FOURTH BIENNIAL REPORT

OF THE

STATE

INSPECTOR OF COAL MINES

OF THE

STATE OF COLORADO.

FOR THE YEARS OF 1889-90.

JOHN McNEIL, M. E.,
INSPECTOR OF MINES.

DENVER:
COLLIER & CLEAVELAND LITH. CO., STATE PRINTERS.
1890.

ERRATA.

PAGE	LINE.	FOR	READ.
10	25	Aeh	Ash
75	37	Explosives	Explosions
76	34	1.459	1 in 459
79	28	Superion	Superior

In production table, 1889, for Salt Creek, read Oak Creek.

On page 14, line 11, between the words "mine" and "during," add, were made.

OFFICE OF INSPECTOR OF COAL MINES,
DENVER, COLO., Dec 31, 1890.

To His Excellency,

JOB A. COOPER,

Governor of Colorado:

HON. SIR:—In compliance with the requirements of an act entitled "Coal Mines," I have the honor, as Inspector, to present to you herewith the Fourth Biennial Report from this department. The rapid progress of our coal mining industry, during the past two years, has received marked attention from many engaged in the coal business throughout the United States, consequently this office has received numerous letters of inquiry from the leading coal mining journals of America, as well as from prospective investors, asking official statistics and other general information relating to the great coal fields of Colorado. Such inquiries have received due attention, the office furnishing as complete information as we were in possession of.

I am pleased to state that my official duties between operators and miners have been, during the past two years, very pleasant, and, as a rule, operators have manifested a willingness to comply with the requirements of the law, thus greatly assisting the Inspector in his efforts to provide the necessary safeguards for the protection and security of the life and general health of the workmen.

By a law passed at the Seventh Session of the General Assembly, entitled "Official Reports," prescribes "All officers required by any law of the State to make reports to the Governor or Legislature shall deposit the same with the Governor on, or before, the fifteenth day of November next preceding the regular session of the General Assembly." To comply with this law, it would require the Inspector to estimate the production of the mines for

November and December. For, in accordance with section (17) of an act entitled "Coal Mines," he is required to make a biennial report, "which shall show the number of coal mines and development on the same during each year," etc., etc. Said report to be printed on, or before, December 31 preceding the biennial session of the Legislature.

Thus it is obvious a law should be passed at the Eighth Session of the General Assembly prescribing that the Inspector's report end with the fiscal year October 31 instead of the calendar year. I take this opportunity to sincerely thank you and other State officers for courtesies extended to this office, and to Mr. L. S. Jones, Assistant Inspector, for the faithful performance of the work assigned to him.

Please allow me to call your attention especially to the recommendation made in article on the White Ash mine disaster, viz., that there be a law passed to govern the working of vertical veins, which will prohibit operators from mining coal under any portion of a mine, or in proximity to an abandoned mine where water exists, without having first pumped such water out. It is my intention to assist some senator from the coal mining districts, in drawing up a bill in legislature to cover this point. I shall feel grateful should you touch the subject in your "message."

I have the honor to be, sir,

Yours faithfully,

JOHN McNEIL.

Coal Production.

The following is a summary of the coal statistics of the State from 1873 to 1890, inclusive:

YEARS.	TONS.
1873	69,977
1874	87,372
1875	98,838
1876	117,666
1877	160,000
1878	200,630
1879	322,732
1880	375,000
1881	706,744
1882	1,061,479
1883	1,220,593
1884	1,130,024
1885	1,398,796
1886	1,436,211
1887	1,791,735
1888	2,185,477
1889	2,400,629
1890	3,075,781

PRODUCTION BY COUNTIES FOR 1889–1890.

SHOWING INCREASE AND DECREASE.

COUNTIES.	1889.	1890.	INCREASE.	DECREASE.
Arapahoe	900	681	.....	219
Boulder	294,093	409,130	115,037	.....
Douglas	300	.....	.....	300
Dolores	.....	.....	.....	.....
El Paso	54,066	26,847	.....	27,219
Fremont	279,855	392,570	112,715	.....
Gunnison	254,808	238,139	.....	16,669
Garfield	144,627	198,086	53,459	.....
Huerfano	309,023	425,606	116,583	.....
Jefferson	9,790	12,334	2,544	.....
Las Animas	900,525	1,134,845	234,320	.....
La Plata	33,280	33,045	.....	235
Mesa	.....	4,200	4,200	.....
Park	47,005	67,203	20,198	.....
Pitkin	46,181	74,362	28,181	.....
Weld	26,176	42,603	16,427	.....
Estimat'd for small mines not reported.	.....	16,130	.....	.....
Totals	2,400,629	3,075,781		

COKE, 1889—1890.

Las Animas	119,436	149,503	30,067	.....
Gunnison	42,858	44,521	1,663	.....
Pitkin	22,125	34,463	12,338	.....
Garfield	500	.....	.....	500
Totals	184,919	228,487		

RECAPITULATION OF STATISTICS FOR 1889–1890.

For the years ending December 1889–1890, the returns of the coal production made to this office, with estimate made for December, 1890, is as follows:

For 1889 there was produced 2,400,629 tons of 2,000 pounds, Of this amonnt 803,113 tons were shipped to points in Kansas, Texas, Utah and Nebraska. The average value of the coal on the car at the mines is estimated $1.94 per ton, making the spot value of the production for the year $4,657,220.26.

The average number of persons employed at the mines is 5,519. Average thickness of the coal seams worked is five feet, ten inches; the thickest seam of clean coal in one stratum is fourteen feet; the thinnest is three feet. The average price paid to miners for digging and loading the coal and timbering their working places, is 76¼ cents per ton of 2,400 pounds "run of mine," which will equal 2,000 pounds of screened coal over an average screen of 1⅛ inches between bars. The highest tonnage paid is $1.12½; the lowest is 50 cents. The average cost (partly estimated) of producing the coal on the railroad car at the mines, including royalty, is about $1.51½ per ton.

There occurred during the year thirteen fatal accidents, in which twenty-three lives were lost; four by falls of coal, four by falls of rock, one by falling down a "chute," two by being run over by cars, two crushed between a pit car and props, and ten by inundation of water from an abandoned mine. By nationality there were eight English, five Italians, four Welsh, three Germans, one French, one Irish and one Swede.

Average number of tons mined for each life lost, 104,375.4. There occurred, during the year, 98 non-fatal accidents. Nature of accidents—bones broken, 24; bones

dislocated, 2; slight injuries by falls of coal and rock, 47; injured by hoisting cage, 1; burned by steam, 1; burned by explosive gas, 1; burned by powder and otherwise injured from premature blasts, 4; injured by pit cars, 16; injured by railroad car, 1; injured by sledge hammer, 1. Average number of tons mined to each non-fatal accident, 24,496.2. Average number of persons employed to each fatal accident, 240; average number of persons employed to each non-fatal accident, 56.3.

