHART,
R. J. KNIGHT,
W. S. HULETT,
G. R. STODDARD,
Jurors.

JOHN R. GUILFOIL,
Coroner Las Animas County.

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Simpson	Mitchell	Acme
Thickness of bed	8 ft.	5 ft.	6 ft.
Kind of opening	Shaft	Shaft	Shaft
Character of coal	Lignite	Lignite	Lignite
January	16,166	2,576	14,473
February	6,275	Shut	9,480
March	7,001	down	4,339
April	9,978	....	4,522
May	7,726	....	3,090
June	5,422	....	4,078
July	5,907	721	3,923
August	8,143	1,782	4,794
September	13,795	2,541	7,157
October	23,809	3,636	16,436
November	16,153	6,494	13,369
December	23,000	3,750	15,300
Totals	143,375	21,500	100,961

BOULDER COUNTY, 1908.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Rex No. 1	Rex No. 2	Hecla	Gorham	Industrial	Vulcan
6 ft.	6 ft.	5 ft.	6 ft.	6 ft.	7 ft
Shaft	Shaft	Shaft	Slope	Shaft	Shaft
Lignite	Lignite	Lignite	Lignite	Lignite	Lignite
13,091	3,304	6,635	8,118	8,333	4,257
9,655	2,518	4,769	7,919	6,613	1,678
4,326	1,607	2,999	6,589	4,278	1,427
4,270	1,925	2,529	5,845	4,705	450
4,279	1,759	1,754	5,406	2,233	345
4,975	1,468	2,414	3,678	Not producing	325
4,151	1,669	2,141	Not producing	3,210	664
5,829	2,429	2,018	4,580	3,535	1,227
7,515	2,421	4,292	6,674	4,256	2,160
14,600	4,540	8,678	9,921	8,803	6,643
13,143	4,347	8,085	9,710	7,952	5,624
15,250	3,600	8,750	6,900	9,500	8,000
101,084	31,587	55,064	75,337	63,418	32,800

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Monarch	Standard	Strathmore	Fox
Thickness of bed	5 to 7 ft.	8½ ft.	6 to 10 ft.	8½ ft.
Kind of opening	Shaft	Shaft	Shaft	Shaft
Character of coal	Lignite	Lignite	Lignite	Lignite
January	15,724	16,299	5,674	4,991
February	15,037	13,801	3,254	2,122
March	13,278	11,591	2,081	1,831
April	10,399	10,729	1,654	1,165
May	9,523	6,505	1,736	861
June	5,593	Not pro-	960	1,150
July	6,331	ducing	1,658	1,113
August	8,466	"	1,478	522
September	11,798	3,666	2,625	1,677
October	16,422	13,278	3,174	6,819
November	15,307	15,004	3,283	6,708
December	14,000	15,000	3,000	7,400
Totals	141,878	105,873	29,977	36,359

BOULDER COUNTY, 1908—Continued.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Matchless	Centennial	Electric	Nonpareil	Sunnyside	Capitol
5 ft.	6 ft.	5 ft.	9 to 10 ft.	5 ft.	6½ ft.
Shaft	Shaft	Shaft	Shaft	Shaft	Shaft
Lignite	Lignite	Lignite	Lignite	Lignite	Lignite
3,178	4,819	4,300	5,349	2,100	....
1,374	3,296	4,400	3,538	2,879	....
1,230	3,030	2,900	2,502	900	New
667	2,003	3,600	1,220	2,159	mine
511	2,180	2,750	1,508	1,800	1,700
367	1,550	1,800	467	205	1,487
819	1,040	3,450	790	702	1,475
1,133	1,100	1,900	1,655	1,741	1,571
1,142	1,350	2,500	3,340	1,602	2,663
2,603	6,000	3,900	5,051	1,694	4,900
3,162	7,290	2,590	6,125	564	5,392
3,500	7,000	3,510	6,000	1,500	8,000
19,886	40,658	37,600	37,545	17,846	27,188

PRODUCTION OF BOULDER COUNTY, 1908—Concluded.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TON OF 2,000 POUNDS.

Name of mine	Lucas	Irvington	Willoughby	New Baker	
Thickness of bed	5 to 6 ft.	5 to 6 ft.	8 to 5 ft.	8 ft.	
Kind of opening	Shaft	Shaft	Shaft	Slope	Total
Character of coal	Lignite	Lignite	Lignite	Lignite	Tonnage
January	....	110	....	....	139,497
February	....	Shut down	...	....	98,808
March	New mine	....	....	....	71,909
April	....	....	....	....	67,820
May	800	....	....	....	56,466
June	395	....	....	....	36,334
July	210	....	....	....	39,374
August	473	....	....	....	54,376
September	1,042	....	...	....	84,216
October	1,962	....	....	....	162,869
November	1,545	....	....	....	151,844
December	2,000	....	1,500	3,350	169,810
Totals	8,427	110	1,500	3,350	1,133,323

PRODUCTION OF DELTA COUNTY, 1908.

SHOWING YEARLY PRODUCTION OF MINE IN TONS OF 2,000 POUNDS.

Name of mine	King (formerly Juanita)	
Thickness of bed	9 to 14 ft.	
Kind of opening	Drift	Total
Character of coal	Bituminous	Tonnage
December	29,951	29,951
Totals	29,951	29,951

PRODUCTION OF DOUGLAS COUNTY, 1908.

SHOWING YEARLY PRODUCTION OF MINE IN TONS OF 2,000 POUNDS.

Name of mine	Platte Canon	
Thickness of bed	5½ to 7 ft.	
Kind of opening	Shaft	Total
Character of coal	Lignite	Tonnage
December	1,250	1,250
Totals	1,250	1,250

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN

Name of mine	Curtis	Rapson No. 2	Danville	Pikeview
Thickness of bed	12 to 17 ft.	7 to 9 ft.	10 ft.	12 ft.
Kind of opening	Shaft	Shaft	Slope	Shaft
Character of coal	Lignite	Lignite	Lignite	Lignite
January	7,779	8,913	4,200	4,793
February	7,602	8,500	3,785	4,535
March	7,376	6,854	3,850	3,273
April	6,953	6,192	3,053	3,346
May	5,967	3,448	4,180	7,470
June	7,054	419	5,426	8,465
July	6,810	823	5,340	9,257
August	7,040	1,049	2,458	8,350
September	7,264	2,321	3,530	7,879
October	8,446	4,383	4,795	9,750
November	8,628	3,783	3,866	9,134
December	9,000	5,000	4,834	11,540
Totals	89,919	51,685	49,317	87,792

EL PASO COUNTY, 1908.

TONS OF 2,000 POUNDS.

Patterson	Williamsville	Austin Bluffs	Franceville	Neer	
16 ft.	4 to 6 ft.	6 ft.	6 ft.	4 ft.	
Slope	Slope	Shaft	Slope		Total
Lignite	Lignite	Lignite	Lignite	Lignite	Tonnage
3,527	1,377	2,422	302	.....	33,313
1,049	1,180	2,145	200	.....	28,996
2,642	1,477	1,055	160	.....	26,687
1,570	615	640	75	.....	22,444
1,571	489	581	60	.....	23,766
1,038	249	213	60	.....	22,924
1,176	Idle	246	.....	.....	23,652
1,039	Idle	405	66	.....	20,407
1,526	326	751	60	.....	23,657
3,100	878	1,509	175	.....	33,036
3,600	500	2,000	185	.....	31,696
3,600	Abandoned	2,000	145	2,600	38,719
25,438	7,091	13,967	1,488	2,600	329,297

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Rockvale	Coal Creek	Fremont
Thickness of bed	3½ ft.	3½ ft.	3 to 15 ft.
Kind of opening	Shaft	Slope	Shaft
Character of coal	Semi-bit.	Semi-bit	Semi-bit.
January	14,846	8,673	7,953
February	11,469	7,805	5,943
March	6,191	4,616	6,427
April	12,317	10,354	5,714
May	14,800	11,126	7,153
June	14,633	11,218	8,738
July	21,347	11,831	9,964
August	20,092	10,656	7,178
September	16,445	9,446	5,731
October	20,198	11,285	9,929
November	21,416	10,512	7,289
December	18,000	10,000	6,000
Totals	191,754	117,522	88,019

FREMONT COUNTY, 1908.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Brookside	Nonac	Chandler	Radiant	Magnet	Royal Gorge
5 to 6 ft.	5 ft. 8 in.	5 to 5 ft.	3½ ft.	4½ ft.	3 ft. 9 in.
Slope	Slope	Shaft	Slope	Slope	to Slope
Semi-bit.	Semi-bit.	Semi-bit.	Semi-bit.	Semi-bit.	Semi-bit.
3,953	2,129	7,570	3,347	4,017	2,999
Shut	Idle	4,786	2,177	4,557	2,883
down	Idle	4,321	3,196	2,349	2,473
.....	Idle	6,476	2,658	3,330	1,527
.....	15	7,830	2,853	3,785	1,682
.....	15	7,194	1,567	2,999	975
.....	.....	11,886	2,181	3,830	2,000
.....	.....	6,178	1,104	3,723	1,400
.....	.....	9,999	1,608	4,255	2,500
.....	.....	11,949	2,000	5,299	4,270
.....	.....	10,869	2,122	3,937	2,833
.....	.....	11,409	2,104	5,200	3,500
3,953	2,159	100,467	26,917	47,281	29,042

PRODUCTION OF FREMONT COUNTY, 1908—Concluded.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS

Name of mine	Cowan	Florence	Williamsburg	Central	Diamond	Emerald	Norton	
Thickness of bed	4 to 5 ft.	3½ ft.	3½ ft.	5 ft.	6 ft.	3 ft.	3½ to 4½ ft.	
Kind of opening	Slope	Drift	Slope	Shaft	Shaft	Slope	Shaft	Total
Character of coal	Semi-bit.	Semi-bit.	Semi-bit.	Semi-bit.	Semi-bit.	Semi-bit.	Semi-bit.	Tonnage
January	227	.....	335	.....	.....	.....	.....	56,049
February	216	.....	325	.....	.....	.....	.....	40,161
March	247	.....	150	.....	.....	.....	.....	29,970
April	107	.....	100	New	.....	.....	.....	42,583
May	Idle	.....	Idle	mine	.....	.....	.....	49,244
June	.....	.....	.....	100	.....	.....	.....	47,439
July	.....	.....	.....	120	.....	.....	.....	63,159
August	.....	.....	.....	132	.....	.....	.....	50,463
September	.....	.....	.....	128	.....	.....	.....	50,112
October	75	....	225	Not	.....	.....	.....	65,230
November	97	.....	225	produc-	.....	.....	712	60,012
December	125	5,750	250	ing	3,290	4,519	1,500	71,647
Totals	1,094	5,750	1,610	480	3,290	4,519	2,212	626,069

PRODUCTION OF GARFIELD COUNTY, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine.....	Midland	Keystone	Coryell	South Canon	Diamond	
Thickness of bed...	6 to 7 ft.	2 ft.	13 ft.	4 & 17 ft.		
Kind of opening.....	Drift.	Slope.	Drift.	Drift.	Drift.	Total
Character of coal...	Bitum.	Bitum.	Bitum.	Bitum.	Bitum.	tonnage
January	8,484	354	7,283	1,565	1,500	19,186
February	8,292	426	3,687	2,337	600	15,342
March	8,372	349	5,175	1,625	None	15,521
April	5,256	231	7,061	866	1,450	14,864
May	4,416	283	5,310	1,844	1,600	13,483
June	4,276	106	5,349	3,748	900	14,379
July	4,232	Idle	5,021	3,376	975	13,604
August	4,947	.....	5,620	2,470	2,000	15,037
September	5,279	.....	5,764	4,558	2,300	17,901
October	6,847	191	9,246	3,740	2,000	22,024
November	5,944	1,908	9,884	3,481	1,400	22,617
December	6,500	2,500	10,000	4,000	2,000	25,000
Totals	72,845	6,348	79,430	33,610	16,725	208,958

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Crested Butte	Floresta	Somerset
Thickness of bed	12 to 20 ft.	3 ft.	21 ft.
Kind of opening	Slope	Drift	Slope
Character of coal	Bituminous	Anthracite	Bituminous
January	7,148	Closed	18,407
February	5,148	.....	12,475
March	8,708	.....	11,203
April	9,039	.....	13,972
May	10,716	6,553	12,516
June	11,139	7,486	13,945
July	7,961	9,254	13,418
August	8,583	9,070	13,687
September	8,336	7,972	19,485
October	8,851	7,655	20,034
November	9,706	6,430	18,536
December	10,000	1,200	21,900
Totals	105,335	55,620	189,578

GUNNISON COUNTY, 1908.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Alpine	Kubler	Porter	Silver Brook	Bulkley	
5 to 7 ft.	.....	15 ft.	3 ft.	5 ft. 4 in	
Shaft	Drift	Slope	Slope and Shaft	Slope	Total
Semi-bit.	Semi-bit.	Bituminous	Anthracite	Bituminous	Tonnage
8,084	945	4,354	1,062	3,705	43,705
4,368	Idle	2,013	1,019	1,362	26,385
3,528	.....	1,871	1,119	Idle	26,429
5,410	.....	1,718	526	.....	30,665
4,618	.....	1,984	954	68	37,409
5,945	.....	2,652	1,220	1,726	44,113
5,543	.....	2,102	1,236	2,862	42,376
2,196	1,943	1,775	1,119	2,652	41,025
6,321	4,591	1,500	1,192	2,385	51,782
5,020	5,870	1,372	1,425	3,612	53,839
5,870	4,859	2,972	1,448	3,766	53,587
7,000	5,500	3,800	1,500	3,800	54,700
63,903	23,708	28,113	13,820	25,938	506,015

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Robinson	Walsen	Rouse	Cameron
Thickness of bed	4 to 7 ft.	5 to 7 ft.	6½ ft.	3 to 3 ft. 8 in.
Kind of opening	Slope	Slope	Slope	Slope
Character of coal	Bituminous	Bituminous	Bituminous	Bituminous
January	17,659	15,955	15,720	2,770
February	9,821	8,799	10,343	4,026
March	8,897	10,296	13,198	4,572
April	17,506	9,968	11,510	4,161
May	17,182	15,742	18,618	3,744
June	19,247	11,184	14,380	3,798
July	20,741	8,788	17,837	3,906
August	26,435	Idle	12,219	4,069
September	20,159	.....	16,273	4,360
October	25,031	.....	19,308	3,831
November	23,119	.....	19,996	3,649
December	24,300	10,000	20,000	4,100
Totals	230,097	90,732	189,402	46,986

HUERFANO COUNTY, 1908.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Hezron	Pictou	Maitland	Pryor	Champion	Toltec
4 ft. 4 in.	4 ft. to 10 ft.	6 ft.	5 ft. to 7 ft.	4½ ft.	3½ ft.
Slope and drift Bituminous	Slope Bituminous	Slope Bituminous	Slope Bituminous	Slope Bituminous	Slope Bituminous
4,030	2,836	10,048	8,957	1,607	5,629
Closed	Closed	9,533	4,136	Closed	4,400
.....	.....	3,240	4,246	.....	2,527
.....	1,459	9,571	4,355	.....	8,196
.....	7,226	9,881	7,212	.....	6,627
5,105	10,104	8,644	6,666	.....	8,027
5,824	10,724	6,928	6,840	.....	7,250
3,804	9,603	6,273	6,095	.....	3,543
3,520	11,658	5,301	7,162	.....	5,568
4,620	9,988	6,600	10,125	522	6,703
5,743	10,217	5,807	10,365	1,790	6,270
7,000	13,100	6,203	10,000	2,000	8,000
39,646	86,915	88,029	86,159	5,919	72,750

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Midway	Rugby	Sunnyside	Pinon
Thickness of bed	6 ft.	4 ft.	6 to 8 ft.	3 to 4 ft.
Kind of opening	Slope	Slope	Slope	Shaft
Character of coal	Bituminous	Bituminous	Bituminous	Bituminous
January	5,726	9,553	5,264	9,294
February	4,259	7,371	4,747	2,319
March	6,788	4,002	3,492	3,392
April	7,360	5,862	3,983	3,554
May	10,227	6,556	3,650	4,680
June	8,591	8,723	3,200	6,616
July	10,225	11,125	3,395	9,700
August	8,934	6,375	5,742	4,353
September	10,952	5,630	4,016	4,042
October	11,230	8,018	5,630	7,548
November	12,182	7,606	4,850	8,042
December	12,000	9,500	7,500	10,000
Totals	108,474	90,321	55,469	73,540

HUERFANO COUNTY, 1908—Continued.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Huerfano	Round Oak	Oakdale	Tioga	Gordon	Big Four
5 and 5½ ft.	2 ft. 9 in.	7½ ft.	5½ ft.	5½ ft.	6½ ft.
Shaft	Slope	Slope	Slope	Slope	Slope
Bituminous	Bituminous	Bituminous	Bituminous	Bituminous	Bituminous
5,308	3,980	2,770	2,829	2,900	413
3,922	2,220	1,996	2,185	2,638	1,164
2,575	1,299	1,742	3,342	1,474	1,041
3,645	2,850	5,586	2,570	2,106	1,431
5,363	2,548	4,175	2,310	2,387	309
5,130	2,448	8,748	2,455	3,707	520
5,408	2,894	7,297	2,672	4,526	1,960
4,724	2,865	5,459	3,289	2,092	2,038
4,262	3,760	5,721	3,198	2,471	2,681
5,448	5,088	8,745	3,857	3,441	3,000
5,243	4,438	9,272	4,517	3,396	4,711
5,400	5,000	10,000	4,500	3,395	5,000
56,428	39,390	71,511	37,724	34,533	24,268

PRODUCTION OF HUERFANO COUNTY, 1908.—Concluded.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Sweet	Occidental	
Thickness of bed	5 ft.	6 ft.	
Kind of opening	Slope	Drift	Total
Character of coal	Bituminous	Bituminous	Tonnage
January	730	412	134,400
February	Closed	472	84,351
March	....	340	76,463
April	....	130	105,803
May	....	740	129,177
June	....	291	137,584
July	....	356	148,396
August	....	Closed	117,912
September	285	....	121,019
October	432	....	149,165
November	866	....	152,079
December	1,000	....	177,998
Totals	3,313	2,741	1,534,347

PRODUCTION OF JEFFERSON COUNTY, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Leyden	Morrison	
Thickness of bed	9 ft.	15 ft. 8 in.	
Kind of opening	Shaft		Total
Character of coal	Lignite	Lignite	Tonnage
January	21,603	....	21,603
February	17,249	....	17,249
March	14,326	....	14,326
April	12,229	....	12,229
May	11,322	....	11,322
June	13,671	....	13,671
July	13,847	....	13,847
August	11,306	....	11,306
September	11,753	....	11,753
October	10,798	....	10,798
November	11,015	....	11,015
December	16,000	850	16,850
Totals	165,119	850	165,969

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Primero	Berwind	Starkville
Thickness of bed	7 ft.	4-4 to 6 ft.	4 to 8 ft.
Kind of opening	Drift	Drift	Drift
Character of coal	Bituminous	Bituminous	Bituminous
January	36,408	35,174	30,584
February	20,664	28,955	22,427
March	20,583	34,058	26,617
April	17,049	34,619	24,044
May	23,332	33,570	32,346
June	14,157	32,551	18,334
July	14,608	32,870	19,097
August	18,309	30,106	20,699
September	18,184	30,979	17,188
October	25,741	34,215	Feb. 14, 1908 22,383
November	26,833	31,553	27,852
December	27,600	32,000	30,000
Totals	263,468	390,650	291,571

LAS ANIMAS COUNTY, 1908.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Engle	Tercio	Sopris	Tobasco	Morley	Frederick
7 ft.	3 to 6½ ft.	3½ to 5 ft.	5 ft.	5 to 7 ft.	7 ft.
Drift	Drift	Drift	Slope	Drift & Slope	Drift
Bituminous	Bituminous	Bituminous	Bituminous	Bituminous	Bituminous
24,116	3,558	12,528	13,738	28,914	18,936
18,804	.....	18,222	9,058	18,662	12,280
24,342	.....	8,064	11,028	28,816	10,456
16,860	.....	11,458	11,427	22,866	7,555
25,451	.....	12,483	12,860	33,526	Idle
14,723	.....	10,266	9,466	20,369	.....
19,542	.....	10,516	8,491	17,805	.....
15,092	.....	10,571	7,691	19,277	.....
19,936	.....	11,698	9,750	15,767	.....
20,853	.....	14,122	9,686	24,697	.....
21,254	.....	11,919	9,282	35,547	7,580
17,600	.....	12,000	9,000	42,000	14,300
238,573	3,558	143,847	121,477	308,246	71,107

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Quinto	Delagua	Hastings
Thickness of bed	6 ft.	6 ft.	5 to 8 ft.
Kind of opening	Drift	Slope & Drift	Slope
Character of coal	Bituminous	Bituminous	Bituminous
January	1,072	57,490	38,680
February	.....	37,161	31,262
March	.....	46,528	31,195
April	.....	39,825	36,954
May	.....	46,898	38,774
June	.....	33,367	36,489
July	.....	31,662	31,311
August	.....	31,726	29,368
September	.....	36,242	28,260
October	.....	52,068	35,978
November	.....	44,551	33,523
December	.....	48,309	34,750
Totals	1,072	505,827	406,544

LAS ANIMAS COUNTY, 1908—Continued.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Gray Creek	Bowen	Cokedale	Piedmont	LeBelle	Francisco
4 to 5 ft.	7 to 8 ft.	6 ft.	4½ ft.	4 ft.	5 ft.
Drift	Drift	Drift & Slope	Slope	Drift	Slope
Bituminous	Bituminous	Bituminous	Bituminous	Bituminous	Bituminous
13,384	19,078	17,967	6,222	4,602	4,296
11,360	13,883	16,833	2,830	4,332	1,250
12,028	9,862	20,003	3,248	2,858	1,620
11,229	16,388	20,150	2,329	4,248	2,506
11,290	12,657	20,958	10,148	4,567	1,548
9,796	12,992	28,734	7,876	3,657	1,986
12,633	10,830	33,800	9,274	3,968	1,667
12,619	13,329	27,153	7,823	4,063	897
10,959	12,945	24,500	10,478	4,320	1,248
11,904	16,467	28,200	10,728	1,787	4,830
15,520	20,176	29,109	9,384	3,977	2,383
13,875	18,326	33,000	10,500	4,400	3,000
146,597	176,933	300,407	90,840	46,779	27,231

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Green Canon	Suffield	Forbes
Thickness of bed	3½ to 4 ft.	5 to 6½ ft.	5 to 6 ft.
Kind of opening	Slope	Slope	Drift
Character of coal	Bituminous	Bituminous	Bituminous
January	7,118	9,607	17,665
February	3,681	1,549	12,855
March	5,704	1,911	14,325
April	5,041	8,724	17,122
May	4,356	482	15,981
June	6,259	1,006	14,326
July	8,262	579	10,366
August	6,569	653	12,247
September	7,082	691	16,609
October	8,606	9,562	21,181
November	6,867	9,885	20,194
December	8,500	12,000	20,000
Totals	78,045	56,649	192,871

LAS ANIMAS COUNTY, 1908—Continued.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Greenville	Black Diamond	Tollar	Brodhead	Majestic	Primrose
6 to 7 ft.	3½ ft.	6 to 7 ft.	4 ft.	5 to 9 ft.	4 ft.
Drift	Slope	Shaft	Slope	Drift	Slope
Bituminous	Bituminous	Bituminous	Bituminous	Bituminous	Bituminous
5,654	3,746	.....	4,300	9,039	7,225
2,943	1,739	.....	3,413	8,638	3,914
1,280	Idle	.....	3,095	9,518	3,849
2,344	2,197	.....	4,500	9,418	5,062
4,304	1,981	.....	4,500	9,607	6,134
1,800	997	.....	4,500	9,089	6,096
4,415	Idle	.....	5,600	8,829	6,561
5,059	1,898	.....	4,100	9,147	7,534
5,409	1,898	.....	5,100	8,072	7,056
7,036	2,835	648	5,550	7,968	6,947
9,037	3,584	547	4,000	6,359	7,039
12,000	6,000	1,000	5,000	7,000	7,000
61,281	25,684	2,195	53,658	102,684	74,417

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Ludlow	Bloom	Rapson No. 1
Thickness of bed	6 and 4 ft.	5 ft.	4 ft.
Kind of opening	Drift	Drift	Slope
Character of coal	Bituminous	Bituminous	Bituminous
January	5,664	2,533	1,168
February	4,491	2,092	1,633
March	2,515	1,678	170
April	1,373	1,189	770
May	2,756	580	1,396
June	2,948	549	1,794
July	3,770	944	2,501
August	4,148	804	3,216
September	4,744	1,083	3,226
October	6,109	1,483	4,064
November	6,923	1,683	5,306
December	6,500	1,709	5,000
Totals	51,941	16,318	30,649

LAS ANIMAS COUNTY, 1908—Continued.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Thomas	Southwestern	Jewel	Stevens	Baldy	Red Robin
3 ft. 8 in.	4½ ft.	3 ft.	5½ ft.	6 ft.	5 ft.
Slope	Slope	Slope	Drift	Drift	Drift
Bituminous	Bituminous	Bituminous	Bituminous	Bituminous	Bituminous
1,991	948	650	640	909	.....
964	987	383	502	518	.....
904	909	53	153	388	.....
Idle	1,183	715	147	300	.....
683	775	516	97	230	.....
Idle	1,383	940	86	296	.....
645	1,488	950	96	278	.....
1,082	560	692	122	367	520
1,037	858	725	245	666	300
1,722	878	690	341	400	758
1,339	1,288	730	372	594	765
1,800	1,350	860	400	595	1,100
12,167	12,607	7,904	3,201	5,541	3,443

PRODUCTION OF LAS ANIMAS COUNTY, 1908—Concluded.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Empire	McLaughlin	
Thickness of bed	6 ft.	6½ ft.	
Kind of opening	Slope	Slope	Total
Character of coal	Bituminous	Bituminous	Tonnage
January	.....	.....	445,604
February	.....	.....	318,285
March	.....	.....	337,758
April	.....	.....	339,592
May	.....	.....	374,786
June	.....	.....	306,832
July	.....	.....	313,758
August	.....	.....	306,250
September	.....	.....	317,255
October	.....	.....	400,437
November	.....	.....	416,955
December	10,575	10,533	469,573
Totals	10,575	10,533	4,347,085

PRODUCTION OF LA PLATA COUNTY, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Hesperus	Porter	Perin's Peak	City	Champion	
Thickness of bed	5 ft.	2 ft. 8 in.	2 to 6 ft.	3 ft.	3 ft.	
Kind of opening	Drift	Slope	Drift	Tunnel	Tunnel	Total
Character of coal	Semi-bit.	Bituminous	Bituminous	Bituminous	Bituminous	Tonnage
January	4,099	2,921	3,627	1,565	1,340	13,552
Febryary	3,831	2,289	3,894	1,865	618	12,497
March	2,127	2,443	5,273	1,774	634	12,251
April	1,598	1,830	4,187	1,888	297	9,800
May	1,677	1,806	5,462	1,859	445	11,249
June	2,127	264	5,122	2,834	539	10,886
July	1,531	Abandoned	6,305	3,009	125	10,970
August	2,587	.....	5,760	3,181	291	11,819
September	4,124	.....	5,039	2,816	542	12,521
October	6,299	.....	6,560	2,489	829	16,177
November	5,944	.....	7,270	2,689	621	16,524
December	5,800	.....	7,500	3,000	Closed	16,300
Totals	41,744	11,553	65,999	28,969	6,281	154,546

PRODUCTION OF MESA COUNTY, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Cameo	Book Cliff	Palisade	Stokes	Garfield	Grandview	P. V.	Farmer	
Thickness of bed	6 ft.	7 ft.	3 ft. 10 in.	3 ft. 8 in.	7 ft.	4 ft.	6 ft.	2½ ft.	
Kind of opening	Drift	Drift	Drift	Drift	Slope	.....	.....	.....	Total
Character of coal	Semi-bit	Semi-bit.	Semi-bit.	Semi-bit.	Semi-bit	Semi-bit.	Semi-bit.	Semi-bit.	Tonnage
January	2,512	1,251	1,189	312	.....	.....	.....	.....	5,264
February	2,267	984	720	290	.....	.....	.....	.....	4,261
March	2,156	719	457	285	.....	.....	.....	.....	3,617
April	1,421	528	521	110	.....	.....	.....	.....	2,580
May	1,483	642	456	170	.....	.....	.....	.....	2,751
June	1,346	328	390	110	.....	.....	.....	.....	2,174
July	1,511	369	275	115	.....	.....	.....	.....	2,270
August	2,061	143	432	140	.....	.....	.....	.....	2,776
September	3,473	69	563	284	.....	.....	.....	.....	4,389
October	4,640	688	309	340	.....	.....	.....	.....	5,977
November	6,686	1,368	648	450	.....	.....	.....	.....	9,152
December	6,000	1,398	800	600	5,800	1,350	300	1,333	17,581
Totals	35,556	8,487	6,760	3,206	5,800	1,350	300	1,333	62,792

PRODUCTION OF MONTEZUMA COUNTY, 1908.