There was 184,919 tons of coke made during the year.

For 1890, the production by eleven months' returns, and estimate made for December, is 3,075,781 tons. There has been shipped to Kansas, Nebraska, Texas, Utah, California and Nevada, 989 801 tons. The average value of the coal on the car at the mines is estimated at $1.87 per ton, making the spot value of the production, for the year, $5,751,710.47. The average number of persons employed at the mines is 6,172. Average thickness of the coal seams worked is 5 feet, 8½ inches; the thickest is 14 feet, the thinnest is 3 feet.

The average price paid to the miners for digging and loading the coal and timbering their working places is 73.4 cents per ton; the highest is $1.12½; the lowest is 50 cents. The average wages paid for labor inside of mines is $2.60 per day, including track-layers, timbermen, mule drivers, machine runners and road cleaners; the highest day wage being $3.50, paid to machine runners; the lowest, $2.00, to road cleaners.

The average cost (estimated) of producing the coal on railroad car at the mines, including royalty, is $1.50 per ton.

There were 14 lives lost during the year—6 by falls of rock, 4 by falls of coal, 1 by being run over by pit cars; 1 by an explosion of gas ($C\ H.^4$), 1 by falling down a shaft, and 1 by premature blast. By nationality there were 3 English, 8 Italians, 2 Austrians, and 1 French. Average number of tons mined for each life lost is, 219,698.5.

There occurred 75 non-fatal accidents; 17 were caused by falls of coal; by falls of rock, 21; by explosion of gas, 4; kicked by mules, 2; injured by cars, 17; and serious ones, bones broken, 14. Average number of tons mined to each non-fatal accident, 41,010.6; average number of persons employed to each non-fatal accident, 82.3; number of persons employed to each fatal accident, 440.8.

WHITE ASH MINE DISASTER.

This sad disaster is doubtless yet fresh in the minds of many, it being the most fatal accident that marks the category of fatal accidents in this report, in which ten men lost their lives. It occurred in the White Ash mine, at Golden, about four o'clock on the ninth day of September, 1889, shortly after the unfortunate men had descended the shaft to commence work on the afternoon shift. At 9 o'clock P. M., I received a telephone message from Mr. Paul Lanius, manager of the mine, which stated: "Come to Golden at once, on a matter of grave importance."

I arrived at the scene of the accident about 12 o'clock, when I was informed that water from the old Loveland shaft had broken into the workings, and that ten men were entombed. After carefully meditating over the situation, I at once commenced to make preliminary arrangements for the recovery of the bodies. I found that the shaft was full to the mouth with black damp ($C.\ O.^2$), and by the aid of a hand line, I ascertained that the face of the water was 100 feet above the bottom of the shaft, which to me clearly demonstrated that the men were already dead *beyond question.* I found that the hoisting cage was fast at a point 630 feet from the surface, no doubt being buried up with *débris* washed down from the "gobs" of the upper levels and "stops" by the enormous pressure that such a body of water in rushing down the almost vertical workings. (See

accompanying map.) The ventilating fan was run up to its capacity, and other arrangements made to remove the noxious gases from the shaft, which soon commenced to decrease, and by three o'clock on the morning of the tenth instant, I lowered a light with a hand line to a depth of 530 feet, at which point it was extinguished by the carbonic acid gas.

The line was then lowered further down to measure the height of the water, and was found 140 feet up the shaft. A bottle was attached to the end of the line and filled with water from below, and brought to the surface, when I was astonished to find that the water had a temperature of 115° Fahrenheit.

This startling discovery quickly brought to my mind, in a tangible shape, something I had strongly suspected on my first visit there, in 1883, as well as on later inspections, viz: That extensive "gob fires" existed in parts of the old workings on the upper level of the White Ash mine, which, it is said, had caved in and been abandoned for upwards of ten years. The water in the Loveland shaft, from which a quantity was pumped daily to feed the steam boilers used by the Golden Brick Company, was known to be at a rather low temperature. Thus, the sudden increase in temperature fully explains that the water, after breaking into the White Ash mine, had passed through, and may have swept before it, the heated "gobs" which had been burning there for years, being supplied with air to support combustion through cave holes extending to the surface.

Failing to detach the hoisting cable from the cage, another was furnished by Mr. Lanius, and by eight o'clock Mr. Evan Jones, foreman of the mine, and myself were lowered into the shaft in a sinking bucket. On descending to a depth of 280 feet, we discovered a strong heat coming out of the cross-cut between the vein and the shaft.

On examination, we found that a portion of the old workings in this level were on fire, and judging from the

intense heat and quantity of air circulating (the fire forming the part of a furnace) there, we felt satisfied that the fire itself would soon reach the shaft timbers, and the question of building off and isolating the fire was now an impossibility, as the strata was very broken, and the shaft timbers were already smoking. We descended some 200 feet below this level, where we found the carbonic acid gas so strong that we could not go further. From this point we could hear water running into the shaft from the 520 feet level. It also appeared to us that the stopping in the cross-cut leading to the 440 feet level had been swept out, and that "black damp" was being expelled from it which almost extinguished our lights.

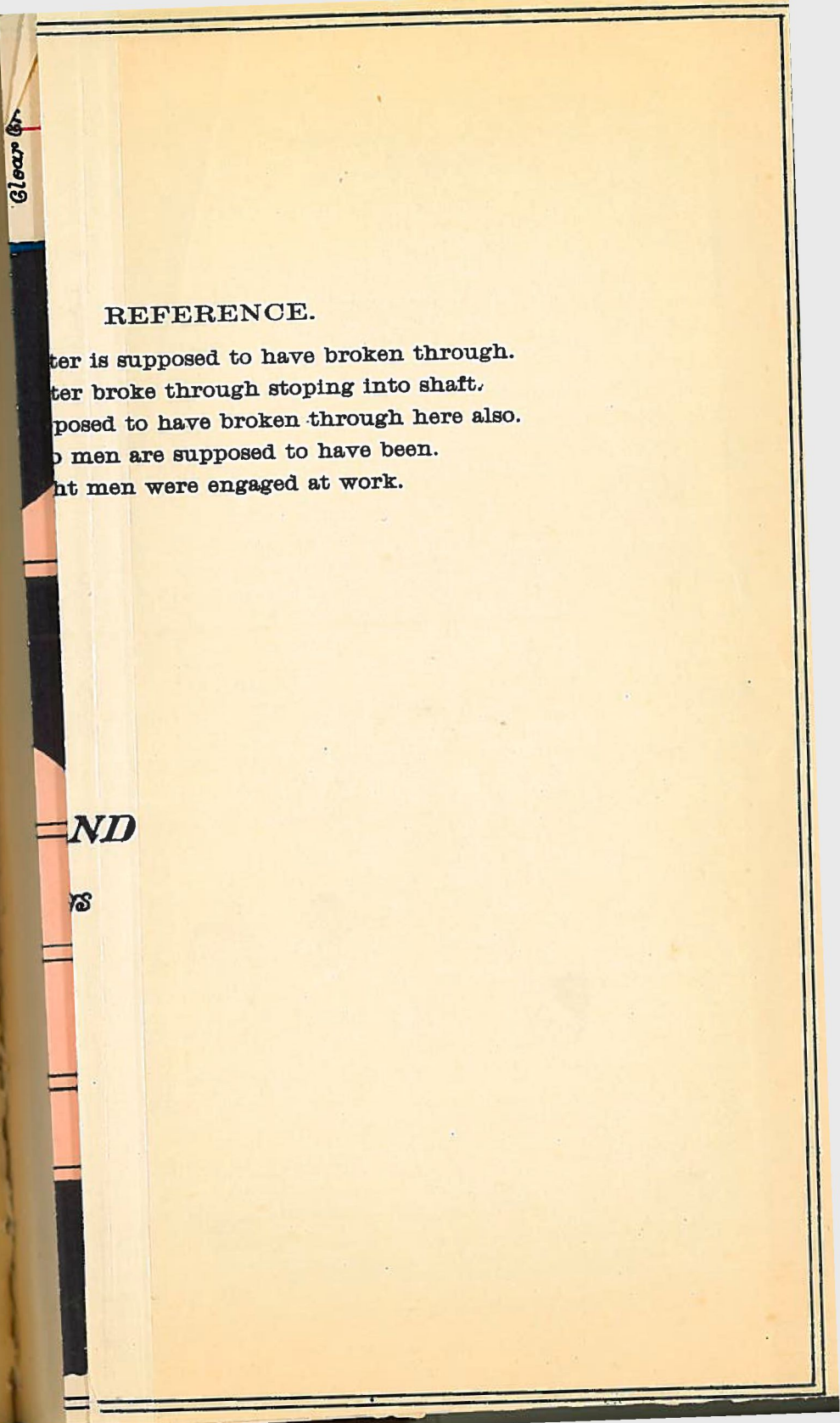
We then gave the signal to ascend, but stopped again at the seat of the fire, which was making rapid progress; the rocks in proximity to the shaft were fairly crackling with the intense heat, and it was with great difficulty we could breathe. We then gave the signal to ascend to the surface which we reached very much to our relief.

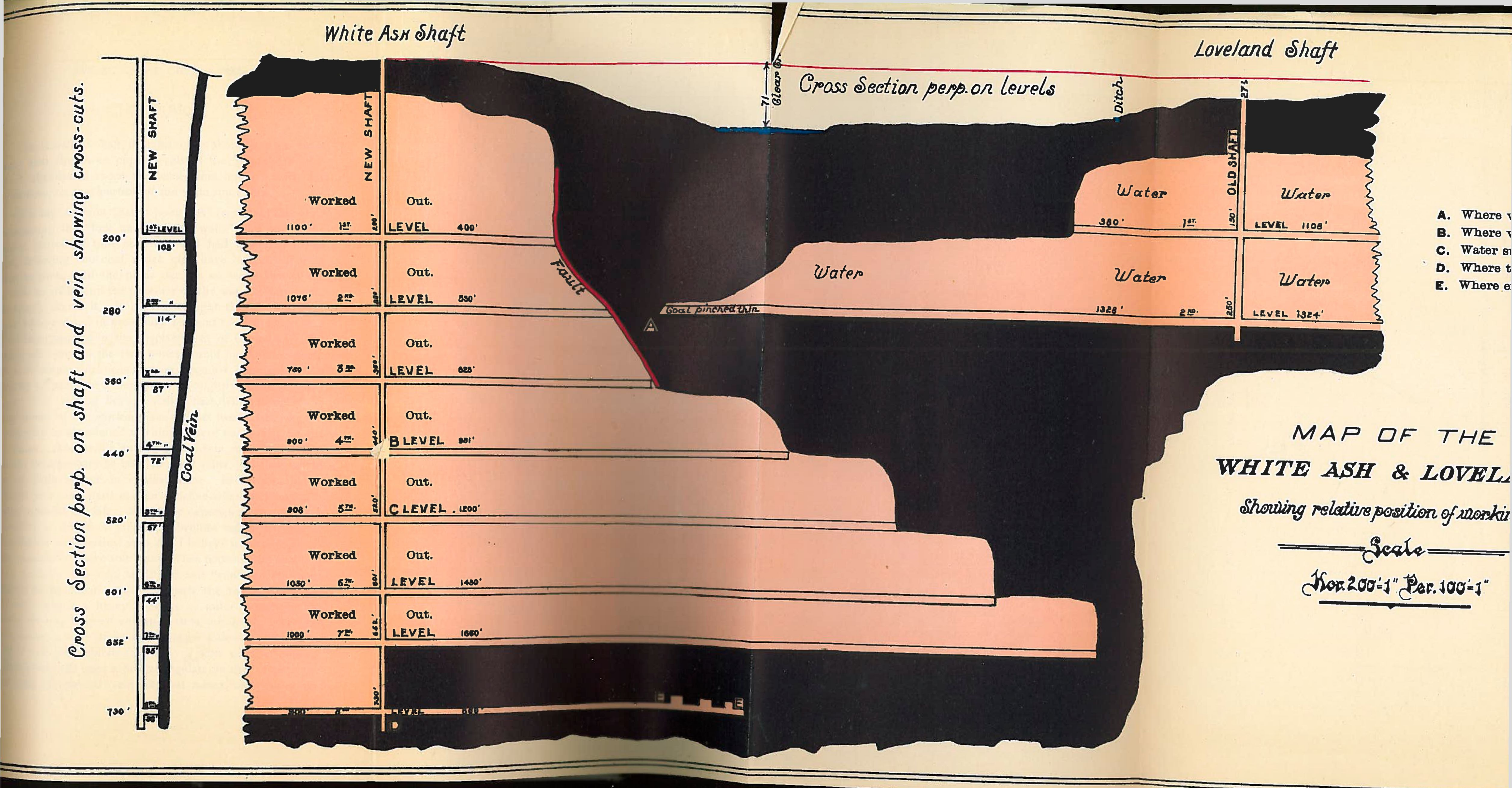
It would have been a foolhardy undertaking to have then attempted or allowed further work, so I gave orders to stop the ventilating fan and seal up both the White Ash and the Loveland mines, to isolate the fire as much as possible, in hopes that the amount of carbonic acid gas generating would in time check the progress of the fire, for until such was done it would have been impossible for any one to enter the mine. I returned to Golden on the 12th instant, and after having a consultation with Mr. Lanius and other mining men, it was agreed that the best course to take was to let the mines remain sealed up for ten days and to isolate the fire from air as thoroughly as possible. The amount of water in the workings with the daily growth of the two mines was figured, and the result showed that with the largest pumps that the shaft would admit it would take about seventy days' actual pumping. Then there would be the time in putting in the pumps, and the frequent changes in lowering them as the water decreased; besides,