SHOWING YEARLY PRODUCTION OF THE MINE IN TONS OF 2,000 POUNDS.

Name of mine	Mancos	
Thickness of bed	2½ ft.	
Kind of opening	Drift	Total
Character of coal	Lignite	Tonnage
December	441	441
Totals	441	441

PRODUCTION OF PITKIN COUNTY, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Spring Gulch	Coalbasin	Marion	
Thickness of bed	6 to 9 ft.	8 ft.	6 ft.	
Kind of opening	Slope	Slope	Drift	Total
Character of coal	Bituminous	Bituminous	Bituminous	Tonnage
January	18,420	8,746	720	27,886
February	1,714	5,253	.....	6,967
March	.....	7,710	.....	7,710
April	4,100	6,425	.....	10,525
May	7,322	6,393	.....	13,715
June	16,140	6,727	.....	22,867
July	17,600	7,827	.....	25,427
August	18,615	6,095	.....	24,710
September	17,378	6,843	.....	24,221
October	17,135	6,518	.....	23,653
November	15,420	5,608	2,301	23,329
December	17,000	7,000	4,000	28,000
Totals	150,844	81,145	7,021	239,010

PRODUCTION OF ROUTT COUNTY, 1908.

SHOWING YEARLY PRODUCTION OF THE MINE IN TONS OF 2,000 POUNDS.

Name of mine	Oak Hills	
Thickness of bed	10 ft.	
Kind of opening	Slope	Total
Character of coal	Bitum.	Tonnage.
December	3,000	3,000
Totals	3,000	3,000

PRODUCTION OF

SHOWING MONTHLY AND YEARLY PRODUCTION

Name of mine	Parkdale	Puritan	Golden Ash
Thickness of bed	12 ft.	10⅓ ft.	8 ft.
Kind of opening	Slope	Shaft	Shaft
Character of coal	Lignite	Lignite	Lignite
January	12,270	....	8,693
February	11,866	....	9,314
March	11,069	....	6,457
April	10,926	....	4,656
May	10,151	374	4,155
June	6,738	560	837
July	8,647	787	1,730
August	11,229	412	2,114
September	11,340	3,462	3,656
October	13,433	6,349	9,051
November	12,290	7,518	9,540
December	13,000	10,800	11,000
Totals	132,959	30,262	71,203

WELD COUNTY, 1908.

OF EACH MINE IN TONS OF 2,000 POUNDS.

Lehigh	Frederick	Evans	Shamrock	Ideal	Warwick
5 ft.	8 ft.	8 ft.	11 ft.	8 ft.	7 ft.
Shaft	Slope	Shaft	Shaft	Slope	Shaft
Lignite	Lignite	Lignite	Lignite	Lignite	Lignite
6,122	697	249	786	813	496
2,906	1,060	490	1,484	875	1,510
3,193	1,040	1,065	781	521	540
2,826	550	986	591	405	343
2,615	280	942	275	375	248
1,548	3,700	890	470	588	270
1,546	3,755	1,110	400	583	325
2,295	3,755	850	579	401	525
3,972	3,790	1,500	1,031	764	332
6,114	4,001	3,072	951	936	1,640
5,839	3,752	3,180	1,161	1,152	1,500
6,450	3,500	5,000	933	1,800	1,500
45,426	29,880	19,335	9,442	9,213	9,229

PRODUCTION OF WELD COUNTY, 1908—Concluded.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH MINE IN TONS OF 2,000 POUNDS.

Name of mine	Firestone	Washington	
Thickness of bed	7 ft.	5 ft.	
Kind of opening	Shaft	Shaft	
Character of coal	Lignite	Lignite	Total Tonnage
January	475	....	30,601
February	750	....	30,255
March	480	....	25,146
April	Not working	....	21,283
May	Not working	....	19,416
June	Not working	....	15,601
July	Not working	....	18,883
August	Not working	....	22,160
September	Not working	....	29,847
October	300	....	45,847
November	50	....	45,982
December	250	1,700	55,933
Totals	2,305	1,700	360,954

PRODUCTION OF THE STATE OF COLORADO, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH COUNTY.
ALL YEARLY REPORTS GROUPED IN THE MONTH OF DECEMBER.

Counties	Boulder	Delta	Douglas	El Paso
January	139,497	....	....	33,313
February	98,808	....	....	28,996
March	71,909	....	....	26,687
April	67,820	....	....	22,444
May	56,466	....	....	23,766
June	36,334	....	....	22,924
July	39,374	....	....	23,652
August	54,376	....	....	20,407
September	84,216	....	....	23,657
October	162,869	....	....	33,036
November	151,844	....	....	31,696
December	169,810	29,951	1,250	38,719
Totals	1,133,323	29,951	1,250	329,297

PRODUCTION OF THE STATE OF COLORADO, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH COUNTY. ALL YEARLY REPORTS GROUPED IN THE MONTH OF DECEMBER.

Counties	Fremont	Garfield	Gunnison	Huerfano
January	56,049	19,186	43,705	134,400
February	40,161	15,342	26,385	84,351
March	29,970	15,521	26,429	76,463
April	42,583	14,864	30,665	105,803
May	49,244	13,483	37,409	129,177
June	47,439	14,379	44,113	137,584
July	63,159	13,604	42,376	148,396
August	50,463	15,037	41,025	117,912
September	50,112	17,901	51,782	121,019
October	65,230	22,024	53,839	149,165
November	60,012	22,617	53,587	152,079
December	71,647	25,000	54,700	177,998
Totals	626,069	208,958	506,015	1,534,347

PRODUCTION OF THE STATE OF COLORADO, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH COUNTY. ALL YEARLY REPORTS GROUPED IN THE MONTH OF DECEMBER.

Counties	Jefferson	Las Animas	La Plata	Mesa
January	21,603	445,604	13,552	5,264
February	17,249	318,285	12,497	4,261
March	14,326	337,758	12,251	3,617
April	12,229	339,592	9,800	2,580
May	11,322	374,786	11,249	2,751
June	13,671	306,832	10,886	2,174
July	13,847	313,758	10,970	2,270
August	11,306	306,250	11,819	2,776
September	11,753	317,255	12,521	4,389
October	10,798	400,437	16,177	5,977
November	11,015	416,955	16,524	9,152
December	16,850	469,573	16,300	17,581
Totals	165,969	4,347,085	154,546	62,792

PRODUCTION OF THE STATE OF COLORADO, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF EACH COUNTY. ALL YEARLY REPORTS GROUPED IN THE MONTH OF DECEMBER.

Counties	Montezuma	Pitkin	Routt	Weld	Total Tonnage
January	....	27,886	....	30,601	970,660
February	....	6,967	....	30,255	683,557
March	....	7,710	....	25,146	647,787
April	....	10,525	....	21,283	680,188
May	....	13,715	....	19,416	742,784
June	....	22,867	....	15,601	674,804
July	. ..	25,427	....	18,883	715,716
August	....	24,710	....	22,160	678,241
September	....	24,221	....	29,847	748,673
October	....	23,653	....	45,847	989,052
November	....	23,329	....	45,982	994,792
December	441	28,000	3,000	55,933	1,176,753
Totals	441	239,010	3,000	360,954	9,703,007
Production from mines not reporting, estimated					70,000
Grand total					9,773,007

PRODUCTION BY COUNTIES.

SHOWING INCREASE AND DECREASE.

Counties	1907	1908	Increase	Decrease
Boulder	1,399,518	1,133,323	.....	266,195
Delta	15,414	29,951	14,537	.....
Douglas	632	1,250	618	.....
El Paso	264,607	329,297	64,690	.....
Fremont	781,628	626,069	.....	155,559
Garfield	214,382	208,958	.....	5,424
Gunnison	578,841	506,015	.....	72,826
Huerfano	1,643,205	1,534,347	.....	108,858
Jefferson	193,819	165,969	.....	27,850
Las Animas	5,036,456	4,347,085	.....	689,371
La Plata	189,357	154,546	.....	34,811
Mesa	61,310	62,792	1,482	.....
Montezuma	150	441	291	.....
Pitkin	312,893	239,010	.....	73,883
Routt	.....	3,000	3,000	.....
Weld	203,428	360,954	157,526	.....
Mines not reporting, product estimated	70,000	70,000	.....	.....
Total tonnage	10,965,640	9,773,007	.....	.....

Decrease in 1908, 1,192,633 tons.

PRODUCTION OF THE STATE OF COLORADO, 1908.

SHOWING MONTHLY AND YEARLY PRODUCTION OF THE DIFFERENT VARIETIES.

Months	Lignite	Semi-Bituminous	Bituminous	Anthracite	Tonnage
January	225,014	74,441	670,143	1,062	970,660
February	175,308	52,621	454,609	1,019	683,557
March	138,068	39,242	469,358	1,119	647,787
April	123,776	52,171	503,715	526	680,188
May	110,970	58,290	566,017	7,507	742,784
June	88,530	57,685	519,883	8,706	674,804
July	95,756	72,503	536,967	10,490	715,716
August	108,249	59,965	499,838	10,189	678,241
September	149,473	69,537	520,499	9,164	748,673
October	252,550	88,396	639,026	9,080	989,052
November	240,537	85,837	660,540	7,878	994,792
December	283,003	107,528	783,522	2,700	1,176,753
Totals	1,991,234	818,216	6,824,117	69,440	9,703,007
Unclassified coal, estimated					70,000
					9,773,007

TABLE.

SHOWING THE TOTAL PRODUCTION OF DIFFERENT COMPANIES OPERATING TWO OR MORE MINES FOR THE YEAR 1908.

	Character of Coal and No. of Mines.								
Companies	No. of Mines	Bituminous or Coking	No. of Mines	Semi-Bituminous or Non-Coking	No. of Mines	Anthracite	No. of Mines	Lignite	Total in tons of 2,000 lbs.
Colorado Fuel & Iron Co	20	2,861,692	5	403,407	1	55,620	..	.....	3,324,719
Victor Fuel Co	5	1,323,930	2	127,384	..	.....	..	.....	1,451,314
Northern Coal & Coke Co	4	103,836	..	.....	..	.....	10	670,552	774,388
Rocky Mountain Fuel Co	6	317,583	3	134,892	..	.....	..	.....	452,475
Parkdale Fuel Co	..	.....	..	.....	..	.....	2	163,221	163,221
Pike's Peak Fuel Co	..	.....	..	.....	..	.....	2	137,109	137,109
Green Canon Coal Co	2	134,694	..	.....	..	.....	..	.....	134,694
Continental Fuel Co	1	102,684	..	.....	..	.....	1	29,977	132,661
Huerfano Coal Co	2	108,369	..	.....	..	.....	..	.....	108,369
Union Coal & Coke Co	2	92,078	..	.....	..	.....	..	.....	92,078
Cedar Hill Coal & Coke Co	3	89,160	..	.....	..	.....	..	.....	89,160
Rapson Coal Mining Co	1	30,649	..	.....	..	.....	1	51,685	82,334
Porter Fuel Co	1	11,553	1	41,744	..	.....	..	.....	53,297
Royal Coal & Coke Co	2	35,250	..	.....	..	.....	..	.....	35,250

COKE PRODUCTION, 1908.

Name of Operators	Location of Ovens	Counties	Number of Ovens	Tonnage
Colorado Fuel & Iron Co.	Cardiff	Garfield	167	50,138
Colorado Fuel & Iron Co.	Crested Butte	Gunnison	154	14,727
Colorado Fuel & Iron Co.	Segundo	Las Animas	800	256,120
Colorado Fuel & Iron Co.	Tobasco	Las Animas	302	130,469
Colorado Fuel & Iron Co.	Starkville	Las Animas	190	99,810
Colorado Fuel & Iron Co.	Sopris	Las Animas	272	34,243
Colorado Fuel & Iron Co.	Redstone	Pitkin	249	27,350
Carbon Coal & Coke Co.	Coakdale	Las Animas	380	140,187
Victor Fuel Co.	Hastings	Las Animas	189	70,379
Victor Fuel Co.	Delagua	Las Animas	80	15,926
American Smelting & Refining Co.	Durango	La Plata	28	15,313
			2,811	854,662

REMARKS.

Not all the above enumerated ovens were in operation.
The Cardiff ovens are supplied by the Spring Gulch mine.
The Redstone ovens are supplied by the Coal Basin mine.
The Segundo ovens are supplied by the Primero mine.
The Durango ovens are supplied by the Porter mine.
The coal of Huerfano is classified as bituminous, but is non-coking coal.

COKE REDUCTION, 1908.

BY COMPANIES AND COUNTIES.

Companies	Total Number of Ovens	Total Tonnage
Colorado Fuel & Iron Co.	2,134	612,857
Carbon Coal & Coke Co.	380	140,187
Victor Fuel Co.	269	86,305
American Smelting & Refining Co.	28	15,313
Total	2,811	854,662

Counties	Number of Ovens	Total Tonnage
Las Animas	2,213	747,134
Garfield	167	50,138
Gunnison	154	14,727
Pitkin	249	27,350
La Plata	28	15,313
Total	2,811	854,662

SUMMARY OF COAL PRODUCTION.

FROM 1873 TO 1906, INCLUSIVE.

Year	Tons	Year	Tons
1873	69,977	1891	3,512,632
1874	87,372	1892	3,771,234
1875	98,838	1893	3,947,056
1876	117,666	1894	3,021,028
1877	160,000	1895	3,339,495
1878	200,630	1896	3,371,633
1879	322,732	1897	3,565,660
1880	375,000	1898	4,174,037
1881	706,744	1899	4,826,939
1882	1,161,479	1900	5,495,734
1883	1,220,593	1901	6,210,405
1884	1,130,024	1902	7,522,923
1885	1,398,796	1903	7,775,302
1886	1,436,211	1904	6,776,551
1887	1,791,735	1905	8,989,631
1888	2,185,477	1906	10,308,421
1889	2,400,629	1907	10,965,640
1890	3,075,781	1908	9,773,007

List of Fatal Accidents for 1908

FATAL ACCIDENTS IN 1908.

UNDERGROUND.

Date	Name of person	Nationality	Occupation	Age	Single or Married	Name of Mine	County	Cause of Accident
Jan. 9	Matt Mason	German	Miner	34	Single	Midway	Huerfano	Struck by run-away car
Jan. 13	Mike Quinn	Irish	Miner	60	Single	Thomas	Las Animas	Fall of rock
Jan. 13	D. C. Johnson	Colored	Miner	45	Married	Curtis	El Paso	Thrown against entry rib, injured skull
Jan. 13	Frank Papish	Austrian	Miner	53	Married	Rockvale	Fremont	Fall of rock
Jan. 28	Alliso Zanot	Italian	Miner	32	Single	Sopris	Las Animas	Fall of roof
Feb. 4	Angelo Terracin	Italian	Miner	34	Married	Primero	Las Animas	Fall of roof
Feb. 6	Harry Shicley	American	Driver	24	Single	Standard	Boulder	Run over by car
Feb. 7	Frank Mohar	Austrian	Miner	29	Single	Delagua	Las Animas	Fall of roof
Feb. 17	Pete Palinere	Italian	Miner	20	Single	Frederick	Las Animas	Fall of coal
Mch. 5	George Poke	Colored	Miner	28	Single	Magnet	Fremont	Fall of roof
Mch. 14	Manuel Nestos	Mexican	Driver	36	Married	Hastings	Las Animas	Fall of rock
Mch. 15	Mike Arestas	Greek	Miner	30	Single	Standard	Boulder	Explosion of firedamp
Mch. 20	Joe Vacari	Italian	Miner	23	Single	Morley	Las Animas	Missed shot
Mch. 20	Salvadore Decamillo	Italian	Miner	19	Single	Morley	Las Animas	Fall of rock
Mch. 31	Joseph Hamilton	American	Fireboss	40	Married	Oakdale	Huerfano	Gas Explosion
Apr. 14	C. A. Williams	American	Companyman	45	Married	Champion	La Plata	Explosion of firedamp
Apr. 15	Andy Bett	Italian	Miner	44	Married	Coalbasin	Pitkin	Fall of rock
Apr. 18	David Hutchison	American	Sinker	24	Single	Tollar	Las Animas	Fell from ascending bucket to bottom of shaft
May 1	Frank Orlando	Italian	Miner	28	Married	Berwind	Las Animas	Fall of rock
May 3	Y. Yamagusi	Japanese	Driver	..	Single	Delagua	Las Animas	Squeezed by mule against car
May 14	Joe Margus	Austrian	Miner	35	Married	Starkville	Las Animas	Fall of drawslate

May	25	Frank Uhr	Austrian	Miner	28	Single	Crested Butte	Gunnison — Fall of rock
May	28	Jim Motto	Italian	Driver	27	Single	Starkville	Las Animas — Squeezed between mule and car
June	2	V. A. Loback	German	Miner	40	Single	Crested Butte	Gunnison — Fall of rock
June	3	George Bairch	Austrian	Miner	31	Single	Pinon	Huerfano — Fall of rock
June	4	William Threlkeld	American	Trammer	23	Single	Royal Gorge	Fremont — Fall of drawslate
July	3	Angelo Vai	Italian	Miner	30	Married	Hastings	Las Animas — Fall of rock
July	6	Calisto Oprandi	Italian	Miner	41	Married	Springs Gulch	Pitkin — Fall of rock
July	25	John Sneller	Austrian	Miner	18	Single	Bulkley	Gunnison — Fall of rock
July	29	Joe Jinore	Italian	Miner	33	Married	Greenville	Las Animas — Fall of roof
Aug.	11	David Torrize	Mexican	Miner	..	Married	Blooms	Las Animas — Fall of rock
Aug.	13	William Price	American	Carpenter	26	Married	Puritan	Weld — Fell from cage to bottom of shaft
Aug.	24	Joe Archiel	Slavonian	Miner	..	Single	Diamond	Garfield — Suffocated from powder smoke
Aug.	26	Joe Birtankie	Italian	Miner	44	Married	Pictou	Huerfano — Fall of coal
Aug.	29	Frank Lumbrada	Italian	Miner	45	Married	Nonpareil	Boulder — Fall of coal and slate
Sept.	1	Lienardo Galluci	Italian	Miner	36	Married	Delagua	Las Animas — Run over by mine car
Sept.	1	Constant Deitrez	French	Miner	45	Married	Nonpareil	Boulder — Gas explosion
Sept.	2	Guadaloupe Paradis	Mexican	Miner	52	Widower	Cokedale	Las Animas — Fall of roof
Sept.	5	Frank Johnson	American	Trapper	22	Single	Berwind	Las Animas — Run over by a trip of cars
Sept.	10	Mike Maccio	Italian	Miner	64	Married	Monarch	Boulder — Run over by a trip of cars
Sept.	14	Joe Ricco	Italian	Driver	18	Single	Delagua	Las Animas — Fall of coal
Sept.	22	Frank Yanulinich	Polander	Miner	28	Single	Midway	Huerfano — Fall of coal
Sept.	24	Mack Coochic	Austrian	Miner	25	Single	Leyden	Jefferson — Squeezed between rib and car
Sept.	28	John Suick	Austrian	Miner	19	Single	Berwind	Las Animas — Fall of roof
Oct.	2	David Morgan	Welch	Tracklayer	21	Single	Brodhead	Las Animas — Fall of roof
Oct.	2	O. P. Holman	American	Driver	50	Married	Ludlow	Las Animas — Fall of rock

FATAL ACCIDENTS IN 1908—Concluded.

UNDERGROUND.

Date	Name of person	Nationality	Occupation	Age	Single or Married	Name of Mine	County	Cause of Accident
Oct. 2	Anton Curano	Italian	Timberman	54	Married	Pryor	Huerfano	Fall of rock
Oct. 3	Thomas McMillen	American	Driver	19	Single	Magnet	Fremont	Crushed between car and coal
Oct. 27	Luccas Prives	Italian	Miner	57	Married	Primrose	Las Animas	Fall of rock
Nov. 4	Peter Jamuzzi	Italian	Miner	35	Single	Rugby	Huerfano	Fall of roof
Nov. 9	J. J. Hipp	American	Miner	28	Single	DeRush	Mesa	Explosion of firedamp
Nov. 11	Y. Ukamoras	Japanese	Miner	35	Married	Cokedale	Las Animas	Fall of coal
Nov. 18	Mike Blozosky	Slavonian	Miner	29	Married	Oakdale	Huerfano	Run-away cars
Nov. 22	Anton Riman	Italian	Miner	38	Married	Frederick	Las Animas	Fall of rock
Dec. 3	Wm. Brown	Scotch	Miner	50	Single	Southwestern	Las Animas	Fall of rock
Dec. 3	George Leonatz	Greek	Miner	..		Mitchell	Boulder	Powder explosion
Dec. 10	C. B. Fossette	American	Pumpman	53	Married	Hastings	Las Animas	Crushed by pump
Dec. 17	August Mackette	Austrian	Timberman	40	Married	Marion	Pitkin	Fall of rock
Dec. 23	Eli Zanich		Miner	..	Single	Morley	Las Animas	Fall of rock
Dec. 26	Harry Morrison	American	Driver	36	Single	Majestic	Las Animas	Struck on the head by car
Dec. 31	Martin Moole		Miner	..		Cameo	Mesa	Fall of rock

KILLED ON THE SURFACE.

Date	Name of person	Nationality	Occupation	Age	Single or Married	Name of Mine	County	Cause of Accident
Jan. 14	D. L. Vigil	Mexican	Carloader	18	Single	Pryor	Huerfano	Run over by two cars
Dec. 31	S. Radocaj	Austrian	Miner	..	Married	Bowen	Las Animas	On gravity plane

New Mines.

(For present outputs see tonnage tables.)

BOULDER COUNTY.

LUCAS MINE.

This mine is located about half a mile northwest of Louisville Junction and is connected with the Colorado & Southern railroad by a short spur. The property is owned and operated by the Lucas Coal Land & Reservoir Company. Sinking commenced February 1, 1907, and was completed August 1 of the same year. Depth of the shaft to bottom of coal is 279 feet. The shaft is in three compartments, two 5 feet 8 inches by 7 feet for hoisting, and one 2 feet by 7 feet for pipe lines, and timbered with 3 by 12 inch Oregon pine.

The surface equipment consists of hoisting engine 12 by 18 made by the Ottumwa Iron Works, diameter of drum 6½ feet; size of rope 1¼ inches, made of steel; one Blaisell, 14 by 22 by 16-inch air compressor; two Hendrie & Bolthoff boilers, 100 H. P. each; shaker screens 21 feet by 6 feet, with two and three-inch perforations; two railroad track scales, 72 feet long, 201,000 pound capacity by Fairbanks, Morse Company. The head and tipple frames of this mine are very substantially constructed. The air shaft is in two compartments, 7 feet by 7½ feet and 7 feet by 2½ feet for ladderway. The ventilation is produced by a 4 by 16-ft. Crawford & McCrimmon Company fan driven by a 10 x 24 engine. The total thickness of the coal bed is 8 feet and the coal is of a good lignite variety. The roof consists of undulating sandstone.

CAPITOL MINE.

Located one mile, a little south of east from Lafayette. It is owned and operated by the Colorado Capitol Coal & Mining Company. Sinking was commenced in May, 1907, and the shaft was completed in November of the same year. Depth of shaft is 212 feet and is in three compartments, two 7 feet 6 inches by 6 feet, and one 2 feet by 7 feet 6 inches, all timbered with 3-inch planks. Surface equipments are an 18 by 36 Litchfield hoisting engine, winding 1⅛-inch crucible steel ropes on 5-foot drums. The cages are of the automatic type each weighing 4,000 pounds, made by the Vulcan Iron Works; one 18 by 24 Norwalk air compressor, two 100 H. P. boilers; shaker screens 7 feet by 42 feet with 2½-inch and 4-inch perforations by the Vulcan Iron Works. The shakers are operated by a 12 by 14 engine. Total length of railroad tracks 3,800 feet, two 72-foot rail-

road car scales 100-ton capacity. The air shaft has two compartments, one 7 feet by 7 feet, and the ladderway 2 feet 6 inches by 7 feet, timbered by 3-inch pine. Ventilation is produced by 10-foot diameter and 12-blade fan made by the Buffalo Forge Co. The fan is driven by a 12 by 14 engine. The coal bed has an average thickness of 6 feet, dipping slightly to the southeast. The coal is of the lignite character and is used principally for stationary steam and domestic purposes. Mode of working is room and pillar, and the coal is mined by machines.

FREMONT COUNTY.

THE DIAMOND MINE

is located in the S. W. ¼, section 25, T. 20 S. R. 70 W., six miles south of Coal Creek. The property is owned and operated by the Diamond Coal Mining Company and contains 160 acres of ground which, it is claimed, is underlaid with four workable beds of coal. The sinking of the shaft was commenced January 1, 1908. Some of the product is disposed of to the farmers of the surrounding district, the balance is hauled in wagons a distance of about two miles to the Santa Fe spur at Radiant, and there transferred on board railroad cars. The coal is of the semi-bituminous variety and is considered a good grade for domestic purposes. It is mined by the Sullivan puncher machines.

THE EMERALD MINE.