I figured that there would be an enormous quantity of *débris* to be removed from the shaft and the level in which the men were entombed. Thus from careful calculation it was estimated that under the most favorable circumstances it would take from five to six months to have reached the bodies, at the extreme end of the lower level. On the 21st of September I went to Golden with a view to offer my assistance in the re-opening of the shaft, when I found that no preparations had been made in the way of procuring pumps and other materials for the work. On calling upon Mr. Lanius, the managing partner of the company, he informed me in behalf of the other members that they would to the extent of the last dollar of their incorporated capital donate to a fund for the recovery of the bodies, but as their incorporated capital was only $5,000 it would be necessary to have a much larger amount to undertake the almost hopeless task. To understand my position in the case, I returned to Denver and consulted the State Attorney General, who informed me that under the present condition of things I had then no further duties to perform in the premises.

I was one of a committee, of which the Hon. John Nichols (then mayor of the town of Golden) was a member, who called upon Governor Job A. Cooper and laid the matter before him, with accompanying diagrams, showing the workings and relative position of the two mines.

The committee desired to learn if the State could do anything to assist in the matter. The Governor, though in great sympathy personally with our desires, could not, under existing laws, do anything with the case in the name of the State. About this time, the impending question of ever being able to recover the bodies before decomposition had reached a state of complete dissolution, became imminent to the most anxious mind. Thus the bodies of the ten men found in the workings of this fateful mine their resting place. The water kept on rising until it reached a point in the shaft eighty feet from the surface, which is on a level with the creek bed.




White Ash Shaft
Loveland Shaft
Cross Section perp. on shaft and vein showing cross-cuts.
NEW SHAFT
Coal Vein
1st LEVEL
200'
108'
280'
114'
360'
87'
440'
72'
520'
57'
601'
44'
652'
35'
730'
58'
Worked
Out.
1100'
1st.
LEVEL
400'
1076'
2nd.
LEVEL
530'
730'
3rd.
LEVEL
623'
800'
4th.
B LEVEL
931'
808'
5th.
C LEVEL
1200'
1050'
6th.
LEVEL
1430'
1000'
7th.
LEVEL
1660'
Fault
A
Coal pinched thin
71
Clear Cr.
Cross Section perp. on levels
Ditch
Water
380'
1st.
OLD SHAFT
150'
LEVEL 1108'
1328'
2nd.
250'
LEVEL 1324'
E
D
A. Where
B. Where
C. Water
D. Where
E. Where
MAP OF THE
WHITE ASH & LOVEL
Showing relative position of worki
Scale
Hor. 200'=1" Per. 100'=1"

REMARKS.

The Loveland shaft, it appears was abandoned ten years ago; also the three upper levels of the White Ash mine wers abandoned about the same time, and *no* work has been done on that portion of the mine since then.

It is my opinion that at point "A" (see map) the strata composing the "foot and hanging walls" had during the above period of time, softened, and had gradually fallen out, relieving the coal, which may have broken off from time to time, until the pillar became so weak that it was unable to withstand the pressure of the water lying almost vertically above it. It is also thought that a "gob fire" may have existed in proximity to point "A," and the same may have assisted in the displacement of the pillar. The pillar left between the two mines would have undoubtedly been of ample thickness to guard against inundation from a body of water in a horizontal or slightly inclined workings. Our mining law prescribes that drill holes shall be kept ahead of the working face at least twelve feet when in proximity to abandoned workings where water is suspected to exist. And while such a precaution may be all that would be necessary to take in level veins, yet such would be of little service in vertical ones. In my opinion it would be a very hard matter to define what thickness of a pillar should be left. From my experience I would not consider a 100 foot pillar an absolute safeguard against inundation in a vertical vein, for I believe it is quite possible, especially where soft material lies between the coal and foot wall, for the coal to break and "run" to a sufficient degree as to cause cracks to reach the top of the pillar, through which a heavy pressure of water would quickly make its way in great volumes; thus, mining in a vertical vein under a body of water cannot be followed with safety, and should be prohibited by law. I trust that our coming Legislature will pass a bill to regulate, in this respect, the working of vertical veins in coal mines, compelling the

owner or agent to drain all upper workings and keep them free from water by pumping or otherwise while working lower levels or approaching abandoned workings. The White Ash mine had but one shaft, and through it was the only means of ingress to or egress from the workings.

I had repeatedly called the attention of those operating the mine to the necessity of having a second opening, and considerable controversy occurred between the manager of the mine and this office relating thereto; and also to the condition of the shaft timbers which I considered unsafe. Frequent inspections of this mine during the year of 1889. Mr. L. S. Jones made an inspection on March 5, and at that time found the shaft in fair condition, but advised careful watch on the timbers, as a "creep" or settling of the strata was perceptible. On May 3, I made an inspection, and found some of the shaft timbers giving away, I notified the company regarding the same and requested that the shaft be retimbered in places and a second opening made. The manager promptly assured me that such instructions would be carried out so far as retimbering the shaft was concerned, but gave no definite answer as to a second opening.

I therefore consulted the State Attorney-General relative to the matter, and on his advice, and in accordance with section two of the mining law, enjoined the company from working more than ten men until a second opening would be made as required by law. This official notice was given to the company on the 21st of June, but in the meantime the manager had been making arrangements to commence work on a new shaft to be sunk on the north side of the creek, in which connection was to be made with the White Ash mine. On the 8th of July I again made an inspection, with a committee of three, and found the work of retimbering the shaft progressing. On the 19th of August I received the following letter from the manager.

JOHN McNEIL,
State Inspector of Coal Mines,
Denver, Colorado:

DEAR SIR:—Referring to the White Ash operation, I beg to state, that the south side of the mine has been entirely abandoned, and all work is now confined to the north side, which in conformation with our coal mining law, section 2, we are extending to connect with a second opening on the north side of Clear Creek, work on which is being performed with due diligence. We are also, in accordance with your instructions, re-timbering the present shaft.

Yours truly,
P. LANIUS, *Manager.*

The men at work in the mine, on learning that I had requested that further operations should cease, and my endeavors to have the same put in safe condition, forwarded to the office the following petition:

GOLDEN, COLORADO,
July 12, 1889.