This mine is located about a mile and a half west of Florence, on the Florence & Rockvale branch of the Santa Fe railroad, with which the property is connected by a short spur. It is operated by the Williamsburg Slope Coal Company. Mr. S. P. Smith is the manager. The mine is opened by a slope which was started early in the spring of 1908 and driven in the lower coal bed, locally known as Rockvale bed. The coal has an average thickness of three feet, semi-bituminous, an excellent quality for domestic uses. During the summer months a tipple and other surface equipments for a 250 daily tonnage was installed, and the mining of coal did not commence until late in the fall. The mine is ventilated by a furnace which will be replaced by a fan as soon as its services are made necessary by increased developments of the workings.

THE CENTRAL MINE.

The sinking of this shaft was completed November 24th, 1908, at a depth of 1,087 feet, and is located in section 16, T. 19, R. 70 S., about 2 miles southeasterly from Canon City. The coal is semi-bituminous and the bed is reported to be 5½ feet in thickness. Permanent equipments for the handling of the product are not yet installed. The mine is operated by the Colorado Central Coal and Mining Company. H. L. Littell, manager.

GUNNISON COUNTY.

THE KUBLER MINE

after a cessation of operations for eight years, was reopened during the summer of 1907 under the ownership and management of the Rocky Mountain Fuel Co., who, in the spring of the same year, purchased the Kubler, Alpine and other adjoining properties. The former property was previously owned by the Baldwin Coal Co. and the Alpine by the Continental Fuel Co. All these properties are located near Mount Carbon (Baldwin) about 18 miles north of Gunnison City. It is the intention of the company shortly to install electric haulage and cutters and place the mine on a larger producing basis.

Analysis of coal:

Fixed Carbon	Volatile Matter	Moisture	Ash	Sulphur
48.0	39.0	6.0	7.0	.44

THE BUCKLEY MINE.

This property contains 280 acres and is located one mile south of Crested Butte. It is owned and operated by the Crested Butte Coal Co., of which Mr. Frank Buckley of Denver, is president. The mine is opened by a slope which was driven in the early part of 1907. The coal is of the bituminous character and the bed under development has an average thickness of 5 feet and 4 inches with a sandstone roof and floor. A gravity plane, 1,450 feet long and 19 per cent. grade, connects the mine with a one and a half mile spur off the R. G. narrow guage railroad. The mine is ventilated by an 8-foot W. E. Cole fan.

Analysis of the coal, by Oscar J. Frost:

Fixed Carbon	Volotile Matter	Moisture	Ash
60.3	32.5	4.1	3.1

THE SILVER BROOK MINE.

In September, 1908, the Pueblo Fuel & Mining Co. completed the sinking of a new shaft in their Silver Brook property, which is located on the "Anthracite" branch of the D. & R. G. narrow guage R. R. near Crested Butte.

The shaft has two compartments, each 8 feet by 5 feet in the clear and is 120 feet deep. The coal is characterized as semi-anthracite and is 3 feet thick and underlies the one developed in the company's old mine which has been in operation for several years. An 8-foot diameter Capell fan connected with one of the compartments in the shaft produces the ventilation for the workings. The following is an analysis of the coal by E. C. Woodward, Colorado Springs:

Fixed Carbon	Volatile Matter	Moisture	Ash
88.8	5.4	1.5	4.3

HUERFANO COUNTY.

CAMERON MINE.

This property is located about one mile south from Walsenburg, and is owned and operated by the Colorado Fuel & Iron Co. Operations on the property commenced May, 1907. It is opened by a double slope, one for haulage and the other for an air-way, both entering upon the outcrop and driven nearly on the dip of the coal, which has a thickness of 42 inches and is of the bituminous variety, and is classified as the "Cameron" bed. The ventilation is furnished by a 20-foot fan, whose casing is constructed to either force or exhaust. The chief equipments consist of haulage engine, box car loader, mining machines and shaker screens, which separate the coal into the three different classes, all driven by electric power furnished by the company's plant at the Walsen mine. The C. & S. R. R. is connected with the mine.

THE "BIG FOUR" SLOPE

is located in section 18, T. 27, S. R. 67 W., one mile southwesterly from Tioga, or about 12 miles northwest of Walsenburg, and is operated by the Big Four Coal & Coke Co. The property contains 160 acres, part of which is underlaid with at least two workable coal beds. The two beds now under development are 7 and 4 feet thick, respectively, and are separated by 60 feet of intervening shale and sandstone. Operations commenced in June, 1907. The slope dips 18 per cent and is opened in the lower of the two beds. At a point about 150 feet from the entrance, a rock cross-cut was driven through the intervening measures into the upper bed, and thus the product of both is brought out through the same slope.

Mode of working is room and pillar and to facilitate the hauling on the heavy grade the workings are divided into panels. Cross entries are driven directly on the pitch of the measures and the rooms are turned on the level. All the coal from the rooms is hauled by compressed air hoisting engines. A 10 by 12 Hendrie & Bolthoff slope engine; two 6-inch by 8-inch underground hoists, a Sullivan air compressor, two 125-H. P. boilers; a Phillipps cross-over tipple; Vulcan shaker screens; one Fairbanks R. R. scales and one mile of railroad tracks to connect with the Tioga branch of the D. & R. G. R. R. constitute the chief improvements. The mine is ventilated by a 13-foot fan and the coal is mined by puncher machines.

THE GORDON MINE.

This property is owned and operated by the Gordon Coal Co. It is opened by a slope which was started October 18, 1907. It is located one and a half miles northwest of Maitland and is connected with the Rio Grande R. R. The coal bed is five feet thick and of the bituminous character, and dipping about 2 per cent. north. The slope has a pitch of 30 per cent. until it strikes the

coal, then it assumes the natural pitch of the measures. The product is pulled up the slope by an 8 by 12 hoisting engine and is dumped over shaker screens, where it is separated into the various grades for market.

THE TIOGA MINE

is located about 12 miles northwest from Walsenburg, near the terminus of the Loma branch of the D. & R. G. R. R., with which the property is connected. Operations commenced Nov. 25, 1907. There are two coal beds under development, which are locally classified as the "Walsen" and the "Robinson" beds; both are of the bituminous character used for steam and domestic purposes. The lower bed is 6 feet 6 inches and the upper 5 feet 6 inches in thickness, and the two are separated by 60 feet of intervening shale and sandstone. The measures are dipping 14 degrees southeasterly. In the lower bed are three parallel slopes, the middle slope is used as an air and manway and the other two for hoisting, and two slopes in the upper, all driven nearly on the dip of the coal. Ventilation is produced by a Cole fan. The tipple is equipped with shaker screen which separates the coal into lump, nut, pea and slack, or to any combination of these sizes. The mine is now operated under a lease by the Minnequa Coal Co.

THE OAKDALE MINE.

The opening and equipping of this mine was completed in the latter part of 1907. The mine is located in the N. W. ¼ of the N. W. ¼, section 15, T. 29 S., R. 69 W., about 6½ miles west of the town of La Veta. It is opened by two parallel slopes, one for hoisting and the other for an airway, driven on the dip of the coal bed, which has a thickness of 7½ feet. This coal ranks with the best grades of any coal produced in Huerfano county, especially for domestic purposes. The total area to be developed, including the original holdings and leased ground, contains about 1,000 acres. The chief surface equipments and improvements consist of an 18 by 30 Litchfield first motion hoisting engine, two 150-H. P. boilers, shaker screens, Ottumwa box car loader, 40 dwelling houses, three boarding houses and a 13-foot W. E. Cole fan, which ventilates the mine. A spur of 2½ miles connects the property with the D. & R. G. R. R.

THE RAVENWOOD MINE.

This mine is located in the S. E. of the S. E. quarter, section 21, T. 27, R. 67, about two miles south from the town of Walsenburg. It is opened by a slope driven nearly on the dip of the measures which have an inclination of 5 per cent. south, 67 degrees west. Operations commenced Sept. 1, 1908. Tipple and other surface equipments are now in course of construction. The coal bed is 3 feet and 6 inches in thickness, and is of the bituminous character and a good grade of fuel for steam and domestic purposes.

Shipping will commence as soon as connections are made with the Colorado & Southern Railroad, to accomplish which it will be necessary to build a spur of about a quarter of a mile in length.

THE CADDELL MINE.

This mine is located about two miles northwest of the town of Walsenburg and is operated by Ed. Caddell. The opening is a slope driven in a 5-foot bed of bituminous coal. Its present capacity is about 1,000 tons per month. The product is conveyed to the railroad cars by means of a pitcar line which connects the mine with the Pictou branch of the D. & R. G. R. R. Operations started in March, 1908.

LAS ANIMAS COUNTY.

RAPSON NO. 1 MINE.

During the summer of 1907 the Rapson Coal Mining Co. opened a new slope at a point about 800 feet north of their old mine near Rugby. The surface improvements consist principally of an up-to-date tipple and shaker screens, Christy box-car loader, three 100-ton 74-foot railroad scales; one Litchfield 12 by 16 hoisting engine, which conveys the coal up the slope and on the plane from the mouth of the slope to the tipple.

The coal bed has an average thickness of 4 feet and is of the bituminous character and "niggerhead" variety, so well known for its efficiency as steam and domestic fuel. The ventilation of the mine is produced by a 13-foot W. E. Cole fan. There were also two miles of railroad tracks constructed connecting the mine with the main line of the Colorado & Southern Railway.

THE MCLAUGHLIN MINE.

Located seven and a half miles west of Trinidad, on the south side of the Purgatoire river. It is operated by the Santiago Coal Co. Developments commenced November, 1907. It is opened by a slope driven in a 6½-foot bed of good high-grade bituminous coking coal. The company built 1,400 feet of side tracks which connect with the Colo. & Wyo. R. R. The bed is classified as the same as that mined at Sopris, a neighboring camp. The Colorado & Southern R. R. also runs on the south side of the property. The mine is ventilated by a furnace.

THE CORNELL MINE.

In November, 1907, the Colorado Fuel and Iron Co. commenced working on the Cornell slope, which is located about 2 miles northwesterly from Tercio. The slope is driven in the coal at an inclination of 15 degrees. The coal bed is 6½ feet thick and is the same as the lower of the three workable beds at Tercio, and is of the coking variety. As no railroad connections have been made yet, the development work of the mine has been confined entirly to slope and entry driving.

THE RED ROBIN MINE.

This property is located about 300 feet west of the main line of the Santa Fe railroad, and 16 miles south of Trinidad. It is operated by the Wootten Land and Fuel Co. The mine is opened by two drifts, which were started December, 1907. It contains three workable coal beds, the one under development is 5 feet thick, of the bituminous variety; 7,600 feet of sidetracks were built by the company, which connects the property with the Santa Fe railroad.

THE TOLLER MINE

is located in Road Canon about one mile southwest from Berwind and is operated by the Cedar Hill Coal and Coke Co. The mine is opened by a three-compartment shaft, 352 feet deep, timbered with square sets, 8 inches by 8 inches, and 4 feet apart. Sinking was completed June 1, 1908. The coal bed under development is 6 feet thick and is of the coking variety and dips 3 degrees southwest. The main surface equipments are: an 18 by 36 Litchfield hoisting engine winding 1⅛ inch ropes on a 6-foot diameter drum. One 100 H. P. boiler, one mile of railroad tracks was built by the company to connect with the C. & S. R. R. The air shaft has two compartments, 6 feet by 6 feet and 2 feet 8 inches by 6 feet, which was completed December 20, 1908. A 11 foot by 5 foot Capell fan is to furnish the ventilation. The plant is not yet fully equipped and very little development work has been done inside of the mine.

PITKIN COUNTY.

THE MARION MINE

was opened June, 1907. The mine is located 2 miles north of Spring Gulch. It is owned and operated by the Colorado Fuel and Iron Company and is connected with the Cardiff & Gulch branch of the Colorado Midland R. R. The formation has an inclination of 45 degrees, and the coal bed under development is 66 inches thick and of the bituminous variety. The mine is situated 2,000 feet from the railroad tracks and the product is conveyed this distance over a mine tramway.

ROUTT COUNTY.

THE OAK HILLS MINE

is owned by the Oak Hills Coal Company and is located in the S. E. quarter of section 30, T. 4, N. R. 85 W. on Oak Creek, about 12 miles north of the town of Yampa. The mine is opened by three parallel slopes, one for hoisting and the other two for air and man-ways, driven in the coal and on the dip of the measures, which are about 12° northwest. The coal bed is 10 feet thick and is of the bituminous variety. The work of opening commenced May 1st, 1908, but developments were retarded by the great difficulty encountered in transporting machinery and

material for equipments until the arrival of the Moffat railroad, with which the property is now connected.

A 30 inch by 60 inch hoisting engine is already installed and the other necessary surface equipments are now in course of erection which, when completed, and the mine sufficiently developed are intended for a daily capacity of at least 1,500 tons.

WELD COUNTY.

THE FREDERICK MINE

is opened by a slope driven through the measures overlying the coal and was completed to a depth of 330 feet, June, 1907. It is located near Frederick and is operated by the Frederick Coal Company. The mine is connected with the U. P. R. R. by 3,000 feet of side tracks. The character of the coal is lignite and the bed is 8 feet thick and lies nearly horizontal. The ventilation is produced by an 18-foot fan erected at the top of a two-compartment, 6-foot by 6 foot and 2 foot by 6 foot air shaft.

THE FIRESTONE MINE

is located about one mile north of Frederick and is opened by a three-compartment shaft, two 5½ feet by 7 feet and one 2½ feet by 7 feet and 106 feet deep, which was completed August, 1907. The coal is lignite and the bed under development varies from 5 to 6 feet in thickness and has a slight dip southeast. The mine has been idle at different periods since operations first commenced, therefore the development work has been slow. Although the mine in situated within close proximity of the U. P. R. R. no connections have yet been made.

THE WARWICK MINE

is located about three-quarters of a mile northeasterly from the town of Frederick, and is operated by the Warwick Coal & Investment Co. It is opened by a three-compartment shaft 125 feet deep, which was completed and equipped for productive operations in the summer of 1907. The two hoisting compartments are 5 feet by 7 feet each, and the air passage 3 feet 4 inches by 7 feet. The thickness of the coal bed is 7 feet and lies with a very slight dip to the southeast. The coal is of the lignite character and is mined by Ingersoll puncher machines driven by compressed air generated by a 12 by 14 by 14 Chicago Pneumatic Tool Co. air compressor. The ventilation is produced by a 12-foot force fan connected with the third compartment of the main shaft. The property is connected with the U. P. R. R.

THE EVANS MINE

is located near the northern suburb of the town of Frederick. It is owned and operated by the Evans Coal & Land Co. The mine is opened by a two-compartment hoisting shaft, each 5 feet 3 inches by 7 feet in the clear and 154 feet deep, and timbered skin

to skin with 3-inch by 12-inch Oregon fir. Sinking was completed October 28th, 1907. The coal bed is 8 feet in thickness and of the lignite character. The measures lie nearly horizontal with sufficient moisture issuing from the strata to keep the workings of the mine free from dust and in a desirable state of humidity. The natural conditions are very favorable for economical mining. The mine is ventilated by a force fan driven by an 8-inch by 12-inch engine. Two side tracks having a combined length of 1,200 feet connects the mine with the U. P. R. R. The coal is mined by machines.

THE IDEAL MINE

is operated by the Ideal Coal Co. and is located in the N. W. quarter section 34, T. 2, N. R. 68 W., about five miles northeast of Erie. The mine is opened by a slope 260 feet in length and was started November, 1907. The coal is of the lignite character and varies from 8 to 11 feet in thickness. The mine has no railroad connections and the product is delivered by wagons. The ventilation is produced by a fan.

THE PURITAN MINE

This property is located in the S. E. quarter section 34, T. 2, N. R. 68 W., about two miles west of Frederick and about four miles northeast of Erie. It is owned and operated by the Parkdale Fuel Co. Mr. H. Van Mater is the president and general manager of the company, and Mr. Joseph Watson general superintendent. The mine is opened by a three-compartment shaft, two, 5 feet 10-inch by 7 feet 4-inch for hoisting, and one, 2 feet by 7 feet 4-inch for pipe and wire lines. Sinking of the main shaft commenced Feb. 17th, 1908, and was completed May 3rd to a depth of 122 feet. Immediately after they began driving their main entries, a two-compartment, 6 feet 1-inch by 7 feet 8-inch and 2 feet by 7 feet 8-inch air shaft was started and was finished Aug. 30th, timbered, skin to skin, with 4-inch white pine. The ventilation is furnished by an 18-foot by 5-foot Sterling fan with 13 blades, built by the United Iron Works.

The coal bed lies practically horizontal, is 10 feet thick, and is of the lignite variety with a soapstone roof and sand rock bottom. The coal is perfectly free from any impurities and is mined by puncher machines.

The method of working is the three entry room and pillar. The men in each entry and its tributary rooms are supplied with a fresh and independent current of air directly from the main intake.

The cages are self dumping and the coal passes over shaker screens with 2½-inch and 6-inch perforations. Hoisting and tipple equipments are up to date in every detail and are constructed to handle 1,500 tons daily. The present daily output is 400 tons and it is intended to increase this until the maximum is reached. A spur of four miles connects the property with the Brighton and Erie branch of the U. P. R. R.

The following article was written at the special request of this department by Mr. W. B. Lloyd, former assistant State Coal Mine Inspector for Colorado, now foreman of the Cokedale mine. The officials in charge of this mine are entitled to the highest commendations for the interest they have manifested in promoting the safety and welfare of their employes, both under and above ground.

THE COKEDALE MINE.

By W. B. Lloyd, Cokedale, Colo.

On the first day of June, 1906, the Carbon Coal and Coke Company began the development of their coal land lying north of the Purgatoire river and between the canyons of Riley and Burro, with the view to supplying the American Smelting and Refining Company with coke for their numerous smelters. The coal underlying this land was known to produce a very high quality of coke, but owing to the general belief that it contained too high a percentage of impurities for a coking proposition, it lay undisturbed until the increasing demand for coke made it imperative that this coal should be mined and coked. The preliminary arrangements being made, contracts were let for the building of the houses, washer, coke ovens, railroad tracks, etc., while underground operations were pushed night and day; the idea being to develop sufficient mine room to produce the desired amount of coal by the time the washery and coke ovens were completed.

The fact being recognized that the coal contained a rather high proportion of impurities, the first step was to determine the type of jig that should be employed for the removal of the same. After a series of tests, the Pittsburg jig was adopted as being nearest to the desired requirements, and a washery containing four of these jigs was soon in course of construction.

In the meanwhile tests and experiments had been conducted to determine the adaptability of concrete for foundations and retaining walls for coke ovens. The experts employed on these tests finally satisfying themselves that this material was suitable for the purpose, contracts were let, stone was quarried and crushed, concrete mixers were soon on the ground, and in an incredibly short time the actual ovens were being completed at the rate of two per day.

While work was being rushed on the washery and coke ovens, a large force of men, under the direction of Mr. John Laughlin, who had secured the contract to make the coke braize-concrete blocks for the houses, and putting them in place, were engaged in the construction of these blocks, and the construction of one hundred and fifty houses of three, four, five, six and eight rooms each; and store, clubhouse, bathhouse, hotel, office, power house and school was commenced. The wood work was added by John Stewart, contracting carpenter, and early in the spring of the following year the houses and public buildings were ready for occupancy.

This company has stepped out of the beaten track regarding houses for their workmen, and instead of the three, four or five plain rooms to the house, each bedroom in Cokedale has a clothes closet; each kitchen has a pantry; while many of the houses have bathrooms, equipped with bathtubs and stationary bowls, and concrete-lined cellars underneath the houses. In addition to this, all houses are adequately lighted by electricity. Each house is surrounded by a neat brown painted fence, and with the roofs painted a bright green and the red gray of the concrete splatter coat with which the houses are covered, backed by the dark green of the pine-clad hills behind the town, the view is presented of one of the prettiest mining towns in the State. To enhance the beauty of their town, absolute cleanliness is insisted upon by the officials, both in and around the houses and public buildings, and this cleanliness is one of the things first noted by any one accustomed to the carelessness in this regard in the average small town.

The school house, built by the company at an expense of about twelve thousand dollars, contains four commodious school rooms on the ground floor, and a large hall for entertainments and lodges on the second floor. The basement contains a boiler from which hot water is conducted to the radiators upstairs. A very efficient corps of teachers is employed and pupils are passed direct from this school to the Trinidad high school. The water for domestic use is secured by means of an underground dam, built just below the town in Riley canyon. The dam, extending from side wall to side wall and to a depth of about thirty feet from the bottom of the arroya, the subterranean flow of pure mountain water is held in check until pumped by an electric pump to a reservoir, situated just above the town at a height sufficient to give a pressure at the houses of about 35 pounds per square inch. This water has been decided by bacteriologists to be absolutely pure, containing no injurious elements, and to this water is due in a very great measure the fact that the town is so remarkably free from sickness.

The water for the washery and ovens is obtained from a pumping station located near the mouth of Long's canyon, about one and a half miles from the plant. The water, after passing through a filtration bed, is pumped by electric pumps to a reservoir, of about two million gallons capacity, situated at a point convenient to the ovens and washery. At the ovens a pressure of about 50 pounds per square inch is obtained.

As electricity plays a very important part in the work of this plant, a finely equipped power house was designed, containing two Hamilton Corliss engines of about three hundred horse power each, one is in service while the other acts as a relay. A 12 inch by 20 inch Ball & Wood steam engine produces a 2,300 volt alternating current for the street arc lights and the house lights. This current is also used to run the pumps for both reservoirs, being transformed at a point near each pump.

These pumps are started and stopped from the power house, and a daily inspection is made of them, to see they are maintained in first-class condition.

The 250 volt direct current produced by the Corliss engines, is used to run the machinery in the machine, carpenter and blacksmith shops, the disposal of the waste from the washery over an aerial tram, the charging of the oven by motor-driven larry cars, the extraction of the coke from the ovens, four Covington coke extractors being used for this purpose; the hauling of the coal from the mine up a six hundred and fifty foot slope by a motor-driven chain haul, and the crushers in the laboratory, in which a complete analysis is made daily of the coal from the mine, the coke from the ovens and the washed coal and waste from the washery.

Seven water tube boilers, generating 1,000 H. P., supplies steam for these engines, the rope haulage engine that pulls the coal from the inside partings to the slope bottom, the 16 inch by 24 inch Erie engine that drives the 15-foot Clifford-Capell fan, used in the ventilation of the mine, and the two engines that drive the machinery in the washery. The exhaust steam from the Corliss engines and Ball and Wood is drawn by a vacuum pump through a heating system that heats the office, bathhouse, machine shop, washery and weigh office.

The building containing the machine shop, carpenter shop, blacksmith shop, store house and store house office is slightly over a hundred feet square, and, while commodious, is none too large. In the blacksmith shop is a 600-pound hammer and three well equipped forges with draft supplied by a 24-inch Sturtevant blower. The machine shop is equipped with a twelve-foot lathe of latest design, one large and one small drill press, a twenty-four inch shaper, a bolt threading machine, two pipe threading machines—one power and one hand driven—an emery wheel stand with two emery wheels, and in a convenient location in the shop is a tool room with a very good stock of tools on hand. The electricians' department, being situated near the machine shop, has no special machinery, this space being used mainly for the storage of repair parts for the motors used on the works. In the carpenter shop a planer and a combined cross-cut and rip sawing machine greatly facilitate the work in this department. In the storehouse and under the care of a storekeeper and an assistant, is kept a very complete supply of material, from mine track spikes to duplicate parts of the different engines; and as this material can only be issued on requisition of a different foreman, needless waste is greatly curtailed.

Another interesting feature of Cokedale is their fire-fighting organization. Connected to the water mains is a powerful pump, automatically governed to maintain a pressure of 100 pounds per square inch. When a fire alarm is turned in from one of the several alarm boxes placed around the town and

works, the fire whistle is sounded and this pump started, and with the four hose carts located at different points in the town, and hose stands, each supplied with five hundred feet of hose, and in close proximity to fire plugs, located at numerous and convenient points about the works, the fire department, of which every outside man is an active member, under the direction of the master mechanic as fire chief, responds instantly, and as a result of continuous practice is able to do most remarkable and efficient work. For instance, a false alarm recently being turned in from one of the washery alarm boxes resulted in seven streams of water being directed against this building well within six minutes, in addition to several hose being ready for action in the interior of the buildings.

A very valuable assistant to efficient co-operation of the several departments of this enterprise is the complete telephone system that connects all parts of the works, both under and above ground with the main office, and with each other. The fact that instant communication between the central portion of the underground workings and the doctor's office is possible, makes the system invaluable in cases where men are injured in the mine. The system is conducted through a local exchange during the day, and at night all phones are "plugged" together, so that any phone wanted is secured by ringing specially arranged signals by one of which each phone is designated.

The plant, adjoining the town on the south, is located about one mile north of the southern line of the property, and about half a mile west of the eastern line. The first object in opening the mine was to reach the southeastern point, and work out the coal retreating. Entries were driven from the crop line at a point about half a mile south of the plant, and from these entries other entries were driven due north and south, connecting on the north with a slope driven from the surface, from the mouth of which a trestle connects with the washery, and on the south with a pair of entries that were driven parallel to, and three hundred feet from, the southern boundary. Three other pairs of entries, six hundred feet apart, were driven parallel to these, and within a year after work was commenced nearly two miles of entry work had been driven, of which 85 per cent. was available for room turning.

A sufficient number of rooms were turned from the entries farthest south, and as soon as driven the pillars are withdrawn. With this system, that expensive and ofttimes dangerous bugbear, "old workings," is practically non-existent in this mine. About half a mile from the crop line the west entries are connected by a second pair of north and south entries, one of which is used for the hauling way for the second block, while the other is used as the main return airway. This method of ventilation is unique, because it not only allows each entry to be ventilated by its own split of fresh air, and rendering the stoppings between the room entries of absolutely no consequence, but it makes it possible to

copiously ventilate the mine without the use of doors, and with but one overcast. Each entry, receiving a separate split of air, from which it goes directly to the fan through the return airway, is not only thoroughly ventilated, but the air traveling at a comparatively slow speed does not carry in suspension the amount of coal dust that would be carried were two entries ventilated by the same current, of which the volume and consequent speed would necessarily have to be doubled.

Another feature worthy of note is the system of shot-firing employed. The miners prepare their shots during the day, and after the men employed on the day shift have left the mine, a corps of shot-firers, each supplied with enough powder to "shoot" his district, proceeds to charge, tamp and fire the holes as he finds them, or refrains from so doing if in his judgment the hole or holes are unsafe or unnecessary. When these shot-firers leave the mine at the completion of their duties, no powder of any description is left in the mine. This system renders it impossible for a reckless or incompetent man to overcharge a shot. The work being entrusted to picked men whose judgment soon ripens with experience, and they realizing *they* are the ones who will *light* the fuses to explode the charges placed, are naturally more careful in charging a hole than would be the case if the shot was charged and tamped by a man who knew he would be on the surface when this shot was exploded. No shots are allowed during the day excepting in extreme cases, and then only under the direct supervision of a competent man, who brings in sufficient powder for this one shot *and no more*. Nyalite is usually used for these shots, it being remarkable for its safety in handling and for the extremely small amount of flame produced. For the shooting in rooms, pillars and entries, however, ordinary 40 per cent. giant powder is used.