JOHN McNEIL,
State Inspector of Mines,
Denver, Colorado:

DEAR SIR:—Understanding that your recent inspections of the White Ash coal mine has been unfavorable for its continued operation, we, the undersigned miners employed therein, thankful for your vigilance for our safety, respectfully petition that, if possible, you would allow the operation to continue until the coal opened up by present development is worked out, provided that the owners and lessee place new timbers in certain parts of the shaft, so its safety may be increased for this additional time. To those of us with homes and families here, a shut-down would make a great hardship. And for the good of all, we hope you will be able to devise some means which will allow us to continue at our present work.

Signed,

ROBERT HOLDSWORTH,
JOS. HOTTER,
JOHN WILLIAMS,
JOHN COLLINS,
JOHN MURPHY,
RICHARD ROWE,
JOSEPH ALLEN,
HARRY ALLEN,
EVAN JONES,
P. MASTERSON,
JOSEPH CUFFNER,
GEORGE YORKE.

While all this controversy and precautions were being considered for the safety of those men against imminent danger which existed, and could be seen and was being guarded against, there was death lurking astride the gloom of which no one ever dreamed about, and the fatal pillar, which had withstood the pressure of the water for ten years, gave way.

The men who lost their lives had expressed themselves that their safety was assured since the re-timbering of the shaft and other necessary work was being done.

The lower levels of the mine were flooded, and the shaft filled up some thirty feet in a few minutes after the pillar broke.

LIST OF FATAL ACCIDENTS—1889.

January 2—Frank Forkas, at Rouse mine No. 1, Colorado Fuel Company, Huerfano county, killed by a fall of rock while engaged in undermining the coal. The rock was of a bell shape, having a "slip" all around its edge, and the coal on being mined from under it suddenly relieved the rock, which probably fell without giving any warning. Forkas, it is said, was an experienced miner.

January 11—C. D. Rice, at Cameron mine, Colorado Coal and Iron Company, Huerfano county, killed by a fall of rock. Mr. Rice was an experienced miner, and his working place was found well timbered. The rock which fell was freed from sustaining force by a glassy "slip" which run parallel with the face of the coal, and could not be readily noticed; its weight caused it to break away from the line of the nearest props and caught the man under it.

January 21—Alfred Calonne, at Marshall mine No. 3, Marshall Consolidated Coal Company, Boulder county, killed by a fall of coal while engaged undermining in a

"pillar" that was somewhat broken by a shot that had been previously fired. On mining to the powder cracks the coal suddenly fell over, striking Calonne with great force.

January 30—John Stuebel, at Cannon mine, Cannon Coal Company, Boulder county, killed by a fall of coal. Stuebel was at work in an entry where a shot had been fired on the previous shift to the accident, which had only removed a portion of the undermined coal, and had made a powder crack ten inches over on the solid which run parallel with the face of the entry. Stuebel on undermining into the crack removed all sustaining force from that portion of the coal, which suddenly fell on him.

June 8—John Smyth, at New Castle mine, Grand River Coal & Coke Company, Garfield county, killed by falling down a "chute." Upon an investigation of this accident it was found that Smyth had returned to the mine at 7:30 o'clock p. m. for the purpose of firing two shots, which required a little work. It appears that he had climbed up the chute (the face of which was but thirteen feet above the main level), and had in some way lost his balance and fell to the bottom on his head, breaking his neck. I am of the opinion that the man was overcome by noxious gas at the face of the chute—probably free nitrogen—and had lost consciousness before falling. I have felt the effects of the above gas to a degree in this mine, and have noticed it in high places so strong as to extinguish a light. The mine at this time was poorly ventilated, and notice had been given the company to erect a ventilating fan, which was soon afterwards put in operation.

July 2—Dominick Angelico, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, seriously injured by a fall of coal, from which he died on the 4th inst. On an investigation it was found that Angelico had been engaged undermining a portion of coal which had been previously loosened by a shot, and on mining into the powder crack the coal suddenly fell over on him.

July 10—Gratano Molacarin, at Sopris mine, Denver Fuel Company, Las Animas county, killed by a fall of coal. It appears that at the time of the accident, Molacarin was in the act of undermining, and on reaching a smooth "slip" in the coal a portion of it broke off, falling on him.

August 13—Joseph Halka, at Rouse mine, Colorado Fuel Company, Huerfano county, killed by a fall of rock. An investigation showed that Halka was engaged loading a car in his working place, that a piece of rock weighing 2,000 pounds fell from the roof crushing him under its weight. The place was not sufficiently timbered.

September 9—John Collins, William Collins, John Murphy, Richard Rowe, Joseph Allen, David Lloyd, John Morgan, H. Huseman, William Bowden and Joseph Hotter, at White Ash mine, Golden Fuel Company, Jefferson county, were drowned by an inundation of water from the old Loveland shaft, (see map and article).

November 23—G. H. Hornstien, at Anthracite mine, Colorado Fuel Company, Gunnison county, killed by a train of incline cars running into the "breaker." The breaker is situated at the bottom of the incline plane which reaches the mine at a vertical height of 800 feet above the breaker; the incline distance is about 2,000 feet. It appears that the brakeman at the top of the incline let the loaded train over the "knuckle" before the empty cars had been attached to the rope at the bottom. On finding such to be the case, he at once stopped the loaded train with the brake. The party at the bottom attached a rope to the cable, and by power transmitted from the breaker engine, undertook to pull the loaded train back over the knuckle, when in some way the rope broke and the loaded cars started down the incline with great accelerating velocity, crushing through the breaker and striking Hornstien on their way.

November 26—Rudolph Endermail and Paul Kail, at Rouse mine No. 2, Colorado Fuel Company, Huerfano

county, killed by a fall of rock. An investigation of this accident showed that Endermail and Kail were engaged together as partners in a room, and while one was engaged loading a car and the other wedging down coal, that a massive rock, measuring ten feet wide, thirteen feet long, and five feet thick, fell, crushing the two men beneath its weight almost beyond recognition. They were Germans and perfect strangers, having only been at work there a few days.

December 4—Mike Faltch, at Brookside mine No. 7, Cañon City Coal Company, Fremont county, seriously injured by being struck by a train of cars, and died twelve hours later. On investigating the cause of the accident, it appeared that Faltch (a runner of an air drill) had put his drilling machine in an empty car of a train on its way down the "slope," in purpose to have it removed to another district of the mine, some 300 feet further down the slope. He pulled the signal wire, with the intention of signaling the cars to be lowered, but, through a mistake, gave the signal to hoist. The engineer at once started the train up the slope. The trip runner, seeing the mistake made, gave the signal to stop, which the engineer did rather suddenly, and the momentum or forward motion of the cars, caused the bridle chains to slack a little, and the clevis pin came out, thus detaching the train of twelve cars from the cable, they descended the slope with a terrific velocity and caught Faltch, breaking both his legs and otherwise injuring him.