The coal is hauled by a mule to a main parting, from which it is hauled by rope to the slope bottom. From here it is taken to the tipple by a motor driven chain haul, which, traveling at the rate of a hundred feet a minute, is capable of delivering two cars a minute to the tipple. The cars holding two tons each, makes a possible production of 240 tons per hour. This amount is not required at present, but it is a policy of the company to have a reserve force with which to meet contingencies as far as possible. The plant is now in full swing and producing coke of a grade and at a cost satisfactory to the company.

NEW EQUIPMENT INSTALLED IN AND ABOUT OLD MINES DURING 1907-1908.

BOULDER COUNTY.

Monarch Mine. A high-speed engine and a Stillwell water heater were added to the plant.

Acme Mine. One 72-inch by 18-foot boiler, a 20 by 24-inch air compressor, a 14 by 20-inch geared hoisting engine to replace old one, and a conveyor for boiler coal were installed.

Sunnyside Mine. New air compressor and a 16-foot ventilator fan.

Simpson Mine. An 8-foot diameter Stine Booster fan was installed in the mine to assist the main fan. By the aid of this Booster fan the air volume was increased about 30 per cent. in two of the largest districts in the mine, besides vast improvements were made in the distribution and conduction of the air current in this mine.

Electric Mine. Underground electric haulage, electric generator and air shaft was sunk.

EL PASO COUNTY.

Patterson Mine. New air shaft, tipple and boiler were added, and the main slope remodeled.

FREMONT COUNTY.

Fremont Mine. New box-car loader and slack conveyor from tipple to the boiler house. A new slope was opened through the old workings and a 120-H. P. electric hoist was installed.

Nonac Mine. New electric hoist, two sets of railroad track scales and a new pump were installed.

Coal Creek Mine. Added one new electric hoist and a new boiler.

Rockvale Mine. Electric hoist, shaker screens and an electric Ottumwa box-car loader.

Chandler Mine. Installed five mining machines, a rotary convertor, Ottumwa box-car loader and slack conveyor from tipple to boiler house.

Radiant Mine. Ottumwa box-car loader, electric shop and water system extended.

GARFIELD COUNTY.

South Canon Mine. During 1908 the following equipments were added to the west Wheeler workings of the mine, viz.: An

outside gravity plane 1,326 feet long, 400 tons per day capacity, for the purpose of conveying the coal from the upper level to the main tramway; two "Booster" ventilating fans inside the mine, an electric haulage for the main entry, and a large triplex pump in addition to the one already in use for sprinkling purposes throughout the mine. This company is operating its west Wheeler bed on the block system, which means a laying out of an area of 700 feet in length by the height of the lift and which can be entirely segregated from the rest of the workings, should this become necessary in case of fire.

Keystone Mine. Opened a new drift and a new tipple was erected.

GUNNISON COUNTY.

Floresta Mine. Installed new ventilating fan and one additional boiler.

Crested Butte Mine. Installed new tail-rope haulage; one air compressor; electric light plant, and water system was enlarged to 100,000-gallon capacity.

Somerset Mine. Two electric generators, one steam hoisting engine, box-car loader, two new pumps and an electric haulage in the mine, constituted the improvements made at this mine.

Alpine Mine. A new machine shop was built.

Kubler Mine. Changed the tipple and installed electric equipments.

HUERFANO COUNTY.

Walsen Mine. Installed a new electric generator and one electric pump and an additional boiler.

Robinson Mine. One underground electric hoist and a Stine Booster fan in the mine.

Picton Mine. A new air shaft was sunk and a new Capell ventilating fan installed, also one air compressor and puncher machines, a Cameron pump and water tank and a new hoisting engine for the main slope.

Rouse Mine. Installed an electric plant, two boilers, one air compressor and a new slope was driven into the Cameron coal bed inside the mine.

Maitland Mine. Sunk new air shaft and installed a new Capell ventilating fan, one new boiler, water heater, four puncher machines, one electric generator, a new mine pipe line, one pump and mine water sprinkling apparatus.

Sunnyside Mine. New machine shop and one Ingersoll puncher and shearer machine.

Pryor Mine. New powder house and equipments at a cost of $5,000.

Midway Mine. Installed new hoisting engine for main slope, one high speed electric generator, one 120-horsepower

boiler, new ventilating fan, three electric pumps and several thousand feet of 2, 4, 6 and 8-inch pipe lines.

Round Oak Mine. 7,900 feet of track to connect with the C. & S. R. R. New tipple and shaker screens and a gravity plane 1,200 feet long.

Rugby Mine. Enlarged air shaft and installed new ventilating fan and engine, one electric generator and one pump

Pinon Mine. Installed an electric haulage underground and washer for nut coal.

JEFFERSON COUNTY.

Leyden Mine. Installed two electric tail-rope haulages, one on each side of the shaft.

LAS ANIMAS COUNTY.

Hastings Mine. New tipple, one set of larry scales, additional laboratory equipment, new blacksmith shop, rock crusher, two 10-ton electric locomotives for mine haulage. Pump and a 10-horsepower motor and new water tank at boiler-house.

Bowen Mine. New tipple, feed-water heater, one 10-ton electric locomotive, one bolt cutter and one motor.

Gray Creek Mine. Installed a new Capell fan, electric mine locomotive and tram lines to new openings.

Delagua Mine. Ventilating fan at No. 1 opening, two electric locomotives, one Jeansville pump, Victor box-car loader, water lines extended, a deep well pump and eighty new coke ovens were installed.

Berwind Mine. One 60-inch by 16-foot boiler and one 20-ton electric locomotive.

Engle Mine. New tipple, three new boilers, a new Capell fan for main opening and another fan for one of the tributary openings. The main air course was enlarged.

Primero Mine. Thirty-five stone stoppings were built to replace wooden ones, the sprinkling system in the mine extended and the electric plant remodeled.

Morley Mine. To complete the equipping of the mine a Capell ventilating fan, steam rope haulage and electric locomotive haulage were installed.

Starkville Mine. Installed a new tail-rope haulage, one centrifugal pump and an electric motor. Remodeled one fan and enlarged one air shaft.

Tobasco Mine. Installed one double hoisting engine, enlarged the electric plant, put in four coke drawing machines, disintegrator engine in washery and equipped larry cars with motors.

Suffield Mine. Installed a new tipple, one Ottumwa box-car loader, two 100-horsepower boilers, a 100-K. W. Jeffrey gen-

erator and a 168-horsepower McEwen engine, a 16-foot Crawford & McCrimmon fan, one 150-H. P. haulage engine and new shaker screens.

Green Canon Mine. One Ingersoll compressor, an 8-foot fan, new tipple and new shaker screens.

Primrose Mine. Installed an 8-inch by 10-inch triplex pump and 3,000 feet 6-inch pipe line.

LA PLATA COUNTY.

Perins Peak Mine. Put in an electric hoist and new ventilating fan.

MESA COUNTY.

The P. V. Mine. Constructed a 256 feet long suspension bridge across the Grand river to railroad siding which has three tracks, the longest being 1,320 feet.

Cameo Mine. Installed new tipple, box-car loader, one mining machine and a ventilating fan.

PITKIN COUNTY.

Coalbasin Mine. Installed three new boilers.

WELD COUNTY.

Shamrock Mine. Installed boiler, air compressor and one mining machine.

Parkdale Mine. Installed a new compressor and shaker screens and enlarged the air shaft.

FIRES OF SURFACE EQUIPMENTS.

The El Moro washeries were totally destroyed by fire Nov. 12, 1907. Cause of ignition not known. The plant has not yet been rebuilt.

At 2 A. M. March 15, 1908, the tipple, boiler house and washery of the Sopris mine was completely burnt. Fire was of incendiary origin. New washery is now under course of construction.

At 5:45 P. M., May 17, 1908, fire started and completely destroyed nearly all of the surface equipments of the Standard mine, located near Lafayette. Cause of ignition supposed to be from a spark flying from a dump fire to the shaker screen engine room. The plant has been rebuilt with modern appliances and of increased capacity.

June 5, 1908, the tipple and surrounding equipments of the Porter mine were totally destroyed by fire. Cause of ignition not known. The mine has not resumed operations since.

About 9 P. M. Sept. 16, 1908, the engine house of the Mitchell mine at Lafayette was destroyed by fire, which is supposed to have started through the accidental ignition of some coal oil located in the engine room. The mine resumed operations in 30 days after.

About 1 o'clock A. M., Sept. 24, 1908, the engine house of the Vulcan mine at Lafayette was partially destroyed by fire. Cause of ignition not known.

About 5:40 A. M., Nov. 4, 1908, the roof of the fan house of the Simpson mine was destroyed by fire. Ignition is believed to have been caused by an electric spark. Loss of time due to fire was only one day.

The following extracts giving thickness of coal beds, coal analyses and other data of the Colorado coal fields are quoted with the gracious consent of the authors, Mr. Wm. P. Headden, A. M., Ph. D., professor of chemistry and geology at the Agricultural College, Fort Collins, and Messrs. Hoyt S. Gale, G. B. Richardson, J. A. Taff and Marius R. Campbell of the United States Geological Survey.

The information contained in their publications is so valuable that I obtained their permission to embody the most important parts of it in the biennial report of this department, believing that thus many interested along these lines in the various district treated upon would have an opportunity to peruse the matter which otherwise would not be likely to fall into their hands. Numerous requests are made annually in this department for information concerning data contained therein. (For locations of the various districts referred to in the Yampa Field see map in pocket.)

AN EXAMINATION OF SOME COALS FROM ROUTT COUNTY, COLORADO.

By Wm. P. Headden.

The samples analyzed represent the bottom and middle series. The top series, the third from the bottom, appears from my notes to have been accessible at one point only—on Dry Creek—where coal had been taken out for local use, but it had been standing for a long time and the coal in the face was badly weathered and evidently of inferior quality, so I did not take a sample. I was, moreover, not prepared to do the work that would have been necessary to obtain a good sample. This breast presented 11 feet of clean coal.

I will group the samples according to the series to which they belong rather than in regard to the location of the property from which they were obtained, though I shall give the latter as I have noted them. All samples were taken by myself unless otherwise stated. As I did not set out with the specific object of sampling these coals I had not provided myself with the means of sealing the samples, consequently the results are all obtained on air dried samples. It is further right that I should state that this work, having to be made secondary to that of the experiment station, was necessarily delayed. The samples, however, were carefully packed, boxed up and kept in the basement of the building, where the temperature is uniform and the air fairly moist. The condition of the samples at this time, though going on three years old, is to all appearances unchanged; there is no checking or slacking shown by the larger pieces. I am not prepared to state that the coals of the bottom and middle series will not slack at all on exposure to the air, but they certainly possess excellent keeping qualities, as one can observe at the mines and in the deportment of samples broken and preserved in the air. The coal of the third series, that which I saw, slacked quite badly.

While changes in the composition of my samples may have taken place before they were analyzed, they could scarcely have been material. It is impossible to give the whole of the analytical work done and the case is, in this respect, incomplete, still the reader can judge from the results given that it is not probable that any serious changes have taken place in the coals.

The bottom series: This series is represented by eight samples.

Sample No. 1.—Stevens property (Ledford and Ducey Mines). Seam, 5½ feet thick. Cleats at right angles, blocky coal. Roof slate and clay, overlain by a soft, clayey sandstone. There is a lower seam, not accessible at the time of my visit. This lower seam is said to be 16½ feet thick. The coal is bright,

black and clean and has not been altered by the intrusive rocks of the neighborhood.

Specific gravity of coal, 1·377. Ash, reddish gray.

PROXIMATE ANALYSIS.* Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	6.535	Carbon	78.592
Volatile	38.477	Hydrogen	5.513
Fixed Carbon	50.273	Nitrogen	1.476
Ash	4.715	Sulfur	.877
		Oxygen	13.542
	100.000		100.000

*I wish to acknowledge my indebtedness to my assistant, Mr. Earl Douglass, for the interest that he has taken in doing a large amount of the analytical work.

Calorific value determined: Air dried coal 6873, calories, 12371 B. T. U.; pure coal 7743 calories, 13937 B. T. U.

Calorific value calculated from the ultimate analysis of the pure coal, 7717 calories, 13891 B. T. U.

Sample No. 2.—Sample taken from property of L. H. Green, Hayden's Gulch. Lots 1, 2 and 3 T. 4 R. 89 W. Thickness of vein 10 feet, 6 inches. Dip 6½° N. 57 E. Breast, 135 feet from entrance. Breast shows 6 inches slate and bony coal 4½ feet above the floor. Sample represents breast above bony streak.

Specific gravity of coal, 1·334. Ash, gray.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	7.240	Carbon	80.247
Volatile	36.776	Hydrogen	4.493
Fixed Carbon	53.489	Nitrogen	1.617
Ash	2.495	Sulfur	.688
		Oxygen	12.955
	100.000		100.000

Calorific value determined: Air dried coal 6764 calories, 12175 B. T. U.; pure coal 7494 calories, 13489 B. T. U.

Calorific value calculated from ultimate analysis, 7489 calories, 13480 B. T. U.

Sample No. 3.—Green's property; same as No. 2, but represents that portion of vein below bony streak. This seam is the third from the top of the series and is opened again four miles west of Green's on Berry's Gulch.

Specific gravity of the coal, 1·356. Ash, gray.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 109°	7.320	Carbon	80.683
Volatile	35.478	Hydrogen	4.275
Fixed Carbon	53.372	Nitrogen	1.665
Ash	3.830	Sulfur	.603
		Oxygen	12.774
	100.000		100.000

Calorific value determined: Air dried coal, 6785 calories, 12213 B. T. U.; pure coal, 7635 calories, 13743 B. T. U.

Calorific value calculated from ultimate analysis of pure coal, 7413 calories, 13343 B. T. U.

The fact that these two samples, Nos. 2 and 3, are parts of the same seam would lead one to expect them to vary but little in their composition and heating value. This view is supported by the analytical results, but the calorimetric results are not consonant therewith. We observe a difference of 222. calories between the number obtained and that calculated from the composition of the pure coal. This difference might be attributed to the inaccuracies of our work and, after all, when the numerous sources of error and the large factors used in our formula are considered it would not be surprising to meet with differences as large as this, but the close agreement in the analyses of the two samples is what one would expect. The analyses was, moreover, practically done in duplicate with close agreement, so that it is probable that the analysis is quite correct and the error, if any, is to be sought in the calorimetric determination of the heat value. This was repeated, the results differing by only 5 calories—practically an identical result. I think that this indicates a slight difference in the value of the coals themselves and that the theoretical value is a little too low.

Sample No. 4.—Sample taken from a property known as Scott's mine, located in a gulch tributary to Hayden's Gulch, and about one-quarter mile from the Green property. This seam shows 10 feet, 6 inches of clean coal. The roof is slate, overlaid by a brown friable sandstone. Beneath the seam occurs a 30-foot stratum of a feebly cemented sandstone. I estimated that this seam is 75 feet higher in the series than the Green seam.

Specific gravity of the coal, 1·321. Ash, gray.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 109°	6.525	Carbon	78.951
Volatile	39.259	Hydrogen	4.716
Fixed Carbon	51.436	Nitrogen	1.577
Ash	2.780	Sulfur	.594
		Oxygen	14.162
	100.000		100.000

Calorific value determined: Air dried coal, 6752 calories, 12154 B. T. U.; pure coal, 7445 calories, 13401 B. T. U.

Calorific value calculated from ultimate analysis of pure coal, 7450 calories, 13410 B. T. U.

Sample No. 5.—Sample taken from lower, smaller seam opened on the James property, Oak Creek. Roof is carbonaceous slate, very tender, if not dangerous. This seam shows five feet of clean coal. What is left as a roof, however, is really only a parting in the seam, and it was stated that there was 3 feet of coal above this. The striking feature of this seam was the difference in the lustre and structure of the coal of its upper and lower portions, the former having a bright lustre and cuboidal fracture, the latter a much duller lustre and a decidedly flaky structure. This sample represents the upper 3 feet of the coal.

Specific gravity of coal, 1.315. Ash, reddish brown.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	5.185	Carbon	79.948
Volatile	39.165	Hydrogen	4.828
Fixed Carbon	53.545	Nitrogen	1.884
Ash	2.105	Sulfur	.903
		Oxygen	12.437
	100.000		100.000

Calorific value determined: Air dried coal, 7164 calories, 12895 B. T. U.; pure coal, 7728 calories, 13910 B. T. U.

Calorific value calculated from the ultimate analysis of the pure coal, 7608 calories, 13694 B. T. U.

Sample No. 6.—Same as No. 5, but represents 2 feet of coal near the bottom of the vein. This coal is used as a blacksmith coal, and it is claimed that it gives good satisfaction.

Specific value of coal, 1.35. Ash, reddish brown.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	4.855	Carbon	78.830
Volatile	37.189	Hydrogen	5.392
Fixed Carbon	56.101	Nitrogen	1.888
Ash	1.855	Sulfur	.759
		Oxygen	13.131
	100.000		100.000

Calorific value determined: Air dried coal, 7283 calories, 13109 B. T. U.; pure coal, 7806 calories, 14051 B. T. U.

Calorific value calculated from ultimate analysis of pure coal, 7677 calories, 13819 B. T. U.

Sample No. 7.—Sample taken from lower portion of what is designated as James' 14-foot vein. This seam shows 12 feet

of clean coal. There is a streak of bone about 3 feet from the floor. This seam is from 70 to 75 feet above the seam represented by the preceding sample. They stated that there is a seam between these two, but I did not see it. The breast is 100 feet in a straight line from the entrance.

Specific gravity of coal, 1·327. Ash, reddish brown.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	5.680	Carbon	78.821
Volatile	36.278	Hydrogen	5.166
Fixed Carbon	56.162	Nitrogen	1.798
Ash	1.880	Sulfur	.521
		Oxygen	13.694
	100.000		100.000

Calorific value determined: Air dried coal, 7088 calories, 12758 B. T. U.; pure coal, 7668 calories, 13802 B. T. U.

Calorific value calculated from ultimate analysis of pure coal, 7571 calories, 13628 B. T. U.

Sample No. 8.—Same as No. 7, but represents the portion of the vein above the bony streak.

Specifiec gravity of the samples is 1·327.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	5.120	Carbon	79.690
Volatile	33.800	Hydrogen	4.938
Fixed Carbon	57.060	Nitrogen	1.768
Ash	4.020	Sulfur	.592
		Oxygen	13.012
	100.000		100.000

Calorific value determined: Air dried coal, 7104 calories, 12787 B. T. U.; pure coal, 7679 calories, 13822 B. T. U.

Calorific value calculated from ultimate analysis of pure coal, 7594 calories, 13669 B. T. U.

I have now presented the analysis of my samples representing the bottom series of seams. These samples are eight in number and represent the extreme points of the territory visited. No 1 represents the most northeasterly point; Nos. 2, 3, and 4 the southwestern point; the distance between these points being 26 miles in a straight line. Nos. 5, 6, 7 and 8 represent the southeastern point, which is 28 miles from the point where No. 1 was taken and 20 miles from that where Nos. 2, 3 and 4 were taken. The relation of the seams from which the samples were taken to the other seams of the series was not determined, so it can not be stated that the samples represent the same seams. It is probable that some of them do and would be comparable in this respect, but I do not know that this is the case.

An examination of these analyses will lead to the inference that these coals are essentially identical in composition, with no more variation than one would expect to find in samples taken within a few hundred feet of one another. The physical properties of sample 1 would lead one to judge it, if one were willing to make any distinction at all, to be inferior to the other samples. This was my impression when I was in the field and the ultimate analysis shows that it is lower in carbon and richer in oxygen than the other samples, but not materially so. We would scarcely have expected this, provided that the Pilot Knob eruptives had exercised any general and extended influence upon the character of the coals in that immediate neighborhood.

The very great similarity of the composition of these coals is shown by the ultimate analysis of the pure coals. The extreme difference in the percentage of carbon is 2·09 per cent.; of hydrogen, 1·1 per cent.; of nitrogen, 0·4 per cent.; of sulphur, 0·4 per cent.; of oxygen, 1·3 per cent. These facts are still more strongly emphasized by the calorimetric results, which, by the way, show that number 1 is just as good a coal as the others. The range in the calorific value of these samples as determined by the bomb calorimeter is from 7445 to 7806, or an extreme difference of 361 calories; the range as shown by the values calculated from the ultimate analysis of the pure coal is from 7413 to 7717, an extreme difference of 304 calories. The formula used in calculating the calorific value from the ultimate analysis was 8080 C+34460 (H—O÷8)+2250 S.

No special coking tests were made, but this group of coals showed the same deportment in the crucible, giving either a pulverulent or, at most, a very slightly agglutinated mass; in no case was there any coking, and whatever classification may be made of these coals they will belong to the non-coke variety.

The middle series: This series is represented by ten samples, beginning with sample No. 9 of this paper.

Sample No. 9.—This sample was obtained from what I take to be the lowest seam of the middle series on the Crawford tract. The breast was 125 to 150 feet from the entrance and showed 11¼ feet of coal, with two streaks of slate, one of them 7 inches, the other 9 inches thick. The floor was not developed.

A sheet of lava passes under this seam at a depth of a few feet—it may be as much as 50 feet below it. The influence of this lava has been to convert the coal into anthracite. I do not know anything about the extent of this sheet under the seam. The sample is not a satisfactory one, as I was compelled to take such as I could get, which means that it is selected to a considerable extent, but is fairly representative of the coal.

Specific gravity of the coal, 1·445. Ash, white.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	1.460	Carbon	90.230
Volatile	10.889	Hydrogen	3.062
Fixed Carbon	81.535	Nitrogen	3.239
Ash	6.125	Sulfur	.807
		Oxygen	2.662
	100.0 0		100.000

Calorific value determined: Air dried coal, 7778 calories, 14000 B. T. U.; pure coal, 8417 calories, 15151 B. T. U.

Calorific value calculated from the ultimate analysis of pure coal, 8413 calories, 15143 B. T. U.

Sample No. 10.—This sample represents a 30-inch seam occurring, as far as I could see, next above the preceding, with an interval estimated at 130 feet. I do not know whether there is any lava sheet included in this interval or not. The opening was shallow and badly caved and the floor was not observable. The coal is bright, hard and has a conchoidal fracture.

Specific gravity of coal, 1·605. Ash, white.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	2.565	Carbon	94.218
Volatile	5.391	Hydrogen	2.131
Fixed Carbon	84.059	Nitrogen	1.527
Ash	7.985	Sulfur	1.041
		Oxygen	1.083
	100.0 0		100.000

Calorific value determined: Air dried coal, 7434 calories, 13381 B. T. U.; pure coal, 8311 calories, 14960 B. T. U.

Calorific value calculated from the ultimate analysis of pure coal, 8324 calories, 14985 B. T. U.

Sample No. 11.—This sample was taken from the third seam, counting from the bottom of the series, and is possibly rather above the average of the coal than below it. The tunnel is 125 feet long and the seam showed 12 feet of coal, with a streak of slate 10 inches thick in its lower part. Roof good; slate floor. The interval between this and the preceding seam is 50 feet, estimated.

Specific gravity of coal, 1·427. Ash, white.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	1.560	Carbon	86.224
Volatile	22.908	Hydrogen	4.154
Fixed Carbon	66.337	Nitrogen	1.767
Ash	9.195	Sulfur	.926
		Oxygen	6.929
	100.000		100.000

Calorific value determined: Air dried coal, 7426 calories, 13367 B. T. U.; pure coal, 8322 calories, 14980 B. T. U.

The calorific value calculated from the ultimate analysis of the pure coal, 8121 calories, 14618 B. T. U.

The determined and calculated calorific values are rather far apart—201 calories—but the analysis on which the calculation is based was done in duplicate with close agreement throughout, 0·2 per cent, being the widest deviation in any case. I, therefore, consider that the analysis is probably correct. On the other hand, the calorific value was redetermined after the discrepancy between the two determinations had been shown, but the redetermination of the calorific value differed from the one given by 10 calories only, so I have preferred to let it stand.

The fuel ratio of this coal, 2·89, classifies it as a bituminous coal, but it is not a coking coal. It was quite pulverulent after ignition.

Sample No. 12.—This sample was taken from a seam 100 feet above the preceding. The breast showed 6½ feet of clean coal. Slate roof and clayey floor. The coal shows few slips; is bright, black and hard. Drift, 140 to 150 feet long.

Specific gravity of coal, 1·395. Ash, white.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	6.840	Carbon	77.151
Volatile	37.348	Hydrogen	4.708
Fixed Carbon	52.572	Nitrogen	3.237
Ash	3.240	Sulfur	.593
		Oxygen	14.311
	100.000		100.000

Calorific value determined: Air dried coal, 6553 calories, 11795 B. T. U.; pure coal, 7283 calories, 13109 B. T. U.

Calorific value calculated from ultimate analysis of pure coal, 7250 calories, 13055 B. T. U.

The four preceding samples represent a section of the seams of the middle group as exposed on the Crawford tract, owned by the Elkhead Anthracite Coal Company. The lower seams have been altered into anthracite; the third seam from the bottom, while not more than 50 feet above the second seam, is a bituminous, but not a coking coal, while the fourth seam is very similar in composition and properties to the coals from the Green, Scott and James properties, the calorific value differing but slightly from these, it being about 200 calories less.

Sample No. 13.—Sample obtained in breast of 165-foot tunnel located north of the road and west of a dry gulch tributary to Morgan Creek. The work had been done 10 or 12 years,

and the face was in bad condition. The coal was badly mixed, but there was some good coal.

I failed to make mention in my notes of the relative position of this vein in the series, but I think that it is the lowest seam and that the sample is comparable with Sample No. 9. In this I may be mistaken, but the seams agree in thickness, 10 to 12 feet, and degree of anthracization. In other respects they are not at all alike.

Specific gravity of coal, 1·609.

PROXIMATE ANALYSIS.

Air Dried Coal.

Moisture at 100°	1.860
Volatile	6.114
Fixed Carbon	81.781
Ash	10.245
	100.000

ULTIMATE ANALYSIS.

Pure Coal.

Carbon	93.293
Hydrogen	2.465
Nitrogen	1.459
Sulfur	.905
Oxygen	1.878
	100.000

Calorific value determined: Air dried coal, 7355 calories, 13239 B. T. U.; pure coal, 8368 calories, 15062 B. T. U.

Calorific value calculated from the ultimate analysis of the pure coal, 8327 calories, 14989 B. T. U.

The next three samples were given to me by Mr. E. Shelton, of Hayden. The samples were obtained in prospecting the property of the Colorado Anthracite Company by a system of drill holes. A good idea of the number of seams and their inclosing strata is given in the following record of a drill hole which I take from the report of the State Coal Mine Inspector, Mr. John D. Jones, for the year 1903-1904. This record was furnished by Mr. Shelton, but its location is not definitely given, and is probably not one of those which furnish either of the samples which he gave me.

Record of drill hole one-fourth mile back from the outcrop:

	Feet	Inches
Clay	25	..
Coal, No. 1	5	..
Shale, gray	9	..
Sandstone, yellow	21	..
Shale, dark	8	6
Coal	1	..
Shale	12	..
Coal, No. 2	2	5
Shale, dark	8	5
Coal, No. 3	6	3
Shale, dark	18	4
Coal	1	..
Shale, dark	25	6
Coal, No. 4	4	4
Shale	25	..
Basalt	1	..

The coals specified in the above section as Nos. 1, 2, 3 and 4 are not necessarily the same seams as those from which the following three samples were taken, but they may be.

Sample No. 14.—Location D, Sec. 32, T. 9 N., R. 86 W. Seam 6 feet, 5 inches thick, 101 feet from the surface to the bottom of the seam.

Specific gravity of the coal, 1·542. Ash, white.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	1.190	Carbon	92.624
Volatile	5.868	Hydrogen	2.492
Fixed Carbon	81.422	Nitrogen	1.339
Ash	11.520	Sulfur	1.679
		Oxygen	1.866
	100.000		100.000

Calorific value determined: Air dried coal, 7236 calories, 13025 B. T. U.; pure coal, 8288 calories, 14918 B. T. U.

Calorific value calculated from the ultimate analysis of the pure coal, 8300 calories, 14940 B. T. U.

Sample No. 15.—Location D, Sec. 32, T. 9 N., R. 86 W. Seam 3 feet 8 inches thick. Depth from surface, 117 feet 8 inches.

Specific gravity of the coal, 1·407. Ash, white.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	1.035	Carbon	87.692
Volatile	12.509	Hydrogen	3.699
Fixed Carbon	78.731	Nitrogen	1.775
Ash	7.725	Sulfur	.992
		Oxygen	5.842
	100.000		100.000

Calorific value determined: Air dried coal, 7611 calories, 13670 B. T. U.; pure coal, 8342 calories, 15016 B. T. U.

Calorific value calculated from the ultimate analysis of the pure coal, 8133 calories, 14641 B. T. U.

Sample No. 16.—Location C. Seam 2 feet 10 inches thick. Depth from surface to bottom of seam, 172 feet 6 inches.

Specific gravity of the coal, 1·398. Ash, nearly white.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	.790	Carbon	89.901
Volatile	14.710	Hydrogen	3.283
Fixed Carbon	80.845	Nitrogen	1.806
Ash	3.655	Sulfur	1.069
		Oxygen	3.941
	100.000		100.000

Calorific value determined: Air dried coal, 8005 calories, 14409 B. T. U.; pure coal, 8378 calories, 15080 B. T. U.

Calorific value calculated from the ultimate analysis of the pure coal, 8249 calories, 14848 B. T. U.

Sample No. 17.—This sample was taken at the head of Sage Creek, and represents the lowest seam of the middle series that I sampled at this place. I was informed that it was really the third from the bottom of the series, which at this point consists of four seams, of which, however, only the upper two have been opened, each by a single drift entering from the east flank of the hill. This seam showed 11 feet 5 inches of coal at the breast of the drift 75 feet from the entrance. Slips are few and indistinct.

Specific gravity of coal, 1·350. Ash, white.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	7.085	Carbon	78.397
Volatile	38.583	Hydrogen	4.595
Fixed Carbon	49.782	Nitrogen	1.761
Ash	4.550	Sulfur	.583
		Oxygen	14.664
	100.000		100.000

Calorific value determined: Air dried coal, 6589 calories, 11860 B. T. U.; pure coal, 7456 calories, 13421 B. T. U.

Calorific value calculated from the ultimate analysis of the pure coal, 7299 calories, 13138 B. T. U.

Sample No. 18.—Sample taken from the top seam of the middle group; this seam has a thickness of 7 feet. The breast was about 75 feet from entrance. The partings were not distinct. The dip of the formation at this point is to the north and east, due to a fold transverse to the axis of the basin.

Specific gravity of the coal, 1·337. Ash, nearly white.

PROXIMATE ANALYSIS. Air Dried Coal.		ULTIMATE ANALYSIS. Pure Coal.	
Moisture at 100°	7.809	Carbon	78.318
Volatile	35.856	Hydrogen	4.482
Fixed Carbon	54.809	Nitrogen	1.935
Ash	1.535	Sulfur	.739
		Oxygen	14.526
	100.000		100.000

Calorific value determined: Air dried coal, 6672 calories, 12010 B. T. U.; pure coal, 7358 calories, 13244 B. T. U.

Calorific value calculated from the ultimate analysis of the pure coal, 7364 calories, 13255 B. T. U.

While there are ten samples representing the middle series, there are only three of them which represent coals which have not in some measure been affected by the presence of lava sheets. These three samples are Nos. 12, 17 and 18, two of them from the top seam and the third one from the next seam below it, or the third seam of the middle series. The composition and calorific values show these coals to be very nearly the same. The fuel ratios are 1:4, 1:3 and 1:5, respectively, while the calorific values are 7283, 7456 and 7358 calories—a maximum difference of 173 calories in the values as determined with the calorimeter.

The values agree still more closely if we take those calculated from the ultimate analyses.

In comparing the coal of the middle and bottom series, we find the latter to be a trifle the better coals, being rather richer in carbon, very nearly the same in hydrogen, and consequently poorer in oxygen. The difference in composition is not great, being 1·47 per cent. in the case of carbon and only 0.4 per cent. in the case of the hydrogen. Slight and uncertain as these differences are, they are consonant with difference shown by the determined calorific values, those for the bottom series being slightly the higher, nearly 300 calories for the two series. These statements do not, of course, pertain to the anthracites. I have, however, included the coals from the James mine in the bottom series. I mentioned the fact that I observed the occurrence of a lava sheet near this property, but stated that I had no opportunity of studying its relation to these coals. I can do no more now than suggest that the coals from this property may owe their character to the influence of intruded sheets, which I failed to observe, for the coal from these mines approach most nearly to coking coals of any which I found in the field, but otherwise they are very similar to the other coals of this series.

There seems to be some difference of opinion regarding the classification of the coals of this field; some of it is, I think, due to the indefinite meaning attached to the term bituminous, and also, perhaps, to a somewhat varying use of the term coking. None of the samples which I obtained proved to be coking coals. This is in harmony with the observations of Mr. R. C. Hills, but not with the statements of other observers.

In regard to the classification of these coals, I shall adopt the carbon-hydrogen ratio. See Professional Paper, No. 48, U. S. Geological Survey, p. 156, et seq., where the subject of the classification of coals is discussed by Mr. Marius R. Campbell. In this instance I shall use the percentages for the air dried coals on the assumption that the water retained by the lignites on air drying constitutes one of the differences between the bituminous and lignitic coals.

Concerning some of these coals, the anthracites, there can be no question about their classification, but concerning the others there evidently is, as they are classed as bituminous coals and also as lignites. These two classes of coals unquestionably pass very gradually into each other, and any dividing line which may be adopted will be, to a greater or less extent, an arbitrary one. For the purposes of this paper I shall adopt three of the Boulder county coals, commercially recognized as belonging to the best type of lignitic coals, the Gorham, Mitchell and Matchless coals, as the standard for a high grade, black lignite. Two of the samples used were taken from cars and represent the coal as delivered here for local use, and were direct from the mines. The third sample was taken from a storage shed and was not so fresh. These samples were treated and preserved in exactly the same manner as the Routt county coals, so that while our carbon-hydrogen ratios may be a little higher than they would have been had it been possible to have taken up the work and finished it while the samples were fresh, they are comparable with one another. The moisture in these samples, determined at 100°, was 9.24, 9.67 and 9.65 per cent., and at 110°, 9.64, 10.16 and 10.97 per cent., which, adopting the water content as the basis of classification, would place them close to the dividing line between the bituminous and the lignitic coals. The carbon-hydrogen ratios are consonant with this view, for they are 13.4, 13.8 and 13.7. While the ratio 13.4 may be too high to take as the limit for black lignites in perfectly fresh samples, I think it a perfectly proper one to take in the present case. It is, however, considerably higher than the limit suggested by Mr. Campbell. I shall give ratios for the samples in the order that they have been taken up.

Sample.	Locality.	Ratio.
No. 1.	Stevens property, bottom series E. of Pilot Knob	14.3
No. 2.	L. H. Green's mine, Hayden Gulch	14.9
No. 3.	L. H. Green's mine, Hayden Gulch	16.6
No. 4.	Scott's mine, Hayden Gulch	17.0
No. 5.	James's mine, lower opening, Oak Creek	14.7
No. 6.	James's mine, lower opening, Oak Creek	14.3
No. 7	James's mine, 14-foot seam, Oak Creek	15.3
No. 8.	James's mine, 14-foot seam, Oak Creek	14.4
No. 9.	Crawford's tract, lowest seam, Morgan Creek	27.9
No. 10.	Crawford's tract, 30-inch seam, Morgan Creek	38.7
No. 11.	Crawford's tract, 12-foot seam, Morgan Creek	20.1
No. 12.	Crawford's tract, top seam, Morgan Creek	13.9
No. 13.	Crawford's tract, north of county road, Morgan Creek	42.1
No. 14.	Location D, Colorado Anthracite Coal Co	35.2
No. 15.	Location D, Colorado Anthracite Coal Co	23.6

Sample.	Locality.	Ratio.
No. 16.	Location C, Colorado Anthracite Coal Co	26.6
No. 17.	Lower opening head of Sage Creek	14.3
No. 18.	Top seam, middle group, head of Sage Creek	14.2

These coals are plainly divisible into two groups, the first consisting of the coals from the property of the Elkhead Anthracite Coal Company, the Crawford tract, and those from the property of the Colorado Anthracite Company, Nos. 9, 10, 11, 13, 14, 15 and 16, the rest belonging together in another group, having, with three exceptions, ratios less than fifteen. Of the three exceptions one, No. 7, showed a slight tendency to coke; the other two are excellent coals, but show no tendency to coke. The first group is anthracite or semi-anthracite, but the highest classification that we can make of the rest of these coals, judging them by the carbon-hydrogen ratio, is to put them at or near the bottom of the bituminous coals, or probably, with greater justice, at the top of the lignites.

The case of No. 12, perhaps, is deserving of a little fuller notice because it is separated from No. 10, an anthracite, by not more than 140 feet of intervening strata, and has a carbon-hydrogen ratio of 13·9, while No. 10 has a ratio of 38·7, according to which the former is an excellent lignite and the latter a very good anthracite. I may add that an intervening seam, represented by Sample No. 11, has a ratio 20·1, which would place it among the bituminous coals, but it resembles the lignites in its physical properties, shows no sign of coking, and contains 7·25 per cent. of water. This coal seam is only 35 feet above the thirty-inch seam of anthracite, and one would be justified in expecting to find much more distinct evidences of the action of the underlying lava sheet than is shown.

It seems to me unfortunate that we have to use the term lignite, either with or without the modifying adjective black, in classifying these coals. I am fully convinced that these coals are properly classified as black lignites according to the standard adopted. It is, however, not my intention to intimate that they are inferior coals, for they are, on the contrary, good coals, which fact is shown by their composition and calorific values. The moisture in the air-dried coals is quite uniformly below 7 per cent., and the calorific values range from 11562 to 13109 B. T. U. In the older classifications we find Canyon City and Gunnison River coals among the lignites, but these coals are not distinguishable from bituminous coals, either in their physical properties or in regard to their calorific values, which in these instances are given as 13097 and 14240 B. T. U. respectively.

We can not use the term semi-bituminous in this case, because this is used to designate a class of coals above and not below the bituminous. We have, at present, no term designating the coals belonging to the lower portion of the bituminous and the upper portion of the lignites, neither is there any reasonable sharp line

of division between them. The term semi-bituminous might be applicable, but it is now in use in a specific sense, and to use it in another sense would only lead to confusion, which, by the way, already exists. There could be no objection to classifying these coals as lignites if this name were not used to designate a very different coal. The designation as black lignite is, perhaps, the best one so far suggested, but it carries with it a suggestion of inferiority which is not just.

COAL FIELDS OF THE DANFORTH HILLS AND GRAND HOGBACK IN NORTHWESTERN COLORADO.

By Hoyt S. Gale.

Location.

The coal fields of the Danforth Hills and the Grand Hogback are situated in the northwestern part of Colorado, in the counties of Routt, Rio Blanco, and Garfield. The territory here described is only a part of a much larger field, the Colorado portion of which has hitherto been frequently referred to as the Grand River coal field.

The Danforth Hills field lies north of White River, west of the White River plateau, south of Axial Basin, and east of the valley of Strawberry Creek and its extension toward the north. This valley is fixed as the western limit to the coal field because the coal-bearing strata dipping in that direction pass beneath it to so great a depth that they can not be considered as workable beyond this line. The Grand Hogback is a long monoclinal ridge lying mainly between Grand and White rivers, containing a relatively narrow belt of the outcropping coal strata which forms the southern extension of the Danforth Hills field. It crosses White River near Meeker, Rio Blanco county, extends due south from this point for about 20 miles, and then southeast for a similar distance, crossing Grand River at the town of Newcastle.

A westward extension from the Danforth Hills coal field north of White River lies along the southern flanks of the Yampa Plateau, or Blue Mountain, as it is locally known, reaching across the State line into Utah, beyond which comparatively little is known of the district as a coal field.

STRATIGRAPHY.

AGE OF COAL-BEARING ROCKS.

The coal beds occur in a series of sandstones and sandy shales that were mapped by the geologists of the Hayden Survey as the combined Fox Hills and Laramie groups of the Cretaceous. In the reports of the early investigators' statements are made to the effect that no definite distinction can be made between the strata of these two formations and that the limits of the groups of strata as then defined were purely arbitrary and were made for the purpose of applying a classification adapted to other fields. The investigations in the Yampa coal field in 1905*a* led to the conclusion that the subdivisions previously made could not be applied to the sequence of rock formations that occur in that field, and names

proposed by Whitman Cross *b* for a similar sequence of Cretaceous beds in the San Juan Mountains region were adopted. These are as follows:

Upper Cretaceous.....	Laramie formation.
	Lewis shale.
	Mesaverde formation.
	Mancos shale.
	Dakota sandstone.

South of the anticlinal axis which separates the Yampa basin from the Danforth Hills coal field the sequence of formations including the coal-bearing rocks apparently does not correspond to that of the Yampa field. While two distinct coal-bearing formations, the Laramie and the Mesaverde, are present in the Yampa field, separated by a thick body of shale, there appears to be but a single series of strata containing coal beds in the southern field, and the evidence at hand points strongly to the equivalence in age of this single series with the older of the coal-bearing formations developed farther north. There can be but little question that the base of the coal-bearing strata in the Danforth Hills field and the base of the Mesaverde formation in the Yampa field are of equivalent geologic age, a conclusion based on the evidence of the fossils which these strata contain and the almost unmistakable structural relations as shown in Axial Basin, where the coal-bearing strata of the two fields are separated by an interval of only 3 or 4 miles across an anticlinal valley.

The question as to what constitutes the Laramie formation has long been a source of doubt and dispute. As stated above, the geologists of the Hayden Survey mapped the upper part of the strata of the Danforth Hills and Grand Hogback as of Laramie age. A few fossils were collected during the present investigation that seem to corroborate this earlier determination, as based on the definitions that were then accepted of the Laramie formation. The fact remains, however, that the coal-bearing rocks in the Danforth Hills and Grand Hogback are, for all practical purposes, a stratigraphic and lithologic unit, without any recognized break or unconformity.

THE COAL-BEARING ROCKS.

The coal-bearing strata of the fields here discussed are distinct in character from both the overlying and underlying formations. They are massive ledge-making sandstones, together with thinner-bedded sandstones and sandy shales and coal beds. This group of strata usually forms ridges or mountains, because the sandstone members offer relatively greater resistance to erosion than either the overlying or underlying shale. The coal-bearing rocks attain a thickness of approximately a mile.

Details of the stratigraphic sections vary from place to place, as do also the thickness and quality of individual coal beds, but

a few general characteristics are found to persist in or dominate certain horizons, although all the minor characteristics vary greatly in detail. These features are illustrated in a set of measured stratigraphic sections taken in various parts of the field (Pl. XV.).

The accompanying table is a summary of the probable correlation, measured thicknesses, description and topographic expression of the groups of strata which occur in or immediately adjacent to the coal field, arranged in the order of their geologic age.

THICKNESS AND NUMBER OF COAL BEDS.

As explained under the heading "Stratigraphy" (p. 266), the group of rock strata that contain the boal is approximately a mile in thickness, and many beds of valuable coal are found in one position or another within this mass. Both the total number and the thickness of the individual beds vary from place to place along the outcrop, as may be observed in the thickening or pinching out of the beds where they can be traced. In only two localities is anything like a complete measurement of the coals now obtainable. One of these, at Newcastle, on Grand river, is particularly favorable for the measurement of what is supposed to be the maximum thickness of coal beds, as it contains the thickest single coal known in the whole field. The other on White river, below Meeker, may be taken as representative of the stratigraphic section of the field in its total quantity of coal, which is somewhat less than that of the Newcastle section. Similar sections are exposed at other localities in the various stream gaps along the Grand Hogback, but the lack of development makes it impossible at the present time to measure the coals.

THICKNESS OF COAL BEDS AT NEWCASTLE.

	Feet.		Feet.
"C seam"	5	"Wheeler seam"	45—48
"Anderson seam"	8	"E seam"	16
"Allen seam"	20	"F seam"	4
"D seam"	5	Total workable coal	105—108

THICKNESS OF COAL BEDS EXPOSED ON WHITE RIVER BELOW MEEKER.

	Ft.	In.
Lion Canyon, upper entry	5	8
Lion Canyon, W. B. Blythe coal mine	8	5
A. H. Adams mine, 3 benches, not including bone	8	5
Old Meeker bed, A. H. Adams property	5	10
F. W. Fairfield property, west entry	6	3
F. W. Fairfield property, middle entry, upper bench	9	8
F. W. Fairfield property, middle entry, lower bench	9	+
F. W. Fairfield property, east entry (old Major bank)	13	+
Mrs. Grace H. Adams property, prospect	3	3
Mrs. Grace H. Adams property, mine	1	1
	73	7

SECTION OF THE 20-FOOT COAL BED AT LAY, ROUTT COUNTY.

	Ft.	In.
Coal without partings	9	9
Shale, carbonaceous	1	3
Coal, apparently free from partings (lower 5 fet 7 inches sampled)	10	6
Shale, carbonaceous.		
	21	6

SECTION OF THE PEACOCK COAL BED AT LAY.

	Ft.	In.
Coal left as roof, thickness reported	1	6
Coal, mined	5	2
Coal, bony, pyritiferous	..	4
Coal, mined	2	..
	9	

SECTION OF THE SWEENEY COAL BED AT LAY.

Shale.	Ft.	In.
Clay, white, kaolin-like	1	..
Coal	3	10
Bone	1	..
Coal	4	..
Bone	1	7
Coal, thickness reported, not measured	4	..
	15	5

SECTION AT COLLOM MINE NEAR AXIAL, ROUTT COUNTY.

Shale.	Ft.	In.
Coal	8	6
Shale or bone	..	½
Coal	16	3
Shale	3+	..
Total coal bed	24	9½

SECTION ON MRS. GRACE H. ADAMS' PROPERTY, WEST OF MEEKER, RIO BLANCO CO.

	Ft.	In.
Shale, blue clay	2+	..
Coal, weathered outcrop	1	6
Shale or blue clay, lenticular bed	..	7+
Coal, weathered outcrop	2	10
Sandstone, single stratum	4	..
Coal weathered outcrop	3	3
Shale, brown	2	8
Sandstone, massive	1	10
Coal (sample No. 6)	4	1
Floor not exposed.	22	9

SECTION AT EASTERNMOST ENTRY ON FAIRFIELD PROPERTY, WEST OF MEEKER.

	Ft.	In.
Shale, sandy, or soft sandstone.		
Sandstone, flaggy	1+	..
Coal, upper bench	4	11
Bone, with coal streaks	..	8
Coal, middle bench	5	3
Parting, flinty, fire clay	..	3
Coal, lowest bench to mine floor	2+	..
Total coal bed measured	13	1+

SECTION OF COAL BEDS ON FAIRFIELD PROPERTY, WEST OF MEEKER.

	Ft.	In.
Coal	9	8
Clay, white, sandy	2	11
Coal	9+	..
	21	7+

SECTION IN WEST ENTRY ON A. H. ADAMS'S PROPERTY, WEST OF MEEKER.

	Ft.	In.
Coal, good	5	11½
Clay, hard	..	1
Coal, good	1	4
Bone, black, flinty, not constant	..	5
Coal, apparently good	1	..
Coal or bone, soft, flaky	1	..
Bone, or carbonaceous shale floor.		
Total coal bed	8	11½

SECTION AT LION CANYON MINE, MEEKER.

Sandstone, very massive	75	..
Coal, sampled	8	5
Clay, hard (weathers readily to a friable bluish shale)	25	0
Sandstone, massive, white (good building stone)	40	..

SECTION AT MORGAN MINE, 7 MILES WEST OF AXIAL, ROUTT COUNTY.

	Feet.
Sandstone	7
Shale	3
Coal	10
	20

SECTION AT COAL PROSPECT IN BOX ELDER GULCH.

	Feet.
Sandstone	7
Shale	2
Coal	5
Coal, clayey	1
Coal (base not reached)	4
Total coal	10+

SECTION IN W. H. MILLER MINE, 1 MILE SOUTH OF AXIAL POSTOFFICE.

Clay roof.	Ft.	In.
Coal, good	3	..
Coal, dirty, powdery	..	4
Coal, good	5	..
Bone	..	1
Coal, not exposed in the mine.	—	—
	8	5

SECTION AT SHAFER MINE ON MILK CREEK SOUTH OF AXIAL BASIN.

Shale roof.	Ft.	In.
Coal, minimum thickness	12	..
Bone	..	2
Coal, minimum thickness	2	..
Coal floor.	—	—
	14	2

SECTION AT THE J. F. WILSON BANK IN MILK CREEK CANYON, RIO BLANCO CO.

Shale.	Ft.	In.
Coal	2+	..
Shale, carbonaceous	1	..
Coal	11	1
Shale, carbonaceous	2	..
Coal	2+	.
	—	—
	18	1+

SECTION IN MILK CREEK CANYON, ONE-FOURTH MILE NORTH OF THE WILSON MINE.

Shale.	Ft.	In.
Coal	1	..
Shale, carbonaceous	..	10
Coal, at least	5	..
	—	—
	6	10

SECTION IN WESSON MINE, COAL CREEK.

	Ft.	In.
Coal roof		(?)
Coal, good	3	..
Coal, dirty seam	..	2
Coal, good	1	6
Coal, dirty seam	..	2
Coal, good	4	3
Coal floor.	—	—
	9	1

SECTION IN MAIN ENTRY, SULPHUR CREEK MINE, NORTH OF MEEKER

	Ft.	In.
Sandstone, massive	20	..
Bone	1	..
Coal	1	3
Bone, sandy	..	1
Coal	..	8
Bone, sandy	..	1
Coal	4	..
Bone floor.		
	—	—
Total coal bed	7	1

SECTION IN SIDE ENTRY, SULPHUR CREEK MINE, NORTH OF MEEKER.

Coal roof (not measured).	Ft.	in.
Coal	1	2
Parting, sandy	..	½
Coal	..	11
Parting, sandy	..	½
Coal	3	1
Bone floor.	—	—
	5	3

SECTION IN OLD MINE ON SOUTHWEST SIDE OF SULPHUR CREEK.

Shale roof (poor).	Ft.	In.
Coal	1	4
Parting, sandy	..	½
Coal (sample No. 23)	3	9
Coal floor.	—	—
	5	1½

SECTION IN BLACK DIAMOND MINE, NEAR MEEKER.

Coal roof.	Ft.	In.
Coal	3	11
Coal, soft, powdery ("mother coal")	..	½
Coal	3	10
	—	—
	7	9½

SECTION AT POLLARD MINE, MEEKER.

	Ft.	In.
Sandstone	4	..
Shale	3	..
Coal	1	8
Shale (reported not constant)	1	1
Coal (base not reached)	5	8
	—	—
Total coal bed measured	8	5

SECTION IN POLLARD MINE 510 FEET FROM ENTRANCE.

Sandstone roof.	Ft.	In.
Coal	2	9
Coal, pyritiferous	..	½
Coal	3	4
Sandstone floor.	—	—
	6	1½

SECTION AT MILLER PROSPECT ON CURTIS CREEK, 6½ MILES NORTH OF MEEKER.

Shale roof.	Ft.	In.
Coal, good	2	3
Coal, dirty	..	3
Coal, good	1	4
Bone	..	1
Coal (peacock colors)	1	4
Shale floor.	—	—
	5	3

SECTION IN MAIN ENTRY OF McLEARN MINE, RIFLE CREEK, GARFIELD COUNTY.

Sandstone, flaggy (roof).	Ft.	In.
Coal (mined)	7	3
Shale, brown, carbonaceous, thin bed at floor.		
Interval, mostly sandstone	10+	..
Coal	2	..
Sandstone	20	..
Coal	2	..
Clay, soft, sandy	..	2
Shale, fine, dark gray	30	..
Sandstone, white, very massive	60	..

Alternating massive white sandstones and shale to entrance of mine.

SECTION AT SUNLIGHT MINE.

	Ft.	In.
Coal ("D seam")	9	..
Shale	25	..
Coal ("C seam")	3	..
Shale and sandstone	6	10
Shale	9	..
Coal ("A seam")	10	..
	62	10

SECTION NEAR THE POCAHONTAS MINE.

	Ft.	In.
Coal ("D seam")	12	..
Shale	17	..
Coal ("C seam")	7	6
Shale	7	6
Coal	1	..
Interval	4	..
Coal ("B seam")	3	5
Interval estimated	20	..
Coal ("A seam")	7	..
Shale, bony	9	..
	88	5

SECTION OF "C SEAM," POCAHONTAS MINE.

Shale roof.	Ft.	in.
Coal	3	11
Shale	4	..
Coal	3	6
Shale floor.	11	5

SECTION OF UPPER PORTION OF 16-FOOT BED AT BLACK DIAMOND MINE.

	Ft.	In.
Coal	2	2
"Mother coal"	..	1
Coal	1	10
Parting	..	2
Coal	5	..
	9	3

During the progress of this investigation 61 samples of coal were collected from different parts of the field for analysis. The results of the analyses of these samples are given in the following table. As the figures here given express the composition of the samples as received at the laboratory in sealed air-tight cans and also the composition of air-dried samples, they should be directly comparable to most of the analyses that have been previously made of the coals from these localities. All chemical analyses and calorific determinations of samples collected during the progress of this work were made at the fuel-testing plant of the United States Geological Survey at St. Louis, Mo., by F. M. Stanton, chief chemist.

In determining the value of a coal from its chemical analysis, and also in comparing one analysis with another, it is important to know how the sample was taken, how it was treated, after it was obtained, and how the analysis was made, especially the determination of moisture. In this work the samples were all collected and treated according to the following methods of sampling adopted by the fuel-testing plant:

After the face of the coal was cleaned of weathered coal and powder smoke a cut was made across the face of the bed from roof to floor, including all of the benches of coal mined and such impurities as were not removed in ordinary work. This cut was about 3 inches wide and 1 inch deep; the coal obtained from it, amounting to 25 [to 100] pounds, was caught upon an oilcloth [or heavy canvas square] spread upon the floor of the mine so as to protect the samples from water and from admixture of shale and clay fragments that usually abound in such places.