December 5—N. J. Thomas, at Sunshine mine, Grand River Coal and Coke Company, Garfield county, seriously injured between a pit car and prop, causing his death on the seventh inst. Mr. Thomas was engaged as a mule driver, but was not on duty on the above date, and had but causually entered inside the "drift" mouth, about the same time a loaded train of cars passed out from the drift, the first of which caught Thomas between it and the first set of timbers, injuring him internally, which caused his death on the date above stated.

December 9—John Massara, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, killed by being caught between a loaded pit car and "collar timber." Massara, when the accident occurred, was engaged taking a loaded car from his room face to the main entry, a distance of 140 feet, on a gaade of four feet in one hundred feet. He was in front of the car, and on reaching the entry it is thought that he raised his head, which was caught behind the collar timber at the room entrance, and that the motion of the car bent his back forward which fractured the spine. He lived a few hours after the accident in an unconscious state.

LIST OF NON-FATAL ACCIDENTS—1889.

January 5—William Goldie, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, leg bruised by a fall of slate.

January 9—Andra Martina, at Sopris mine, Denver Fuel Company, Las Animas county, foot and arm bruised by a fall of coal.

January 11—James Carnisini, at Como mine No. 1, Union Coal Company, Park county, legs and hips bruised by a fall of coal.

January 14—Morgan S. Morgan, at Coal Creek mine No. 1, Colorado Coal & Iron Company, Fremont county, leg burned by stepping into the "sump" where a steam pump exhausted.

January 16—William Jones (mule driver), at Rockvale mine No. 5, Cañon City Coal Co, Fremont county, side and shoulder injured by being caught between pit car and "rib side."

January 17—John Gillespie, at Coal Creek mine No. 1, Colorado Coal & Iron Company, Fremont county, three ribs broken by falling on a rail.

January 30—Daniel Trisscle, at Sunshine mine, G. R. Coal & Coke Company, Garfield county, shoulder dislocated by a fall of coal.

January 31—Fred Bowie, at Sunshine mine, Grand River Coal & Coke Company, Garfield county, foot bruised by a pit car.

February 4—Nicklos Borillo, at Coal Creek mine No. 2, Colorado Coal & Iron Company, Fremont county, leg bruised by a fall of slate.

February 6—Adam Morris, at Valley mine, Raton Coal and Coke Company, Las Animas county, bruised by a fall of coal.

February 18—Thomas Pernello, at Franceville mine, Denver and Texas Fuel Company, El Paso county, hands and face burned and otherwise injured by a premature blast.

February 19—Thomas Beach, at Rockvale mine No. 5, Cañon City Coal Company, Fremont county, shoulder cut and bruised by a fall of rock.

March 6—Hugh A. Young, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, leg and back bruised by being caught with a pit car.

April 10—Owen Conway, at Sopris mine, Denver Fuel Company, Las Animas county, back injured by a fall of rock.

April 15—Stimpson Rizen, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, foot and leg injured by being caught with a pit car.

April 18—Thomas Lewis, "cager," foot bruised by being caught under cage, at Rockvale mine No. 1. Cañon City Coal Company, Fremont county.

April 26—Edward Howard, at Star mine, Star Coal Company, Boulder county, leg broken and otherwise injured by a fall of coal.

April 27—Frank Ostter, at Sopris mine, Denver Fuel Company, Las Animas county, seriously injured by a fall of coal.

April 30—Owen Conway, at Sopris mine, Denver Fuel Company, Las Animas county, leg injured by a fall of coal.

April 30—Thomas Gramaldy, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, shoulder bruised by a fall of rock.

May 4—Batiste Orizio, at Sopris mine, Denver Fuel Company, Las Animas county, leg broken by a fall of coal.

May 17—Antonio Gisdrosich, at Sopris mine, Denver Fuel Company, Las Animas county, seriously injured by a fall of coal.

May 17—Antonio Gionist, at Sopris mine, Denver Fuel Company, Las Animas county, hip bone fractured by a fall of coal.

May 23—Dominick Canostrana, at Coal Creek mine No. 2, Colorado Coal and Iron Company, leg bruised by being caught between loaded pit cars.

May 30—Adam Fevin, at Picton mine No. 1, Southern Colorado Coal Company, Huerfano county, back injured by a fall of rock.

June 1—Charles Samuel, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, foot bruised by a fall of coal.

June 2—Mathew Pagino, at Coal Creek mine No. 2, Colorado Coal and Iron Company, small bone of leg broken by a fall of slate.

June 3—David Brown, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, arm broken by a fall of slate.

June 17—Ralph Gregor, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, fingers injured by a fall of slate.

June 22—John Bryce (a boy), at Rockvale mine No. 1, Cañon City Coal Company, Fremont county, hand injured by being caught between pit cars.

June 26—Alexander Patterson, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, ribs bruised and otherwise injured, by being struck with crank handle at coal chutes.

June 26—Joseph Rees, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, injured by a fall of coal.

July 11—John Murphy, at El Moro mine, Colorado Coal and Iron Company, Las Animas county, leg broken by a fall of coal.

July 11—John W. Nash (a boy), at Rockvale mine No. 4, Cañon City Coal Company, Fremont county, back seriously hurt by a fall of rock.

July 13—L. Briggs, at Sopris mine, Denver Fuel Company, Las Animas county, hip bruised by a fall of coal.

July 13—S. Thrower, at Sopris mine, Denver Fuel Company, Las Animas county, arm injured by a fall of coal.

July 24—Miller Harris, at Cleveland mine, Cleveland Coal Company, Boulder county, foot bruised by a pit car.

July 29—Juan Martini, at Sopris mine, Denver Fuel Company, Las Animas county, leg bruised by a fall of coal.

August 10—Pascue Dejacimo, at Coal Creek mine No. 1, Colorado Coal and Iron Company, finger injured by a fall of rock.

August 14—Joseph Clark, at Coal Creek mine No. 1, Colorado Coal and Iron Company, finger injured by a fall of rock.

August 20—Frank Giozanni, at Starkville mine No. 1, Trinidad Coal and Coke Company, Las Animas county, leg broken by being struck with coal from a premature blast.

August 21—Lewellyn Hughes, at Rockvale mine No. 1, Cañon City Coal Company, fingers injured by a fall of rock.

August 21—Mike Gavin, at Sopris mine, Denver Fuel Company, Las Animas county, thumb injured by stroke from a sledge hammer.

August 24—Peter Falan, at Elmoro mine, Colorado Coal and Iron Company, Las Animas county, leg broken and otherwise injured by a fall of rock.

August 26—Moses Davis, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, back injured by a fall of rock.

August 27—Alexander McKillop, at Sopris mine, Denver Fuel Company, Las Animas county, fingers injured by being caught between large pieces of coal while loading a car.

August 28—Dominick Capena, at Coal Creek mine No. 1, Colorado Coal and Iron Company, leg broken by a fall of coal.