The coal composing the sample was then pulverized and quartered down, according to the generally accepted rules for preparing samples, until a quart sample was obtained, the particles of coal being reduced to a size not much greater than one-half inch in diameter. The sample was placed in an air-tight galvanized-iron can, having a screw top, and the can was hermetically sealed by screwing the top down tight and covering the joint with adhesive tape. The can containing the sample was then mailed to the testing plant. When it reached the chemical laboratory, the sample was at once transferred to a glass jar, in which it was sealed until the time arrived for making a chemical analysis.

By being sealed at the mine the sample reached the chemical laboratory with its moisture content unchanged. Part of this moisture is inherent in the coal and part is extraneous, either derived from water in the mine or from the atmosphere. In order to eliminate some of the extraneous moisture, the samples, during the first year's work at the testing plant, were exposed to the air after they were pulverized until they reached a fair degree of constancy of weight and then were analyzed. The amount lost during the exposure to the air is noted in the

report as "less of moisture on air drying." This method, however, was found to be unsatisfactory, since the amount of loss depended almost entirely upon the degree of saturation of the air, and this varied greatly from day to day.

Later, when these samples and those from the Yampa field were analyzed, the method was changed, the samples being artificially dried in order to secure greater uniformity of the moisture content, the method being as follows: *a*.

In order to make determinations of the loosely held moisture more uniform and definite, a special drying oven has been designed and introduced into the laboratory. In this oven samples of several pounds weight can be dried in a gentle current of air, raised from 10° to 20° above the temperature of the laboratory. In this way the coal is air dried in an atmosphere with a very low dew-point and not subject to large percentage variations, and the results obtained were considerably more concordant

ANALYSES OF COAL SAMPLES FROM DANFORTH HILLS AND GRAND HOGBACK COAL FIELDS, IN NORTHWESTERN COLORADO.

	Lay, 20-foot bed	Lay, Peacock bed	Lay, Sweeney bed	Axial	Meeker				
Laboratory No.	3463.	3461.	3462.	3466.	3483.	3482.	3498.	3504.	3502.
Analysis of sample as received:									
Prox. Moisture	14.65	13.31	12.31	11.25	12.53	10.31	9.41	12.00	13.20
Prox. Volatile matter	34.73	35.18	36.17	38.80	31.78	34.86	37.97	40.04	39.02
Prox. Fixed carbon	44.48	46.53	45.40	47.92	50.51	45.23	45.38	45.72	42.35
Prox. Ash	6.14	4.98	6.12	2.03	5.18	9.60	7.24	2.24	5.43
Ult. Sulphur	.99	.90	1.10	.32	1.36	.73	.75	.51	.68
Ult. Hydrogen	5.80	.....	5.75	.....	.....	.....	5.34	.....	.....
Ult. Carbon	60.07	.....	62.72	.....	.....	.....	63.39	.....	.....
Ult. Nitrogen	1.10	.....	1.16	.....	.....	.....	1.23	.....	.....
Ult. Oxygen	25.90	.....	23.15	.....	.....	.....	22.05	.....	.....
Calorific value determined:									
Calories	5,869	.....	6,163	.....	.....	.....	6,291	.....	.....
British thermal units	10,564	.....	11,093	.....	.....	.....	11,324	.....	.....
Loss of moisture on air drying	5.30	4.50	4.00	3.50	4.40	3.20	2.40	3.30	3.20
Analysis of air-dried sample:									
Prox. Moisture	9.87	9.23	8.66	8.03	8.50	7.34	7.18	9.00	10.33
Prox. Volatile matter	36.67	36.84	37.68	40.21	33.24	36.01	38.90	41.40	40.31
Prox. Fixed carbon	46.97	48.72	47.29	49.66	52.84	46.73	46.50	47.28	43.75
Prox. Ash	6.49	5.21	6.37	2.10	5.42	9.92	7.42	2.32	5.61
Ult. Sulphur	1.05	.94	1.14	.33	1.42	.75	.76	.53	.70
Ult. Hydrogen	5.50	.....	5.53	.....	.....	.....	5.20	.....	.....
Ult. Carbon	63 43	.....	65.33	.....	.....	.....	64.95	.....	.....
Ult. Nitrogen	1.16	.....	1.22	.....	.....	.....	1.26	.....	.....
Ult. Oxygen	22.37	.....	20.41	.....	.....	.....	20.41	.....	.....
Calorific value determined:									
Calories	6,193	.....	6,419	.....	.....	.....	6,446	.....	.....
British thermal units	11,156	.....	11,554	.....	.....	.....	11,602	.....	.....
Thickness of coal bed	Ft. in. 20 3	Ft. in. 9	Ft. in. 7 10	Ft. in. 24 11	Ft. in. 4 1	Ft. in. 21 7	Ft. in. 6 3	Ft. in. 9	Ft. in. 8 5
Thickness of part sampled.	5 7	7	5 5	10	4 1	9 8	6 3	6 6	8 5

a Bull. U. S. Geol. Survey No. 290, 1906, pp. 29-30.

	Deepchannel Creek		Morgan Gulch		Box Elder Gulch, prospect pit	Axial			Thornburg
Laboratory No.	3571.	3569.	3688.	3690.	3689.	3703.	3704.	3707.	3792.
Analysis of sample as received:									
Prox. Moisture	19.21	21.02	15.26	15.37	31.40	14.18	12.01	13.15	10.81
Prox. Volatile matter	34.12	39.32	30.70	35.21	32.66	34.78	35.83	36.44	33.94
Prox. Fixed carbon	40.81	33.58	50.33	43.11	30.91	44.46	47.54	47.54	45.30
Prox. Ash	5.86	6.08	3.71	6.31	5.03	6.58	4.62	2.87	9.95
Ult. Sulphur	.59	.47	.55	.97	.33	.56	.52	.57	.52
Ult. Hydrogen	.....	.....	.....	.....	.....	5.81	5.44	5.48	.....
Ult. Carbon	.....	.....	.....	.....	.....	60.62	63.87	64.12	.....
Ult. Nitrogen	.....	.....	.....	.....	.....	1.01	1.35	1.07	.....
Ult. Oxygen	.....	.....	.....	.....	.....	25.42	24.20	25.89	.....
Calorific value determined:									
Calories	.....	.....	.....	.....	.....	5,838	6,312	6,328	.....
British thermal units	.....	.....	.....	.....	.....	10,508	11 362	11,390	.....
Loss of moisture on air drying	4.40	5.70	6.50	6.20	17.60	6.30	3.40	4.90	3.30
Analysis of air-dried sample:									
Prox. Moisture	15.49	16.24	9.37	9.77	16.75	8.41	8.91	8.67	7.77
Prox. Volatile matter	35.69	41.70	32.83	37.54	39.64	37.12	37.09	38.32	35.10
Prox. Fixed carbon	42.69	35.61	53.83	45.96	37.51	47.45	49.22	49.99	46.84
Prox. Ash	6.13	6.45	3.97	6.73	6.10	7.02	4.78	3.02	10.29
Ult. Sulphur	.62	.50	.59	1.03	.40	.60	.54	.60	.54
Ult. Hydrogen	.....	.....	.....	.....	.....	5.46	5.24	5.20	.....
Ult. Carbon	.....	.....	.....	.....	.....	64.69	66.12	67.42	.....
Ult. Nitrogen	.....	.....	.....	.....	.....	1.08	1.40	1.12	.....
Ult. Oxygen	.....	.....	.....	.....	.....	21.15	21.92	22.64	.....
Calorific value determined:									
Calories	.....	.....	.....	.....	.....	6,231	6,534	6,654	.....
British thermal units	.....	.....	.....	.....	.....	11,214	11,762	11,977	.....
Thickness of coal bed	Ft. in. 7 2	Ft. in. 7+	Ft. in. 10+	Ft. in. 10+	Ft. in. 9+	Ft. in. 26 10	Ft. in. 8+	Ft. in. 14+	Ft. in. 18±
Thickness of part sampled	6 2	6—	6	5 2	5	8	6 4	7 6	7

	Rifle Creek		Harvey or Dry Gap, 14-foot bed *b*	Harvey or Dry Gap, Wheeler bed *b*	Newcastle				
Laboratory No.	3943.	3946.			3936.	3932.	3938.	3933.	3937.
Analysis of sample as received:									
Prox. Moisture	6.32	7.21	.....	.....	3.68	4.16	3.51	3.51	4.00
Prox. Volatile matter	36.90	36.09	.....	.....	36.66	35.55	38.38	38.50	38.41
Prox. Fixed carbon	50.84	51.39	.....	.....	52.77	54.94	53.17	53.34	53.74
Prox. Ash	5.94	5.31	.....	.....	6.89	5.35	4.94	4.65	3.85
Prox. Sulphur	1.12	.69	.....	.....	.44	.42	.54	.52	.51
Ult. Hydrogen	5.48	5.50	.....	.....	5.12	5.27	5.10	.....	.....
Ult. Carbon	68.72	68.21	.....	.....	71.99	73.24	72.86	.....	.....
Ult. Nitrogen	1.57	1.58	.....	.....	1.39	1.44	1.74	.....	.....
Ult. Oxygen	17.17	18.71	.....	.....	14.17	14.28	14.82	.....	.....
Calorific value determined:									
Calories	6,903	6,856	.....	.....	7,178	7,290	7,370	.....	.....
British thermal units	12,425	12,341	.....	.....	12,920	13,122	13,266	.....	.....
Loss of moisture on air drying	2.10	3.10	.....	.....	.90	1.00	.80	.70	1.20
Analysis of air-dried sample:									
Prox. Moisture	4.31	4.24	4.54	4.81	2.81	3.19	2.73	2.83	2.83
Prox. Volatile matter	37.69	37.24	40.67	36.45	36.99	35.91	38.69	38.77	38.88
Prox. Fixed carbon	51.93	53.04	51.09	45.79	53.25	55.49	53.60	53.72	54.39
Prox. Ash	6.07	5.48	3.70	2.95	6.95	5.41	4.98	4.68	3.90
Ult. Sulphur	1.14	.71	.55	.53	.44	.42	.54	.52	.52
Ult. Hydrogen	5.36	5.32	.....	.....	5.07	5.21	5.05	.....	.....
Ult. Carbon	70.20	70.39	.....	.....	72.65	73.98	73.45	.....	.....
Ult. Nitrogen	1.60	1.63	.....	.....	1.40	1.45	1.76	.....	.....
Oxygen	15.63	16.47	.....	.....	13.49	13.53	14.22	.....	.....
Calorific value determined:									
Calories	7,072	7,075	.....	.....	7,243	7,364	7,429	.....	....
British thermal units	12,691	12,736	12,933	11,412	13,037	13,255	13,373	.....	.....
Thickness of coal bed	Ft. in. 7 3	Ft. in. 7 3	Ft. in.	Ft. in.	Ft. in. 2—	Ft. in. 2—	Ft. in. 14	Ft. in. 14	Ft. in. 14
Thickness of part sampled.	7 3	5 9	.....	.....	1 8	1 8	9	4 2	5 3

*a*Thickness reported, not verified.
*b*Republished from Hills, R. C., Mineral Resources U. S

	Newcastle		South Canyon, east Wheeler bed		South Canyon, D bed	Gulch, Sunshine bed	Gulch, Anderson bed	Coal Basin	
Laboratory No.	3935.	3939.	3959.	3960.	3961.	4010.	4009.	4041.	4043.
Analysis of sample as received:									
Prox. Moisture	4.04	4.06	6.55	5.51	7.44	2.30	2.77	1.33	1.15
Prox. Volatile matter	37.66	38.20	36.63	35.89	36.18	34.74	35.15	21.48	22.43
Prox. Fixed carbon	52.56	52.71	47.89	48.76	53.90	56.71	58.68	70.24	68.85
Prox. Ash	5.74	5.03	8.93	9.84	2.48	6.25	3.40	6.95	7.57
Ult. Sulphur	.53	.51	.48	.29	.47	.14	.46	.51	.48
Ult. Hydrogen	.....	5.24	.....	5.27	5.36	5.23	.....	.....	.....
Ult. Carbon	.....	72.98	.....	65.66	69.73	76.12	.....	.....	.....
Ult. Nitrogen	.....	1.71	.....	1.36	1.65	1.54	.....	.....	.....
Ult. Oxygen	.....	14.53	.....	17.58	20.31	10.42	.....	.....	.....
Calorific value determined:									
Calories	.....	7,352	.....	6,606	7,047	7,766	.....	.....	.....
British thermal units	.....	13,234	.....	11,891	12,685	13,979	.....	.....	.....
Loss of moisture on air drying	1.10	1.20	2.20	1.70	3.10	1.20	1.50	.40	.30
Analysis of air-dried sample:									
Prox. Moisture	2.97	2.90	4.45	3.88	4.48	1.21	1.29	.93	.85
Prox. Volatile matter	38.08	38.66	37.45	36.51	37.34	35.17	35.69	21.57	22.50
Prox. Fixed carbon	53.14	53.35	48.97	49.60	55.62	57.30	59.57	70.52	69.06
Prox. Ash	5.81	5.09	9.13	10.01	2.56	6.32	3.45	6.98	7.59
Ult. Sulphur	.54	.52	.49	.30	.49	.45	.47	.51	.48
Ult. Hydrogen	.....	5.17	.....	5.17	5.18	5.16	.....	.....	.....
Ult. Carbon	.....	73.87	.....	66.79	71.96	77.05	.....	.....	.....
Ult. Nitrogen	.....	1.73	.....	1.38	1.70	1.56	.....	.....	.....
Ult. Oxygen	.....	13.62	.....	16.35	18.11	9.46	.....	.....	.....
Calorific value determined:									
Calories	.....	7,441	.....	6,720	7,376	7,860	.....	.....	.....
British thermal units	.....	13,394	.....	12,106	13,090	14,149	.....	.....	.....
Thickness of coal bed	Ft. m. 14	Ft. in. 14	Ft. in. 18 [illegible]	Ft. m.	Ft. in. 4 8	Ft. in. 14 [illegible]	Ft. in. 4 10	Ft. in. a20	Ft. in. a20
Thickness of part sampled	9	14	12 8	15 10	4 8	.....	4 10	6 3	7 6

	Coal Basin			Sunlight, C bed	Sunlight, B bed	Sunlight, D bed		Sunlight, A bed	
Laboratory No.	4047.	4049.	4042.	4045.	4046.	4033.	4048.	4032.	4034.
Analysis of sample as received:									
Prox. Moisture	0.96	1.22	1.27	5.65	6.93	5.19	6.49	5.50	5.32
Prox. Volatile matter	21.49	22.02	22.38	36.29	35.55	47.77	37.23	24.68	36.29
Prox. Fixed carbon	68.93	67.84	67.35	52.89	52.73	43.21	53.38	58.64	49.60
Prox. Ash	8.62	8.92	9.00	5.17	4.79	3.83	2.90	11.18	8.79
Prox. Sulphur	.52	.59	.50	.82	.67	.79	.93	.69	.76
Ult. Hydrogen	4.66	.....	.....	.....	.....	.....	5.56	.....	5.26
Ult. Carbon	79.61	.....	.....	.....	.....	.....	71.51	.....	67.76
Ult. Nitrogen	1.83	.....	.....	.....	.....	.....	1.79	.....	1.58
Ult. Oxygen	4.76	.....	.....	.....	.....	.....	17.31	.....	15.85
Calorific value determined:									
Calories	7,961	.....	.....	.....	.....	.....	7,299	.....	6,902
British thermal units	14,330	.....	.....	.....	.....	.....	13,138	.....	12,424
Loss of moisture on air drying	.20	.40	.40	2.60	3.80	2.00	3.50	2 80	3.00
Analysis of air-dried sample:									
Prox. Moisture	.76	.82	.87	3.13	3.25	3.26	3.10	2.78	2.39
Prox. Volatile matter	21.53	22.11	22.47	37.26	36.96	48.74	38.58	25.39	37.41
Prox. Fixed carbon	69.07	68.11	67.62	54.30	54.81	44.09	55.32	60.33	51.14
Prox. Ash	8.64	8.96	9.04	5.31	4.98	3.91	3.00	11.50	9 .06
Prox. Sulphur	.52	.59	.50	.84	.69	.81	.96	.71	.78
Ult. Hydrogen	4.65	.....	.....	.....	.....	.....	5.36	.....	5.08
Ult. Carbon	79.77	.....	.....	.....	.....	.....	74.10	.....	69.86
Ult. Nitrogen	1.83	.....	.....	.....	.....	.....	1.86	.....	1.63
Ult. Oxygen	4.59	.....	.....	.....	.....	.....	14.72	.....	13.59
Calorific value determined:									
Calories	7,977	.....	.....	.....	.....	.....	7,564	.....	7,115
British thermal units	14,359	.....	.....	.....	.....	.....	13,614	.....	12,808
Thickness of coal bed	Ft. in. 20	Ft. in. a20	Ft. in.	Ft. in.	Ft. in.	Ft. in. 9 ±	Ft. in. 8 3	Ft. in. 10—	Ft. in 10 9
Thickness of part sampled	9	9	.....	.....	6	4	8 3	7 6	10 2

a Thickness reported; not verified.

THE BOOK CLIFFS COAL FIELD, BETWEEN GRAND RIVER, COLORADO, AND UTAH LINE.

By G. B. Richardson.

INTRODUCTION.

The Book Cliffs coal field is part of the southern edge of an immense basin in western Colorado and eastern Utah around which the outcrop of coal-bearing rocks can be traced for more than 500 miles. Pl. XVIII shows the outline of this field. On the southwest from the vicinity of Mount Hilgard, Utah, northward to Castlegate, the coal measures from the eastern escarpment of the Wasatch Plateau. Thence they trend southeastward to Grand River, constituting in the Books Cliffs the southern rim of the Uinta Basin. Beyond Grand River the coal measures continue eastward, forming the southern base of Grand Mesa and extending to the vicinity of Crested Butte. From that place the outcrop trends northward and, crossing Grand River again in the vicinity of Newcastle, continues northward along the Grand Hogback to the Danforth Hills. Thence the coal measures turn westward and outcrop along the southern flank of the Uinta Mountains. This great coal field has been but partially prospected and mines are in operation in only a few localities, but enough of the area has been explored to prove that it is one of the most important coal reserves of the Rocky Mountain region.

SECTION OF COAL BED AT GARFIELD MINE.

	Ft.	In.
Sandstone, shaly.		
Coal	1	1
Bone	..	2
Coal	1	9
Bone	..	¼
Coal	3	2
Bone	..	..
Coal	1	..
Shale, carbonaceous	1	..
Sandstone.		
Total coal bed	7	11¼

SECTION OF COAL BED AT BLACK DIAMOND MINE.

	Ft.	In.
Shale.		
Coal	..	9—11
Clay	..	1— 3
Coal	4	8
	5	6

At a prospect north of Palisade the following section is exposed:

SECTION OF COAL AT PROSPECT NORTH OF PALISADES.

	Ft.	In.
Coal	3	6
Bone	..	1
Coal	2	5
	—	—
	6	

SECTION OF COAL BED IN BOOK CLIFF MINE.

	Ft.	In.
Coal	3	..
Bone	..	¼
Coal	4	6
	—	——
	7	6¼

SECTION OF COAL BED ONE-FOURTH MILE EAST OF STEELE MINE.

	Ft.	In.
Coal	2	6
Bone	..	5
Coal	3	2
Shale	..	8
Sandstone.		
	—	—
Total coal bed	6	1

SECTION OF COAL BED FIVE MILES NORTHWEST OF CORCORAN MINE.

	Ft.	In.
Sandstone.		
Shale	..	6
Coal	3	..
Bone	..	4
Coal	2	..
Shale	..	4
Sandstone.		
	—	—
Total coal bed	5	10

SECTION OF COAL BEDS AT HUNTER MINE.

	Ft.	In.
Sandstone.		
Coal	2	..
Bone	..	4
Coal	4	5
Bone	..	8
Coal	..	7
Sandstone	25	..
Coal	2	..
Bone	1	..
Coal	3	..
Sandstone.	——	—
	39	..

SECTION OF COAL BEDS AT JOHNSON MINE (NO. 22).

	Ft.	In.
Sandstone.		
Shale, carbonaceous	..	5
Coal	1	6
Bone	..	3
Coal	4	..
	—	—
Total coal bed	5	9

SECTION OF COAL BED AT LANE MINE.

	Ft.	In.
Sandstone.		
Shale, sandy	..	4
Coal	1	3
Bone	..	4
Coal	3	..
Shale, carbonaceous	1	..
Coal, bony	1	..
Shale.	—	—
	6	11

A mile and a half up the creek are outcrops of several coal beds which have not been prospected. These have the following sections:

SECTION OF HIGHER COAL BEDS 1½ MILES EAST OF LANE MINE.

Shale.	Ft.	In.
Coal	1	4
Bone and coal	..	8
Coal	1	3
Shale, carbonaceous	2	..
Coal	3	10
Shale, carbonaceous	18	..
Coal	..	8
Shale, carbonaceous	7	..
Coal	4	1
Shale.	—	—
	38	10

The following section was measured at about the same horizon on the cliffs north of Malone's ranch:

SECTION OF HIGH COAL BEDS THREE MILES NORTH OF MALONE'S RANCH.

Shale, carbonaceous.	Ft.	In.
Coal	1	4
Bone	..	6
Coal	2	..
Bone	..	5
Coal	..	5
Bone	..	4
Coal	3	10
Shale, sandy	7	..
Coal	3	1
	—	—
	18	11

PROXIMATE ANALYSES OF COALS FROM THE BOOK CLIFFS COAL FIELD, COLORADO.

Analyses by F. M. Stanton, Chief Chemist.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Laboratory No.	3550.	3547.	3542.	3540.	3546.	3541.	3549.	3539.	3545.
Analysis of sample as received:									
Moisture	8.42	8.17	7.55	4.71	7.57	7.52	8.77	9.02	13.96
Volatile matter	33.32	33.69	31.07	34.68	33.56	36.03	36.55	34.51	31.30
Fixed carbon	47.53	53.42	48.27	52.66	52.91	50.46	48.72	50.89	48.73
Ash	10.73	4.72	13.11	7.95	5.96	5.99	5.96	5.58	6.01
Sulphur	.60	.57	.57	.56	.72	.85	.83	.67	.63
Loss of moisture on air drying	4.30	2.80	2.60	.10	2.20	2.00	2.50	3.10	4.40
Analysis of air-dried sample:									
Moisture	4.30	5.52	5.08	4.61	5.49	5.63	6.43	6.11	10.00
Volatile matter	34.82	34.66	31.90	34.72	34.32	36.77	37.49	35.61	32.74
Fixed carbon	49.67	54.96	49.56	52.71	54.10	51.49	49.97	52.52	50.98
Ash	11.21	4.86	13.46	7.96	6.09	6.11	6.11	5.76	6.28
Fuel ratio	1.12	1.59	1.55	1.52	1.58	1.40	1.33	1.47	1.56

	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.
Laboratory No.	3490.	3496.	3494.	3581.	3495.	3493.	3489.	3488.	3640.
Analysis of sample as received:									
Moisture	11.42	10.75	10.89	11.03	9.54	15.39	6.86	6.52	5.40
Volatile matter	34.25	34.83	34.12	35.90	34.49	32.57	34.20	35.75	33.30
Fixed carbon	44.49	47.58	44.77	46.35	46.33	45.69	43.90	48.37	55.57
Ash	9.84	6.84	10.22	6.72	9.64	6.35	15.04	9.36	5.73
Sulphur	.84	.55	1.09	.68	.78	.62	.62	.67	.49
Loss of moisture on air drying	5.60	3.50	5.20	5.80	3.10	7.20	1.80	.60	.20
Analysis of air-dried sample:									
Moisture	6.17	7.51	6.00	5.55	6.65	8.83	5.15	5.96	5.21
Volatile matter	36.28	36.09	35.99	38.11	35.59	35.10	34.83	35.96	33.36
Fixed carbon	47.13	49.31	47.23	49.21	47.81	49.23	44.70	48.66	55.69
Ash	10.42	7.09	10.78	7.13	9.95	6.84	15.32	9.42	5.74
Fuel ratio	1.30	1.32	1.31	1.29	1.34	1.40	1.28	1.35	1.67

	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	XXVI.
Laboratory No.	3587.	3585.	3586.	3584.	3730.	3728.	3729.	3732.
Analysis of sample as received:								
Moisture	9.44	9.73	8.27	5.55	18.63	9.32	10.96	10.77
Volatile matter	35.51	35.27	36.90	36.01	30.61	33.64	32.19	33.68
Fixed carbon	49.33	49.95	48.67	52.75	46.28	49.52	42.45	48.36
Ash	5.72	5.05	6.16	5.69	4 48	7.52	14.40	7.19
Sulphur	1.02	1.30	1.26	.93	.38	.51	.48	.56
Loss of moisture on air drying:	5.50	5.20	3.60	1.60	9.10	3.00	4.50	3.90
Analysis of air-dried sample:								
Moisture	4.17	4.78	4.84	4.01	10.48	6.52	6.76	7.15
Volatile matter	37.58	37.20	38.28	36.60	33.68	34.68	33.71	35.05
Fixed carbon	52.20	52.69	50.49	53.61	50.91	51.05	44.45	50.32
Ash	6.05	5.33	6.39	5.78	4.93	7.75	15.08	7.48
Fuel ratio	1.39	1.41	1.32	1.46	1.51	1.47	1.32	1.44

I. Sec. 34, T. 10 S., R. 98 W.; Colorado.
II. Do.
III. Do.
IV. Upper coal, Sec. 3, T. 11 S., R. 98 W.
V. Do.
VI. Secs. 3-4.
VII. Do.
VIII. Do.
IX. Sec. 6, T. 11 S., R. 98 W.
X. Sec. 8, T. 10 S., R. 99 W.
XI. Do.
XII. Do.
XIII. Do., first coal below upper coal.
XIV. Sec. 7, T. 10 S., R. 99 W.
XV. Sec. 1, T. 10 S., R. 100 W.; weathered sample.
XVI. Sec. 36, T. 9 S., R. 100 W.
XVII. Sec. 35, T. 9 S., R. 100 W.; weathered sample.
XVIII. Sec. 5, T. 9 S., R. 100 W.
XIX. Sec. 27, T. 8 S., R. 101 W.
XX. Sec. 29, T. 8 S., R. 101 W.
XXI. Sec. 30, T. 8 S., R. 101 W.
XXII. Sec. 18, T. 8 S., R. 101 W.
XXIII. Sec. 16, T. 7 S., R. 102 W.; 21-foot coal bed; weathered sample.
XXIV. Sec. 11, T. 7 S., R. 104 W.; on east side of gulch opposite mine.
XXV. Carbonera, Sec. 14, T. 7 S., R. 104 W.
XXVI. Do.

ULTIMATE ANALYSES OF COALS FROM THE BOOK CLIFFS COAL FIELD.