August 31—Owen Conway, at Sopris mine, Denver Fuel Company, Las Animas county, hips and wrist injured by a fall of slate.

August 31—Christ Frey, at Rouse mine, Colorado Fuel Company, Huerfano county, leg broken and back bruised by a fall of slate.

September 3—George W. Wills, at New Castle mine, Grand River Coal and Coke Company, Garfield county, slightly burned and otherwise injured by an explosion of carbureted hydrogen gas.

September 10—William R. Richards, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, arm injured by being caught between a pit car and "rib side."

September 10—Samuel Abernethy, at Coal Creek No. 2, Colorado Coal and Iron Company, Fremont county, foot bruised by a fall of rock.

September 12—Elijah Trevethan, at Sopris mine, Denver Fuel Company, Las Animas county, received bodily injuries by a fall of coal.

September 14—D. Llewellyn, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, leg bruised by a fall of coal.

September 14—Thomas McLuckey, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, back injured by a fall of rock.

September 14—John Coakerck, at Marshall mine No. 5, Marshall Consolidated Coal Company, collar bone and two ribs broken and hip joint dislocated by a fall of coal while undermining.

September 14—Vencencis Tassatorio, at El Moro mine, Colorado Coal and Iron Company, Las Animas county, back seriously injured by a fall of rock.

September 17—John Davis, at New Castle mine, Grand River Coal and Coke Company, Garfield county, injured by a premature blast.

September 17—George Davis, at New Castle mine, Grand River Coal and Coke Company, Garfield county, seriously injured by a premature blast.

September 18—John Rutherford, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, back injured by a fall of rock.

September 19—John Murray, at Marshall mine No. 5, M. C. C. Co., Boulder county, head seriously injured by a fall of coal.

September 20—John Dohn, at Rouse mine, Colorado Fuel Company, Huerfano county, leg broken by a fall of slate.

September 23—George Pallino, at Coal Creek mine No 1, Colorado Coal and Iron Company, Fremont co unty fingers injured by a fall of slate.

September 24—Paul Shirly, at Rouse mine, Colorado Fuel Company, Huerfano county, leg bruised between railroad cars at "chutes."

September 26—Charles A. Davis, at Rockvale mine No. 1, Cañon City Coal Company, Fremont county, foot and leg injured by a fall of rock.

September 28—Thomas Croslan, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, foot bruised by a fall of coal.

September 29—John Llewellyn, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, back bruised by a fall of rock.

October 5—John Addell, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, back and leg injured by a fall of rock.

October 7—John Hicks, at Coal Creek mine No. 2, Colorado Coal and Iron Company, foot bruised by a fall of rock.

October 10—Richard Jones, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, foot sprained by a pit car.

October 16—Joseph Clark, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, arm injured by fall of coal.

October 18—Henry Gregor, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, foot bruised by a fall of coal.

October 18—Neles Mangus, at Simpson mine, Simpson & Spencer Coal Company, Boulder county, leg broken (afterwards amputated) by a fall of slate.

October 26—Lenord Koenig, at Crested Butte mine, Colorado Coal and Iron Company, Gunnison county, leg broken.

October 29—Joe Buzzdli, at New Castle mine, Grand River Coal and Coke Company, leg broken by being caught under a pit car.

October 31—Robert D. Wiggans, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, ankle sprained by a pit car.

November 2—R. Y. Lawther, at Pictou mine, Southern Colorado Coal Company, Huerfano county, foot seriously injured by a fall of rock; toes were afterwards amputated.

November 9—J. Knowles, at Coal Creek mine, Colorado Coal and Iron Company, Fremont county, shoulder dislocated by falling while pushing a car.

November 9—Joe Deminty, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, eye injured by being struck with a piece of coal.

November 11—George Roocroft, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, hand cut by a fall of rock.

November 11—Thomas Titzers, at Simpson mine, Simpsan & Spencer Coal Company, Boulder county, leg broken by a fall of rock.

November 12—David John, at Rockvale mine No. 1, Cañon City Coal Company, badly bruised between pit cars.

November 13—Sebastian Rapp, at Rockvale mine No. 1, Cañon City Coal Company, Fremont county, legs and shoulders seriously bruised between passing cars.

November 19—John Richardson, at Rockvale mine No. 1, Cañon City Coal Company, Fremont county, ankle sprained by a fall of rock.

November 21—John Williams, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, back and legs injured by being caught with a pit car.

November 24—Elmer Edward, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county,

finger injured by being caught between a "spragg" and the wheel of a pit car.

November 25—Louis Raucheles, at Pictou mine, Colorado Southern Coal Company, Huerfano county, leg broken by a fall of rock.

November 28—Joseph Naukwell, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, back and foot bruised by a fall of rock.

November 28—William Webb, at Rouse mine, Colorado Fuel Company, Huerfano county, collar-bone broken while "spragging" a car.

December 4—John Murphy, at Anthracite mine No. 1, Colorado Fuel Company, Gunnison county, shin-bone broken.

December 5—Frank Norr, at Coal Creek mine No 2, Colorado Coal and Iron Company, Fremont county, burned and otherwise injured by a premature blast.

December 5—Nicholas Osti, at El Moro mine, Colorado Coal and Iron Company, Las Animas county, back bruised.

December 11—John Milliken, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, arm broken.

December 12—John Lynn, at Rockvale mine No. 1, Cañon City Coal Company, Fremont county, leg broken by a fall of coal.

December 14—Thomas Kilcoyme, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, back injured by a fall of rock.

December 16—P. D. Wright, at Sopris mine, Denver Fuel Company, Las Animas county, finger crushed while "spragging" a car.

December 17—Daniel Evans, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, toe cut off by being run over with a pit car.

December 20—J. B. Daniels, at Crested Butte mine, Colorado Coal and Iron Company, Gunnison county, leg broken by a fall of slate.

LIST OF FATAL ACCIDENTS—1890.

January 18—Mike Starr, at Sopris mine, Denver Fuel Company, Las Animas county, killed by a fall of coal. From an examination of the scene of the accident, it was learned that Starr had fired a shot in the coal on the day previous, but that the same had failed to properly blast down the coal, and that he undertook to dig it out when the coal fell in a large body on him. He lived six hours after the accident.

January 20—John Sworn, at Crested Butte mine, Colorado Coal and Iron Company, Gunnison county, killed by a fall of rock. Sworn, at the time the accident occurred, was engaged building a stone "stopping in a cross-cut," when a rock weighing 250 pounds fell from the roof, striking him on the right thigh, breaking the bone and cutting the flesh so badly that he died from loss of blood shortly after the accident.

January 28—John Caratto, at Como mine No. 5, Union Coal Company, Park county, seriously injured by falling between moving cars, from which injuries he died on the 5th of February. Caratto was an aged man, and accidentally fell between two pit cars, breaking some of his ribs and receiving internal injuries.