	I.a	V.	VI.	IX.	X.	XVIII.	XIX.
Laboratory No.	3550.	3546.	3541.	3545.	3490.	3640.	3587.
Analysis of sample as received:							
Hydrogen	5.45	5.50	5.26	5.82	5.46	5.39	5.94
Carbon	65.52	69.47	68.43	62.19	61.84	70.18	68.47
Nitrogen	1.20	1.56	1.55	1.40	1.07	1.20	1.56
Oxygen	16.50	16.79	17.92	23.95	20.95	17.01	17.29
Sulphur	.60	.72	.85	.63	.84	.19	1.02
Ash	10.73	5.96	5.99	6.01	9.84	5.73	5.72
Calorific value determined:							
Calories	6,466	6,913	6,838	6,034	6,166	6,894	6,811
British thermal units	11,639	12,443	12,308	10,861	11,099	12,409	12,260
Loss of moisture on air drying	4.30	2.20	2.00	4.40	5.60	0.20	5.50
Analysis of air-dried sample:							
Hydrogen	5.19	5.38	5.14	5.58	5.13	5.38	5.64
Carbon	68.46	71.03	69.83	65.05	65.51	70.32	72.46
Nitrogen	1.26	1.60	1.58	1.47	1.13	1.20	1.65
Oxygen	13.25	15.16	16.47	20.96	16.92	16.87	13.12
Sulphur	.63	.74	.87	.66	.89	.49	1.08
Ash	11.21	6.09	6.11	6.28	10.42	5.74	6.05
Calorific value determined:							
Calories	6,757	7,069	6,978	6,312	6,532	6,908	7,207
British thermal units	12,162	12,723	12,550	11,361	11,757	12,434	12,973
Carbon-hydrogen ratio	13.00	13.20	13.59	11.66	12.77	13.07	12.85

	XX.	XXI.	XXV.
Laboratory No.	3585.	3586.	3729.
Analysis of sample as received:			
Hydrogen	5.81	5.54	5.63
Carbon	68.84	67.48	58.42
Nitrogen	1.55	1.57	1.24
Oxygen	17.45	17.99	19.83
Sulphur	1.30	1.26	.48
Ash	5.05	6.16	14.40
Calorific value determined:			
Calories	6,809	6,771	5,815
British thermal units	12,256	12,188	10,467
Loss of moisture on air drying	5.20	3.60	4.50
Analysis of air-dried sample:			
Hydrogen	5.52	5.33	5.37
Carbon	72.62	70.00	61.17
Nitrogen	1.63	1.63	1.30
Oxygen	13.53	15.34	16.58
Sulphur	1.37	1.31	.50
Ash	5.33	6.39	15.08
Calorific value determined:			
Calories	7,182	7,024	6,089
British thermal units	12,928	12,643	10,960
Carbon-hydrogen ratio	13.16	13.13	11.39

*a*For localities see preceding table.

The following is a list of the mines and prospects in this area. The numbers correspond to those used, with the various analyses.

1. Cameo mine.
2. Prospect on upper coal.
3. Mount Lincoln mine.
4. Riverside mine.
5. Prospect on upper coal.
6. Palisades mine.
7. Garfield mine.
8. Prospect on lower coal.
9. Old Book Cliff mine.
10. Book Cliff mine.
11. Keystone or Steele mine.
12. Black Diamond mine.
13. Farmer's mine.
14. Bob Cat mine.
15. Excelsior mine.
16. Corcoran mine.
17. Hunter mine.
18. Kiel or Gross mine.
19. Nugent mine.
20. Nearing mine.
21. Mott prospect.
22. Johnson mine.
23. Lane mine.
24. Prospect.
25. Prospect.
26. Uinta Railroad Company's mine.

ANALYSES OF COAL SAMPLES FROM DURANGO DISTRICT, COLORADO.

F. M. Stanton, Chief Chemist.

Locality	Three miles northwest of Durango	Near Durango	Three miles southeast of Durango	Near Durango	Hesperus	Near Marcos	Near Marcos	Porter
Laboratory No.	3562	4174	4552	4118	7573	4225	3991	2092
Analyses of sample as received:								
Proximate: Moisture	3.54	2.70	3.05	1.41	5.55	5.44	6.12	2.73
Proximate: Volatile matter	37.70	32.75	32.70	35.37	36.23	38.71	35.86	36.65
Proximate: Fixed carbon	53.85	59.82	47.47	55.97	52.53	50.10	49.44	54.48
Proximate: Ash	5.22	4.73	16.78	9.35	5.69	5.75	8.58	6.74
Proximate: Sulphur	1.30	.98	1.30	.58	.64	1.01	.63	.53
Ultimate: Hydrogen	5.39		4.73		5.46	5.80		
Ultimate: Carbon	73.40		64.21		72.70	72.26		
Ultimate: Nitrogen	1.48		1.45		1.37	1.47		
Ultimate: Oxygen	11.15		11.55		14.14	13.71		
Calorific value determined:								
Calories	7,580		6,611		7,289	7,170		7,730
British thermal units	13,360		11,900		13,120	12,906		13,914
Loss of moisture on air drying	1.90	1.70	.90	.40	2.80	2.00	2.50	1.30
Analyses of air-dried sample:								
Proximate: Moisture	1.67	1.02	2.17	1.01	3.33	3.51	3.71	2.46
Proximate: Volatile matter	38.40	33.32	33.09	35.40	37.98	39.30	36.78	37.13
Proximate: Fixed carbon	54.92	60.86	47.90	56.29	55.77	51.12	50.71	55.19
Proximate: Ash	5.31	4.81	16.82	9.38	5.82	5.87	8.80	6.82
Proximate: Sulphur	1.38	.70	1.31	.58	.68	1.03	.64	.54
Ultimate: Hydrogen	5.39		4.67		5.32	5.60		
Ultimate: Carbon	74.84		64.79		74.41	73.73		
Ultimate: Nitrogen	1.50		1.45		1.40	1.50		
Ultimate: Oxygen	8.80		10.85		12.39	12.18		
Calorific value determined:								
Calories	7,670		6,671		7,491	7,316		
British thermal units	13,810		12,008		13,429	13,163		

THE YAMPA COAL FIELD, ROUTT COUNTY, COLORADO.

By N. M. Fenneman and Hoyt S. Gale.

INTRODUCTION.

LOCATION.

The Yampa coal field lies in the eastern part of Routt county, Colo. It takes its name from Yampa (Bear) river, which is the principal stream of this part of the country. The territory wihin which coal is known to occur is irregular in outline and extends considerably beyond the field as described in this report, but the more valuable coal beds are limited to an area of about 1,200 square miles in the center of the valley, west of the Park Range and north of the White River plateau and Axial basin. The field is roughly triangular in outline, its corners being, approximately, at Lay post-office, Sand mountain, and a few miles north of Yampa village. The village of Hayden is located near the center of the field, and Steamboat Springs, the chief town of the county, is about 28 miles east of Hayden and about 10 miles east of the border of the coal field.

COAL.

COLORADO COAL FIELDS.

AREA.

The total area of the coal fields of the State of Colorado has been estimated as 18,100 square miles, of which area 50 per cent. is estimated as workable. The State ranks fifth in the area of its coal fields and eighth in the tonnage of its production, according to the reports for the year 1904, the total production in Colorado in that year amounting to 6,658,355 short tons.

DISTRIBUTION.

As shown on fig. 2, the coal fields of Colorado lie on both flanks of the Rocky Mountain range. The South Platte river field, the Raton field, and the Canyon field lie along the eastern edge of the mountain ranges, the Middle Park and North Park fields lie within the great mountain area, and the Yampa, Grand River and Durango-Gallup fields lie on the western flanks of the mountains. With this latter group should be classed the Carbon-Hanna, Rawlins and Rock Springs fields in southern Wyoming.

CHARACTER.

The general character of the Cretaceous coals of the Western States is subbituminous, but owing to conditions of mountain building and volcanic action they have been metamorphosed local-

ly into the higher grades of bituminous coal and anthracite. This form of metamorphism is frequently designated "regional," as contrasted with "local." By regional metamorphism is meant those changes in rocks that are wrought by the forces of heat and pressure accompanying deep burial and mountain-building upheavals. Local metamorphism includes those changes effected by igneous intrusion, which are largely the result of the heat of the molten rock, but also includes the chemical changes brought about by the hot gases and solutions which accompany such processes. As these names indicate, the former is comparatively uniform and far reaching in its effects, while the latter is restricted to the immediate vicinity of the eruptive masses which cause the change. The anthracite coals of Pennsylvania are the product of regional metamorphism of original or normal bituminous coals, just as the bituminous coals of the Rocky mountains are the products of regional metamorphism of original subbituminous coals, but the anthracites of the Rocky mountains are the product of local metamorphism.

In general it may be said that in close proximity to the mountains the coal is changed to bituminous and at some distance it retains its original subbituminous character. East of the Rocky mountains the subbituminous coals in general occur in the central and eastern parts of the fields, while bituminous varieties are found along the flanks of the ranges. North and south of the region as a whole a similar change can be noted, from the high-grade coals near the mountain masses to subbituminous in Wyoming and New Mexico. On the west, also, the low-grade coals are found in the fields farther removed from the great mountain masses which constitute the core of the Rocky and San Juan mountain ranges.

On account of this metamorphism in the vicinity of the mountain masses, and also on account of its variability from place to place, the State of Colorado contains representatives of almost all grades of coal that are known. Anthracite is found only in limited areas, and at present is mined only at Crested Butte, in Gunnison county, where approximately 50,000 short tons were produced in 1904.

Bituminous coal is much more common, occurring in the Raton, Durango, Grand River and Yampa fields in large quantity, and probably in other fields to some extent. Subbituminous coal occurs in almost all of the fields of the State.

There are a great number of classes of bituminous coals, but perhaps the most important is the class of coking coals. These are indispensable in the modern practice of iron making, and consequently they are in great demand. So far as known at the present time the Raton, Durango and Grand River fields are the only ones containing good coking coal. From time to time reports are current regarding the discovery of coking coals in other fields, but the quantity has always proved too small to be of commercial value, or the quality such that the product could not be marketed.

Las Animas, Gunnison, Pitkin and La Plata counties now produce coal that is utilized for coking, and coal from Garfield county has been coked in the past. Of the 6,600,000 tons of coal produced in Colorado in 1904, about 1,100,000 tons were made into coke, this product being largely from the Raton field in Las Animas county.

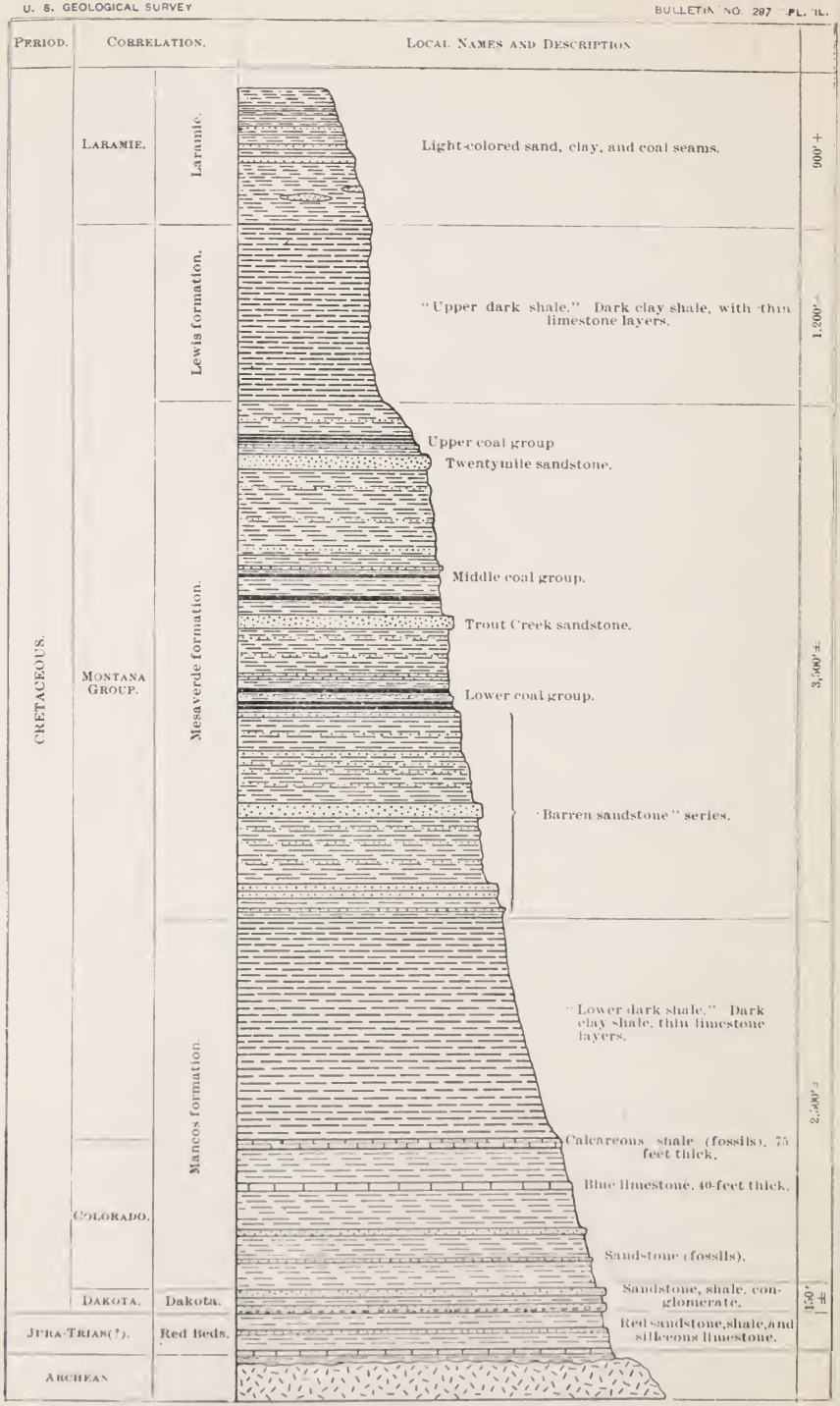
The general principles outlined above apply fully to the conditions found in the Yampa field. Anthracite occurs in regions in which extensive eruptive activity has taken place since the time in which the coals were formed. The bituminous beds lie within the folded and broken strata of the Colorado Plateau, where these beds now lie titled against the old uplifted core of the Rocky mountains. The stresses that produced the folding were transmitted from the center of uplift through the resistant sandstone members that form a part of this bituminous coal-bearing series. The coal seams within these beds were at that time buried under the tremendous weight of many thousands of feet of sediments which have now been eroded wherever the coals are exposed. Thus, confined between beds of massive and resistant sandstone, buried under the weight of thousands of feet of sediments, these coal seams were compressed vertically and laterally into folds and broken by faults. The forces that accomplished this were transmitted through the beds in which the coals were contained. The weaker shaly beds above and below conformed themselves to the structures determined in the sandstone series. The Laramie beds not only supported a comparatively lesser weight of overlying sediments, but by reason of their weaker constituent members accommodated themselves to shifting positions by minor internal crumpling and breaking, and their coal seams were not so unusually compressed.

ROCKS.

The greater part of the coal-bearing strata of Colorado is of Upper Cretaceous age, the Montana and Laramie formations containing most of the valuable coals. It has been the popular impression that the coals of the Rocky Mountain fields are contained almost wholly in the Laramie formation and many statements have been published to this effect, but the geologic explorations that have been carried on in these fields within the past few years have shown that a considerable amount of the valuable coal is older than the Laramie. Owing to the present confusion in the names of the geologic formations of the Yampa and adjacent coal fields, a brief account is given of the manner in which these names were originally applied to the strata west of the Rocky Mountains and to those of the Yampa field in particular.

STRATIGRAPHY.

The coal-bearing rocks of the Yampa field are found in the Mesaverde formation and in the Laramie. Between the coal field proper and the Park Range on the east are outcrops of



GENERAL STRATIGRAPHIC SECTION FOR YAMPA COAL FIELD, COLORADO.

older Mesozoic rocks, the entire section in and adjacent to the coal field being as follows (Pl. II):

Cretaceous:	Feet.
Laramie formation, sandstone and shale, with coal.....	1,000
Lewis shale, dark shale, calcareous layers.....	1,000—2,000
Mesaverde formation, sandstone, shale and coal seams..	2,500—3,500
Mancos shale, dark shale, containing limestone and sandstone layers	2,000—2,500±
Dakota formation, conglomerate and shale.....	200 ±

Jurassic-Triassic (?) "Red Beds" (Triassic to Carboniferous?).
Archean (ancient crystalline and metamorphic rocks).

The rocks below the coal-bearing group were not studied in great detail. In a preliminary examination to determine the stratigraphic relations of the coal measures the lower sedimentary formations were crossed and examined along a few sections between Yampa and Steamboat Springs, and also in the vicinity of Hahns Peak. A geologic map is published herewith, showing the distribution of formations both north and south of the Yampa field (Pl. III). This has been compiled from the results of the present survey, from the Hayden Atlas of Colorado, and in lesser part from the King Atlas of the Fortieth Parallel Exploration.

SECTION SHOWING COAL SEAMS OF THE LOWER COAL GROUP AT LAY.

	Feet.	Inches.
1. Coal (reported, but not examined).....	10	..
2. Soil-covered slope	60	..
3. Coal	9	9
4. Bone	1	3
5. Coal	10	6
6. Shale and sandstone.....	7	..
7. Coal	4	..
8. Shale and thin-bedded sandstone.....	90	..
9. Coal	9	..
10. Soil-covered slope with sandstone top.....	100	..
11. Coal	3	10
12. Bone	1	..
13. Coal	4	..
14. Bone	1	7
15. Coal	4	..
16. Sandstone and shale.....	10	..
17. Sandstone with coal streaks.....	12	..
18. Soil-covered slope	20	..
19. Coal (reported, but not examined).....	4	..
	361	11

SECTION OF THE MIDDLE COAL GROUP IN SAGE CREEK CANYON.

		Feet.
1.	Talus covered, probably sandstone	50
2.	Soil covered, probably shaly beds	130
3.	Probably sandstone	58
4.	Series of four strong sandstones	50
5.	Waste-covered slope	304
6.	Sandstone	10
7.	Shale	19
8.	Coal	12
9.	Sandstone and shale	22
10.	Thin-bedded sandstone and shale with occasional sandstone beds	110
11.	Waste-covered slope	10
12.	Coal	8
13.	Waste-covered slope	34
14.	Shale	2
15.	Coal	1
16.	Not exposed	7
17.	Sandstone	7
18.	Not exposed	22
19.	Shaly sandstone	3
20.	Coal	2½
21.	Not exposed	28
22.	Sandstone	3
23.	Not exposed	119
24.	Trout Creek sandstone (estimated)	80
		1,001½

SECTION OF THE UPPER COAL GROUP AT THE MOUTH OF SAGE CREEK CANYON.

		Feet.	Inches.
1.	Coal	11	..
2.	Sandstone	2	..
3.	Shaly sandstone and shale	11	..
4.	Coal, with carbonaceous shale above and below	5	6
5.	Sandstone, yellow and iron-stained	46	..
6.	Coal	4	8
7.	Sandstone	2	..
8.	Waste-covered slope, probably shale and shaly sandstone	43	..
9.	Coal	3	..
10.	White sandstone	55	..
11.	Not exposed	45	..

		Feet.	Inches.
12.	Coal indications	..	..
13.	Not exposed	10	..
14.	Coal	1	..
15.	Carbonaceous shale	9	..
16.	Coal	..	6
17.	Not exposed	10	..
18.	Sandstone, with coal indications above	1	..
19.	Not exposed	6	..
20.	Sandstone	2	..
21.	Shale, with coal indications below	2	..
22.	Not exposed	23	..
23.	Carbonaceous shale	2	..
24.	White sandstone	38	..
25.	Carbonaceous shale, with streak of coal above	2	..
26.	Thin-bedded dark shale, with occasional beds of sandstone	45	..
27.	Twentymile sandstone member	51	..
		430	8

SECTION OF COAL-BEARING STRATA IN DUNKLEY CANYON.

	Feet.
Twentymile sandstone. Massive white ledges at the top of the series; no upper coals were noted at this point	
Interval of less resistant beds, probably mostly shaly strata, with here and there thin sandstones	900
Coal, one large and several small seams (see next table)	12+
Shaly beds	50
Sandstone, massive	15
Shaly beds	130+
Sandstone, massive (Trout Creek member)	18
Shale, forming marked valleys	800
Sandstones, massive. Two beds, between which is a 6-foot coal seam belonging to the lower group	150
Total (not including upper coal group nor lower barren sandstones)	1,175

MEASUREMENT AT 12-FOOT SEAM OF MIDDLE GROUP IN DUNKLEY CANYON.

	Feet.
Clay	2
Coal	12
Sandstone, thin-bedded, and shale	8
Coal	3
Interval not recorded, shale and thin sandstone beds	(?)
Coal	2
Shale	10
Coal	8
Shale, brown carbonaceous	1
Sandstone	15

SECTION OF LOWER COALS AT "STEAMBOAT SPRINGS ELECTRIC COMPANY" MINE, ON OAK CREEK.

	Feet.	Inches.
Sandstone, massive	35	..
Covered (probably shaly beds)	70	..
Coal, old working	6+	..
Sandstone	30	..
Shale	10	..
Coal	..	6+
Interval (probably shaly)	25	..
Coal	2+	..
Shale	50	..
Coal (equivalent to seam of old mine on south side of creek)	(?)	..
Interval (probably shaly beds)	60	..
Coal smut	(?)	..
Interval (shale exposed in lower half)	40	..
Coal (old mine), thought to be equivalent to Shuster seam	6+	..
Sandstone, massive	(?)	..

SEAM OF THE LOWER COAL GROUP AS EXPOSED ON HIGH MESA SOUTH OF OAK CREEK.

	Feet.	Inches.
Coal	5	6
Blue clay	2	..
Coal	4	6
Blue clay	4	..
Bituminous shale	1	2
Blue clay	2	6
Coal	2	6
Talus covered	50	..

MEASUREMENT AT BREAST OF UPPER OPENING OF TROUT CREEK CANYON.

	Ft.	In.
Coal (under shale roof)	3	9
Bone	..	3
Coal	..	5
Bone	..	3
Coal (base not reached)	1	..
	5	8

MEASUREMENT MADE AT MALE MINE, TROUT CREEK.

	Feet.
Clay	6+
Coal	8+
Shale	8+

SECTION OF COAL-BEARING STRATA TAKEN ALONG COUNTY ROAD NEAR JUNCTION OF FISH AND TROUT CREEKS.

Top.	Feet.
Shales with thin bands of brown sandstone, containing Corbula undifera, Unio ( ), Amonia, etc	20
Coal in mine at forks of the road (SW. ¼ Sec. 1, T. 5, R. 86)	9+
Shale (covered)	25
Talus with several heavy ledges of brown sandstone exposed	100
Estimated interval of soft beds (mostly covered)	500
Sandstone, massive, soft light-gray, with bands of shale in middle portion and hard brown sandstone concretions near top	40
Shale, soft, sandy	20
Shale, with beds of sandstone	30
Coal (6)	...
Shale, with nodular sandstone containing conifers, ferns and dicotyledons	8
Coal (5)	5
Shale	20
Coal (4)	7
Shale	30
Sandstone, gray, weathered brown, alternating with shale	40
Shale	20
Sandstone, argillaceous, with fragmentary plant remains	8
Coal (3)	1
Shale, carbonaceous	8
Sandstone, massive, gray	8

Top.	Feet.
Shale, carbonaceous, with coal (2)	6
Shale, gray, sandy, and argillaceous sandstone	20
Coal (1)	3
Interval not recorded	50
Sandstone, massive gray	40
Soft (probably shaly) beds represented in talus slope	200+

SECTION OF COAL BED IN McCROSKY MINE, YAMPA RIVER.

	Ft.	In.
Sandstone roof	.....	..
Coal, bony	2½—3	..
Coal, good	4	8
Coal, bony	.....	6
Clay	.....	3½
Coal, good	3	11
Coal, bony	1	..
Sandstone floor	.....	..
Total below upper bony coal	10	4½

SECTION OF UPPER COAL GROUP ON DRY CREEK.

	Ft.	In.
Sandstone, white	..	..
Shale	3	..
Coal	3	..
Parting	..	1
Coal (mined)	7	10
Shale	12+	..
Coal	2	..
Bone	..	8
Coal	2	..
Sandstone	4	..
Shale, sandy	1	..
Coal	5	3
	43	10

SECTION OF COAL SEAM BELONGING TO LOWER GROUP, DEAL GULCH.

	Ft.	In.
Coal (thin seam)	(?)	..
Shale, sandy	12+	..
Coal	..	8
Shale, sandy	2	6
Coal	7	3

SECTION OF LOWER GROUP ON GREELEY PROPERTY IN LOWER CANYON OF YAMPA RIVER.

		Ft.	In.
	Trout Creek sandstone	..	..
1.	Intervaal, estimated	250—300	..
2.	Coal, burned in outcrop	(?)	..
3.	Interval	75	..
4.	Coal	4	..
5.	Interval	50	..
6.	Coal, indeterminate	..	..
7.	Interval	40	..
8.	Coal	12	..
9.	Sandstone and shale	70	..
10.	Coal	7	..
11.	Sandstone	32	..
12.	Coal	5	8
13.	Sandstone, thick-bedded	40—50	..
14.	Coal	1	8
15.	Sandstone, massive	40	..
	Total coal seams, minimum measurement	30	4

SECTION SHOWING THE ANTHRACITE SEAMS IN ELKHEAD CANYON.*

		Ft.	In.
1.	Igneous sheet	150	..
2.	Shale	25	..
3.	Sandstone, spheroidal weathered	5	..
4.	Bone	..	6
5.	Coal, anthracite	3	3
6.	Shale, bone and black	..	6
7.	Dark shale and bone	5	..
8.	Shale with sand lenses	12	..
9.	Coal, anthracite	2	4
10.	Bone	..	8
11.	Sandstone, single bed	15	..
12.	Sandstone, thin-bedded and burned shale	5	..
13.	Sandstone, massive	11	..
14.	Coal, anthracite	..	3
15.	Sandstone, massive	5	..

*Thicknesses, except coals, are estimated.

SECTION AT EGERIA COAL COMPANY'S PROSPECTS ON QUAKER MOUNTAIN.

		Ft.	In.
1.	Shale, clay.		
2.	Coal	5	3
3.	Shale, blue clay	6	..
4.	Sandstone, soft yellow	3	..
5.	Shale, sandy	2	..
6.	Sandstone, bedded yellow	3	..
7.	Shale, blue drab clay	8	..
8.	Sandstone, yellow	2	..
9.	Shale, blue clay	6	..
10.	Sandstone, yellow	3	..
11.	Clay, blue, soft	2	..
12.	Coal, clean	5	9
13.	Clay, plastic, dark gray or drab	2	..
14.	Coal (bottom covered by water)	7	3
15.	Sandstone, massive, white, cross-bedded, single stratum	17	3
16.	Coal	3	..
17.	Clay floor.		

MEASUREMENT AT PROSPECT 2 MILES NORTHEAST OF SEYMOUR MINE.

	Feet.
Coal (top of seam not found)	4
Clay	4
Coal	8

PROXIMATE ANALYSES OF COALS FROM THE YAMPA FIELD, COLLECTED DURING THE PRESENT SURVEY.

F. M. Stanton, Analyst.

Description of Samples			Analyses of Samples as Received					Analyses of Air-Dried Samples							
Lab. No.*a*	Letter	Name and Location	Moisture	Volatile combustible	Fixed carbon	Ash	Sulphur	Loss on air drying	Moisture	Volatile combustible	Fixed carbon	Ash	Sulphur	British thermal units *b*	Fuel ratios
		BITUMINOUS													
1799	A	Shuster seam, Oak Creek	8.85	36.06	50.19	4 90	1.51	2.30	6.70	36.91	51.37	5.02	1.54	12,447	1.4
1831	B	Trout Creek Canyon entry	8.59	33.85	47.30	10.26	1.50	4.10	4.68	35.30	49.32	10.70	1.57	.....	1.4
1832	C	Hutchinson seam, Eddy	12.50	35.15	46.91	5.44	0.42	6.20	6.72	37.47	50.01	5.80	0.45	11,777	1.3
1843	D	McCrosky (whole seam)	12.03	34.51	42.79	10.67	0.47	4.40	8.00	36.09	44.75	11.16	0.49	.....	1.2
1936	F	Crawford 6-foot seam	11.74	35.31	47.36	5.59	0.56	5.70	6.41	37.44	50.22	5.93	0.60	.....	1.3
1946	H	Miller Gulch prospect	10.80	34.32	49.41	5.47	0.58	5.70	5.41	36.39	52.40	5.80	0.62	.....	1.2
1991	I	McCrosky (lower bench only)	12.36	36.02	43.17	8.45	0.53	3.40	9.27	37.29	44.69	8.75	0.55	.....	1.2
2030	K	Wadge (old drift)	9.49	37.89	47.04	5.58	0.41	2.40	7.26	38.82	48.20	5.72	0.42	11,903	1.2
3031	L	Buteherknife Creek	10.92	36.53	46.73	5.82	0.60	3.40	7.79	37.81	48.38	6.02	0.62	.....	1.3
2032	M	Sage Creek (11-foot seam)	11.03	35.85	47.46	5.66	0.52	2.70	8.56	36.84	48.78	5.82	0.53	11,681	1.3
2033	N	Sage Creek (6-foot seam)	11.23	37.07	47.52	4.18	1.60	4:20	7.34	38.70	49.60	4.36	1.67	.....	1.3
2034	O	Wadge (new drift)	10.59	36.75	47.53	5.13	0.44	4.00	6.87	38.28	49.51	5.34	0.46	.....	1.3
2082	P	Dry Creek	15.74	33.37	46.77	4.12	0.41	9.20	7.20	36.75	51.51	4.54	0.45	.....	1.4
2210	Q	Hayden Gulch, Green seam	11.34	34.49	49.57	4.60	0.50	3.40	8.22	35.70	51.32	4.76	0.51	.....	1.4
1937	G	Crawford 11-foot seam	6.85	23.84	60.00	9.31	0.55	4.20	2.77	24.88	62.63	9.72	0.58	.....	2.5
		ANTHRACITE													
1902	E	Crawford 11-foot seam	6.94	3.42	75.61	14.03	0.57	4.20	2.86	3.57	78.92	14.65	0.59	12,255	22.1

*a*The laboratory numbers given in this column will be used in the report of the fuel-testing plant, Bull. U. S. Geol. Survey No. 290, in which these analyses will appear.
*b*As determined experimentally in a Mahler bomb calorimeter.

ULTIMATE ANALYSES OF AIR-DRIED SAMPLES OF COALS FROM THE YAMPA FIELD, COLLECTED DURING THE PRESENT SURVEY.
F. M. Stanton, Analyst.

	Sample A, No. 1799	Sample C, No. 1832	Sample E, No. 1902
Carbon	70.20	67.43	76.62
Hydrogen	5.57	5.48	2.50
Nitrogen	1.58	1.52	1.35
Oxygen	16 09	19.32	4.29
Sulphur	1.54	0.45	0.59
Ash	5.02	5.80	14.65
	100.00	100.00	100.00
Carbon-hydrogen ratio	12.6	12.3	30.6

UTILIZATION.

By M. R. Campbell.

The coals of the Yampa field, as illustrated by the samples analyzed, show a fairly low percentage of ash, only two of the bituminous coals carrying more than 10 per cent. in the mine samples, while percentages of 4, 5 and 6 are usually found in the other samples. It is true generally that, owing to lack of care in mining and handling the coal, the ash in coal as it reaches the market is greater than it is in mine samples from the same mine. In the work of mine sampling and testing commercial coal in a large way at the coal-testing plant, this difference was found to be fairly regular, so that a coefficient of increase of 1.3 was adopted for reducing one to the other. On this basis the ash in commercial coal from this field may reasonably be expected to run as follows:

PROBABLE PERCENTAGE OF ASH IN COMMERCIAL COAL FROM THE YAMPA FIELD.

Sample	Per Cent. of Ash	Sample	Per Cent. of Ash
A	6.53	I	11.37
B	13.91	K	7.44
C	7 54	L	7.83
D	14 51	M	7.57
E	19 04	N	5.67
F	7 71	O	6.94
G	12.64	P	5.90
H	7.54	Q	6 19

The sulphur is low, being generally less than 1 per cent. The greatest sulphur content noted is 1.67 per cent., while the average of all the analyses is 0.71 per cent. This is about the same as Colorado coals generally run, but it is below the sulphur contained in all but the purest eastern coals. In this respect Colorado coal is far ahead of any coal from the Mississippi Valley.

The best method of utilizing coals depends largely on their character. The anthracite of this field, although of a somewhat limited extent, will doubtless be used largely as a domestic fuel. The bituminous coals will serve well for both domestic and steam purposes. At present the greatest demand in this part of the West is for a good coking coal; but it is very doubtful if any of the coals of the Yampa field belong to this class. Whenever they have been tried they have failed to coke, or have made such an inferior product that they are generally regarded as non-coking. No coking tests were made on the samples that were analyzed, for the reason that an exhaustive series of such tests, together with actual firing of the same coal in standard beehive ovens, seemed to show that no relation exists between results obtained in the crucible and in actual practice.

So far, the interest in the Yampa field is centered around the area which contains bituminous and anthracite coals, and the poorer grades have been considered unworthy of notice. The success at the coal-testing plant at St. Louis of experiments in converting low-grade coals into producer-gas and the utilization of this gas in a gas engine was so pronounced that it seems almost possible now to look ahead to the time when the subbituminous coals, and even the lignites, will be utilized in this way for the production of power. If this is accomplished, the low-grade coals of the Laramie north of Hayden and Craig may have a much greater value that seems possible to-day, and in fact they may successfully compete with the bituminous coals described in this report.

Directory of Coal Mines.

BOULDER

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
Simpson	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Mitchell	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Acme	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Rex No. 1	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Rex No. 2	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Hecla	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Gorham	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Industrial	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Vulcan	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Monarch	National Fuel Co., Denver	H. Van Mater	Joseph Watson
Standard	Standard Coal & Land Co., Denver	C. W. Babcock	
Strathmore	Continental Fuel Co., Denver	M. S. Donnelly	
Fox	Fox & Patterson, Gorham		
Matchless	Fox, Patterson & Evans Louisville		
Centennial	Centennial Coal Co., Denver		
Electric	Electric Coal Co., Lafayette		
Nonpareil	Brooks - Harrison Fuel Co., Louisville		J. E. Brooks
Sunnyside	The Vesuvius Fuel Co., Louisville		
Capitol	Colorado Capitol Coal Co., Lafayette		
Lucas	Lucas Coal, Land & Reservoir Co., Louisville		
Independent	Northern Colorado Power Co., Louisville		
Rosser No. 7	Wm. Rosser, Gorham		
Senator	Willoughby Coal & Land Co., Lafayette		
New Baker	Flavell, Park & Flavell, Lafayette		

COUNTY.

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad Connections	Remarks
Henry Denman		Fan	90,000	C. & S., B. & M.	
Henry Denman		Fan	30,000	B. & M.	
	D. G. Wilson	Fan	65,000	C. & S.	
	Wm. Atkin	Fan	80,000	C. & S.	
	Thos. Hilton	Fan	40,000	C. & S.	
	N. Hodgson	Fan	30,000	C. & S.	
	Geo. Giles	Fan	25,000	C. & S.	
	F. J. MacCormick	Fan	25,000	C. & S.	
	Burt Hurd	Fan	25,000	B. & M.	
	C. P. O'Neil	Fan	40,000	C. & S.	
	A. D. Sanders	Fan	42,000	B. & M.	
	T. R. Ovington	Fan	30,000	C. & S.	
	Wm. Fox	Fan	.....	C. & S.	
	D. E. Evans	Fan	16,000	C. & S.	
	S. S. Barrett	Fan	11,000	B. & M.	
	Jos. Simpson	Fan	.....	C. & S.	
	Jno. Edwards	Fan	25,000	C. & S.	
	J. H. Hammond	Fan	33 000	C. & S., B. & M.	
	Chas. Rankin	Fan	26,000	B. & M.	New mine
	Thos. Williams	Fan	30,000	C. & S.	New mine
		Natural	.....	None	
		Natural	.....	None	
	R. W. Morgan	Fan	.....	B. & M.	
		Fan	.....		

DELTA

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
King	Juanita Coal & Coke Co., Pueblo	Alexander Bowie	

COUNTY.

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad Connections	Remarks
.....	.....	Furnace	.....	D. & R. G.....	

DOUGLAS

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
Platte Canon.....	Platte Canon Fuel & Power Co., Littleton.....		

COUNTY.

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad Connections	Remarks
.....	.....	Fan	.....	C. & S.....	

EL PASO

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
Curtis	Curtis Coal Mining Co., Colorado Springs	C. H. Curtis	
Rapso No. 2	Rapson Coal Mining Co., Colorado Springs	C. H. Curtis	
Danville	Pike's Peak Fuel Co., Colorado Springs		
Pikeview	Pike's Peak Fuel Co., Colorado Springs		
Patterson	Alexander Patterson, Colorado Springs		
Williamsville	Monument Valley Coal Co., Colorado Springs		
Austin Bluffs	Keystone Fuel Co., Colorado Springs		
Franceville	Joseph M. Cell, Fountain		
Neer	H. B. Neff, Colorado Springs		

COUNTY

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad connections	Remarks
.....	Ralph Wooden	Fan	25,000	S. F.	.....
.....	Ralph Wooden	Fan	32,000	R. I.	.....
.....	James Comisky	Fan	22,000	S. F.	.....
.....	P. L. Dixon	Fan	22,000	D. & R. G.	.....
.....	Geo. Patterson	Fan	15,000	None	.....
.....	A. C. Isaacs	Furance	.....	None	.....
.....	W. T. Tudor	Natural	.....	None	.....
.....	.....	Natural	.....	None	.....
.....	.....	Natural	.....	None	.....

FREMONT

	Name and address of operator	General Mgr.	General Supt.
Rockvale	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Coal Creek	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Fremont	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Brookside	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Nonac	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Chandler	Victor Fuel Co., Denver		W. J. Murray
Radiant	Victor Fuel Co., Denver		W. J. Murray
Magnet	Rocky Mountain Fuel Co., Denver	E. E. Shumway	
Royal Gorge	Royal Gorge Coal & Fire Clay Co., Canon City		
Cowan	Cowan Coal Co., Coal Creek		
Florence	Florence Coal Co., Florence	M. E. Lewis	
Williamsburg Slope	Donnelly Coal Co., Florence		
Central	Colorado Central Coal & Mining Co., Colo. Spgs.		H. L. Littell
Diamond	Diamond Coal Mining Co., Canon City	Jno. D. Lloyd	
Emerald	Williamsburg Slope Coal Co., Williamsburg		
Norton	Colorado Colliery Co., Denver		

COUNTY

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad connections	Remarks
Joe Ball....	Henry John	Fan	39,600	S. F.	
Joe Ball	Ben Beach	Fan	15,036	D. & R. G.	
Joe Ball	D. Griffiths	Fan	29,600	D. & R. G.	
Joe Ball		Fan	24,800	S. F.	Closed down
Joe Ball		Fan	11,800	S. F.	Closed down
	G. H. Williams	Fan	22,980	D. & R. G.	
	E. W. Jones	Furnace	11,400	S. F.	
	W. J. Evans	Fan	18,000	S. F.	
	L. J. Wood	Fan	8,500	S. F.	
	Charles Cowan	Furnace		None	
	H. Locke	Furance	5,000		
	Henry Donnelly	Natural	4,950	None	
		Fan			
	Joseph Walton	Furnace		None	New mine
		Furance	2,100	S. F.	New mine
	John McDowell	Fan		D. & R. G.	New mine

GARFIELD

Name of mine	Name and address of operator	General Mgr.	General Supt.
Midland	Rocky Mountain Fuel Co., Denver	E. E. Shumway	
Keystone	Rocky Mountain Fuel Co., Denver	E. E. Shumway	
Coryell	Coryell Mine Leasing Co., Denver	J. W. Cummins	
South Canon	South Canon Coal Co., Denver	W. B. Lewis	
Diamond	Cardiff Coal Co., Cardiff		

COUNTY

Div. Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad connections	Remarks
.....	Chas. I. Coryell	Fan	15,000	C. M.	.....
.....	J. H. Cummins	Natural and Fan	25,000	C. M. and D. & R. G.	..
.....	Chas. S. Meerdink	Fan	25,300	C. M.	.....
....	R. C. Jones	Fan	55,000	C. M.	.....
.....	D. W. Mansfield	Fan	18,000	C. M.	.....

GUNNISON

Name of Mine	Name and Address of Operator.	General Mgr.	General Supt.
Crested Butte	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Floresta	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Somerset	Utah Fuel Co., Somerset		
Alpine	Rocky Mountain Fuel Co., Denver	E. E. Shumway	
Kubler	Rocky Mountain Fuel Co., Denver	E. E. Shumway	
Porter	Littell Coal & Mining Co., Colorado Springs	H. L. Littell	
Silver Brook	Pueblo Fuel & Mining Co., Colorado Springs	H. L. Littell	
Bulkley	Crested Butte Coal Co., Denver	Frank Bulkley	

COUNTY

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic ft. per Min	Railroad Connections	Remarks
J. P. Thomas	R. McAllister	Fan	46,800	D. & R. G.	
J. P. Thomas	J. W. Allen	Fan	33,180	D. & R. G.	
	Gus Goodart	Fan	71,100	D. & R. G.	
	D. W. Jones	Fan	30,000	C. & S.	
	D. W. Jones	Furnace		C. & S.	Reopened
	I. A. Littell	Fan		D. & R. G.	
	I. A. Littell	Fan		D. & R. G.	
	John Calderhead	Fan		D. & R. G.	

HUERFANO

Name of Mine	Name and Address of Operator.	General Mgr.	General Supt.
Robinson	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Walsen	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Rouse	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Cameron	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Hezron	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Pictou	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Maitland	Victor Fuel Co., Denver		W. J. Murray
Pryor	Union Coal & Coke Co., Denver	J. W. Bowen	
Champion	Union Coal & Coke Co., Denver	J. W. Bowen	
Toltec	Northern Coal & Coke Co., Denver		
Midway	The Nicholls Coal Co., Pryor		
Rugby	Rugby Coal Mining Co., Denver	J. M. League	
Sunnyside	Sunnyside Coal Mining Co., Strong		
Pinon	Rocky Mountain Fuel Co., Denver	E. E. Shumway	
Huerfano	Huerfano Fuel Co., Denver	S. S. Murphy	
Round Oak	The Alliance Coal Co., Walsenburg		
Oakdale	Oakdale Coal Co., Oakview		
Tioga	Minnequa Coal Co., Tioga	E. M. Gowan	
Gordon	The Gordon Coal Co., Walsenburg		
Big Four	The Big Four Coal & Coke Co., Tioga		
Sweet	Silver State Coal Co., Mayne		
Occidental	Occidental United Metal & Coal Co., La Veta		
Laramie	The Laramie Coal & Construction Co., Canon City		
Caddell	Ed. Caddell, Walsenburg		

COUNTY

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic ft. per Min	Railroad Connections	Remarks
Joe Ball	R. K. Graham	Fan	45,360	D. & R. G.	
Joe Ball	R. K. Graham	Fan	32,500	D. & R. G.	
Joe Ball	W. G. Deck	Fan	32,640	D. & R. G.	
Joe Ball	W. J. Davis	Fan	20,700	C. & S.	New mine
Joe Ball	J. P. Breen	Fan	14,500	D. & R. G.	
Joe Ball	M. T. Brennan	Fan	70,800	D. & R. G.	
	J. Mathews	Fan	89,462	C. & S., D. & R. G.	
	Chas. Benchat	Fan	25,000	C. & S., D. & R. G.	
	R. J. Clark	Fan	18,000	C. & S., D. & R. G.	
	Leased by Frinth & Antley	Fan	26,000	D. & R. G.	
	Wm. Gordon	Fan	20,000	D. & R. G.	
	W. J. Hannahan	Fan	13,000	C. & S., D. & R. G.	
	Jas. Handwright	Fan	45,000	C. & S., D. & R. G.	
	W. J. Smith	Fan	39,740	D. & R. G.	
	R. F. Pole	Fan	20,000	C. & S., D. & R. G.	
	James McDowell	Furnace		C. & S.	
	T. J. Stone	Fan		D. & R. G.	
	Geo. Phipps	Fan	18,000	D. & R. G.	
	H. J. Elliott	Fan	14,700	D. & R. G.	New Mine
	E. Nesbit	Fan		D. & R. G.	Leased by Peltier & Nesbit.
	John McDowell			None	
		Natural	14,800		Closed down
	Evan Jenkins				New Mine
					New Mine

JEFFERSON

Name of Mine	Name and Address of Operator.	General Mgr.	General Supt.
Leyden	The Leyden Coal Co., Denver	S. M. Perry	
Morrison	The Morrison Coal Mining & Development Co., Morrison	S. T. Shipman	

COUNTY

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic ft. per Min	Railroad Connections	Remarks
.....	J. G. Perry	Fan	40,000	D. & N. W.....	
.....	.....	.....	.....	None.....New Mine	

PRODUCTION OF LAS

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
Primero	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Berwind	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Starkville	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Engle	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Tercio	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Sopris	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Tobasco	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Morley	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Frederick	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Quinto	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Delagua	Victor Fuel Co., Denver	W. J. Murray	
Hastings	Victor Fuel Co., Denver	W. J. Murray	
Gray Creek	Victor Fuel Co., Denver	W. J. Murray	
Bowen	Victor Fuel Co., Denver	W. J. Murray	
Cokedale	Carbon Coal & Coke Co., Cokedale	Frank Guiterman	
Piedmont	Rocky Mountain Fuel Co., Denver	E. E. Shumway	
La Belle	Rocky Mountain Fuel Co., Denver	E. E. Shumway	
Francisco	Rocky Mountain Fuel Co., Denver	E. E. Shumway	
Green Canon	Green Canon Coal Co., Denver	H. Van Mater	Joseph Watson
Suffield	Green Canon Coal Co., Denver	H. Van Mater	Joseph Watson
Forbes	Chicosa Fuel Co., Forbes	Joseph Cox	
Greenville	Cedar Hill Coal & Coke Co., Denver		David Davis
Black Diamond	Cedar Hill Coal & Coke Co., Denver		David Davis
Toller	Cedar Hill Coal & Coke Co., Denver		David Davis
Brodhead	Las Animas Coal Co., Denver	E. L. Prentiss	
Majestic	Continental Fuel Co., Denver	M. S. Donnelly	
Primrose	Primrose Coal Co., Rugby		
Ludlow	Huerfano Coal Co., Denver	S. S. Murphy	
Bloom	Jeffryes Coal & Mining Co., Trinidad		
Rapson No. 1	Rapson Coal Mining Co., Colorado Springs	C. H. Curtis	
Thomas	Wichita Coal & Material Co. Rugby		
Southwestern	Northern Coal & Coke Co., Denver	Leased by the Southwestern Fuel	
Jewel	Northern Coal & Coke Co., Denver	Leased by the King Coal Co., Aguilar.	
Empire	Northern Coal & Coke Co., Denver	Leased by the Empire Coal Min-	
Stevens	J. J. Abercrombie & Brg Co., Trinidad		
Baldy	Baldy Coal Co., Trinidad		
Red Robin	The Wootten Land & Fuel Co., Lynn, N. Mex		
McLaughlin	James McLaughlin, Sopris		
Maltby	Chicosa Fuel Co., Trinidad	Joseph Cox	

The Colorado Fuel & Iron Company appointed a special mine inspector, Joseph A. C. French is Div. Supt. C. F. & I. Co.'s Mines in Las Animas Co.

ANIMAS COUNTY, 1908.

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad Connections	Remarks
	Thos. Jolly	Fan	110,000	C. & W.	
	J. S. Young	Fan	90,000	C. & S.	
	Jas. Wilson	Fan	25,000	S. F.	
	A. H. Robinson	Fan	36,000	C. & S.	
		Natural	19,000	C. & W.	Closed
	Chas. Chambers	Fan	38,500	C. & S.	
	C. O. Neil	Fan	30,000	C. & S.	
	Joseph Haske	Fan	35,900	S. F.	New mine
	A. Alexander	Furnace	14,000	C. & W.	New mine
		Furnace		C. & S.	Closed
	G. J. Johnson	Fan and furnace	84,000	C. & S.	
	Thomas Lee	Fan	100,000	C. & S. & D. & R. G.	
	Joe Curran	Fan	34,500	C. & S.	
	B. W. Snodgrass	Fan	40,740	C. & S.	
	F. P. Bayles	Fan	48,500	C. & W.	
	J. B. Hutchinson	Fan	28,000	C. & W.	
	Thos. Hutchinson	Furnace	10,000	C. & S. via Sopris.	
	Thos. Hutchinson	Fan	15,000	Trinidad Electric	
	R. I. Pettigrew	Fan	25,000	C. & S., D. & R. G.	
	O. C. Clark	Fan	40,000	C. & S.	
	H. Smith	Furnace	14,200	C. & S., D. & R. G.	
	E. E. Sherfick	Fan	40,000	C. & S.	
	S. J. Ayers	Fan	25,000	D. & R. G., C. & S.	
		Natural and steam blower		C. & S.	New mine
	Geo. Morrison	Fan	20,000	C. & S.	
	Henry Dalby	Fan	36,000	C. & S.	
	Robt. Wyper	Fan	25,000	C. & S., D. & R. G.	
	C. V. Westover	Furnace	16,000	C. & S.	
	A. G. Jeffryes	Natural	7,000	None	
	Ralph Wooden	Fan	10,000	C. & S.	
	John Davis	Fan	7,000	C. & S.	
	J. W. Siple	Furnace	5,000	C. & S., D. & R. G.	
	T. W. King	Furnace	5,000	C. & S.	
	C. V. Stewart	Fan	15,000	C. & S., D. & R. G.	Reopened
		Natural	6,000	None	
	E. P. Sherman	Furnace		None	
	C. V. Stewart	Natural	2,500	S. F.	New mine
		Furnace		C. & W.	New mine
		Furnace		C. & S.	

Smith. The Victor Fuel Company, James Cameron.

LA PLATA

	Name and Address of Operator.	Gen. Manager	Gen. Supt.
Hesperus	Porter Fuel Co., Durango		
Porter	Porter Fuel Co., Durango		
Perin's Peak	Calumet Fuel Co., Durango		
City	Royal Coal & Coke Co., Durango		
Champion	Royal Coal & Coke Co., Durango		

COUNTY.

Divis. Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad Connections	Remarks
.....	W. J. Gifford	Fan	15,000	R. G. S.....	
.....	W. J. Gifford	Fan	35,000	R. G. S.....	Closed
.....	L. McCormick	Fan and natural	21,150	R. G. S.....	
.....	Geo. C. Logan	Natural	6,000	D. & R. G.....	
.....	Geo. C. Logan	Natural	6,000	D. & R. G.....	

MESA

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
Cameo	Grand Junction Mining & Fuel Co., Denver	John McNeil	
Book Cliff	Book Cliff Railroad Co., Grand Junction	W. S. Phillips	
Palisade	Palisade Coal & Supply Co., Palisade		
Stokes	Walter Stokes, Palisade		
Garfield	Garfield Coal Co., Grand Junction	Geo. Smith	
P. V.	The P. V. Coal Co., Grand Junction	Geo. Smith	
Grandview	Grand View Coal Co., Palisade	F. F. DeRush	
Farmer	Farmers' Mutual Mining Co., Palisade	F. M. Milleson	
Wearing	D. W. Yount, Fruita		

COUNTY.

Division Supt.	Local Supt.	Mode of Ventilation	Air in Cubic Ft. Per M.	Railroad Connections	Remarks
	John McNeil, Jr.	Fan	40,000	D. & R. G.	
	T. E. Sanford	Natural		Book Cliff	
	F. Rowley	Natural		C. M.	
		Natural		None	
		Natural		None	New mine
		Natural		None	New mine
				D. & R. G.	
		Natural		None	
		Natural		None	

MONTEZUMA

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
Mancos	Mancos Fuel Co., Mancos	Geo. S. Spencer	

COUNTY.

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad Connections	Remarks
.....		Tunnel.....	.....	None	.....

PITKIN

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
Spring Gulch	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Coalbasin	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	
Marion	Colorado Fuel & Iron Co., Pueblo	E. H. Weitzel	

COUNTY.

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad Connections	Remarks
J. P. Thomas	Tim Tinsley	Fan	44,800	C. M.	
J. P. Thomas	Wm. Manley	Fan	56,000	C. R.	
J. P. Thomas	Richard Molloy	Natural	14,000	C. M.	New opening

ROUTT

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
Oak Hills	Oak Hills Coal Co., Denver	S. M. Perry	
Lion Canon	A. B. Blythe, Meeker		

COUNTY.

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad Connections	Remarks
.....	J. G. Perry	Fan.....	.....	D. & N. W.....	
.....	.....	Natural.....	.....	None	

WELD

Name of Mine	Name and Address of Operator	General Mgr.	General Supt.
Parkdale	Parkdale Fuel Co., Denver	H. Van Mater	Joseph Watson
Puritan	Parkdale Fuel Co., Denver	H. Van Mater	Joseph Watson
Golden Ash	Consolidated Coal & Coke Co., Denver	E. L. Baum	
Lehigh	Northern Coal & Coke Co., Denver	J. D. Skinner	J. C. Williams
Frederick	Frederick Coal Co., Denver		
Evans	Evans Coal & Land Co., Denver		
Shamrock	Shamrock Coal Co., Erie		
Ideal	Ideal Coal Co., Erie		
Warwick	Warwick Coal & Investment Co., Frederick		
Firestone	Firestone Coal Co., Firestone		
Washington	David Brimble, Erie		

COUNTY.

Division Supt.	Local Supt.	Mode of Ventilation	Volume of Air in Cubic Ft. Per M.	Railroad Connections	Remarks
	Geo. Watson	Fan	36,000	B. & M.	New mine
	J. Cochrane	Fan	40,000	U. P.	New mine
	F. S. David	Fan	48,600	U. P.	
	Henry Denman	Fan	24,000	U. P.	
	Edward Saunders	Fan	32,500	U. P.	New mine
	John L. Dunmire	Fan	19,500	U. P.	New mine
	James Brennan	Steam jet	5.000	None	
	Phineas D. Woolley	Fan		None	New opening
	E. H. Whiles	Fan		U. P.	
	James Lindsay	Natural		None	New mine
		Fan		U. P.	

INDEX

INDEX.