January 29—John Bourger, at Como mine No. 5, Union Coal Company, Park county, seriously burned and otherwise injured by an explosion of carbureted hydrogen gas, from which injuries he died on February 6. From an examination of the scene of this accident it was learned that Bourger had been notified by the fire boss that there was a quantity of explosive gas in his place, and that he

should be careful in "brushing" it out. He went up into his place, took off his shirt, and with it commenced brushing out the gas. As suggested by the fire boss he extinguished his lamp as a precaution against igniting the gas, but in brushing it out on the main level where other men were at work it ignited from their lamps, and Bourger at the time of the explosion having his body naked he was much more seriously burned than the others. In my opinion *it is a mistake* where a fire boss ever gives an order to brush out gas. It should be removed by brattice conducting the air to where the gas has accumulated, and while the same is being removed there should not be any naked lights allowed in that particular district of the mine, and such work should only be done under the personal supervision of the fire boss or other competent person.

January 31—Justina DeCamp, at Ajax mine, Ajax Coal Company, Boulder county, killed by a fall of slate. DeCamp had fired a shot in the coal, and returned before the smoke had sufficiently cleared away; the blast had blown out some props that had been set under bad roof; it is thought that DeCamp, after examining the result of the shot, was preparing to re-set the props, when a portion of the roof that had been freed from the face of the coal by a "slip," fell, catching him under its weight.

March 14—Andrea Trosserillo, at Starkville mine No. 2, Trinidad Coal and Coke Company, killed by a fall of slate. Trosserillo, at the time the accident occurred, was engaged loading a car under roof, which he knew was dangerous, and had been warned by the foreman to place props under it, but he failed to do so, and the rock fell on him. The accident was doubtless due to carelessness in not setting the props as ordered.

March 24—John McDermot, at Chicosa mine No. 1, Trinidad Fuel Company, Las Animas county, fatally injured by a fall of rock, and died on the 27th inst. At the time of the accident, it appears that McDermot was engaged

taking down loose rock on his road-way, when a portion of the roof fell, striking him on the breast.

April 12—Thomas Irwin, at Simpson mine No. 2, Simpson & Spencer Coal Company, Boulder county, killed by falling down the shaft. From an investigation it was learned that Irwin was engaged in weighing and dumping coal. It appears that he had pulled a loaded car off the south cage, on which men were afterwards lowered, Irwin pulling the "rests" for the men to descend. After dumping the coal, he pushed the empty car into the south compartment of the shaft, which fell to the bottom (a distance of 240 feet), dragging Irwin with it. On being found at the bottom immediately after falling, he was dead. There were no safety gates on top. It was a new mine, the first coal being taken from it on the first of said month, and the general equipments were in course of construction, which may account for the want of the gates.

April 26—Tomaso Martini, at Sopris mine, Denver Fuel Company, Las Animas county, seriously injured by a fall of coal. Martini was engaged undermining, when a portion of loose coal from the face fell on him, causing injuries from which he died on the seventh day of May.

June 6—John Kitell, at Coal Ridge mine, Colorado Fuel Company, Garfield county, fatally injured by bring struck with fragments from a blown out shot, dying from his injuries on June 7.

September 6—Velentine Paganini, at Sopris mine, Denver Fuel Company, Las Animas county, fatally injured by a fall of coal and died on the 10th inst. Paganini, when the accident occurred, was engaged undermining a portion of coal that had been previously loosened by a shot. On mining into the powder crack, the coal was freed from its sustaining force and fell suddenly, catching him under its weight.

September 23—Pedro Abezta, at the Sopris mine, Denver Fuel Company, Las Animas county, killed by a fall of

rock. Abezta at the time the accident occurred was engaged mining through a pillar, and had struck a "slip" in the coal which run into the roof, relieving the rock, the weight of which broke itself from the props behind, and fell on him.

October 14—Peter Sualdie, at Spring Gulch mine, Grand River Coal and Coke Company, Pitkin county, fatally injured by a fall of rock, and died six hours after the accident. From an examination of the scene of this accident, it was learned that Sualdie was engaged undermining coal that had been partly broken by a shot which had been fired on the 13th, and on mining into the "powder crack" the sustaining force which supported a large rock, being freed suddenly fell on him. It was evident that the place had been poorly timbered.

October 25—Carmine Carluci, at Marshall mine No. 2, Marshall Consolidated Coal Company, Boulder county, killed by a fall of coal. On examining the scene of the accident, it was found that Carluci had fired a blast in the bottom coal, and on resuming work, he, it is thought, failed to notice that the shot had made a crack through the top coal, and commenced to undermine below it, when six tons of the top bench of coal fell on him.

December 9—William Golightly, at Pictou mine, Colorado Fuel Company, Huerfano county, fatally injured by an explosion of powder, and died on the 14th instant. It appears that Golightly attempted to open a keg of powder with a pick. This mode of opening powder kegs is practiced by many miners, but it is a very dangerous one, for if the iron keg is struck by a steel pick, even with a light force, a spark of fire may occur.

December 19—William Clark, at the Standard mine, Standard Coal Company, Boulder county, killed by falling down the shaft. From an investigation of this accident it appears that Clark was engaged as night engineer, and it is supposed that he went to the mouth of the shaft with a

view to look down to see if the water was pumped from the bottom, as was his custom to do, when it is thought he lost his balance and fell in. The shaft is 100 feet deep.

LIST OF NON-FATAL ACCIDENTS—1890.

January 3—James Longouske, at Sopris mine, Denver Fuel Company, Las Animas county, injured by being crushed between a mule and pit car.

January 9—A. Guani, at Sopris mine, Denver Fuel Company, Las Animas county, bruised by a fall of slate.

January 13—F. Gonzales, at Sopris mine, Denver Fuel Company, Las Animas county, thumb crushed by a fall of coal.

January 20—John Graham, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, foot bruised by a fall of coal.

January 21—Thomas Edwards, at Sopris mine, Denver Fuel Company, Las Animas county, ribs fractured by a pit car.

January 22—P. Moya, at Sopris mine, Denver Fuel Company, Las Animas county, back bruised by a fall of coal.

January 22—Thomas F. Carroll, at Rouse mine, Colorado Fuel Company, Huerfano county, back and shoulder bruised by a fall of slate.

January 25—P. J. Breen, at Anthracite mine, Colorado Fuel Company, Gunnison county, compound fracture of leg by a fall of slate.

January 27—I. C. Widdisworth, at McFerran mine, El Paso county, leg broken.

January 29—Parcel James, Thomas Sarclete and Ike Weightman, at Como mine No. 5, Union Coal Company, Park county, were burned and otherwise injured by an explosion of carbureted hydrogen gas (C. H.[4]).

January 30—Peter Maddio, at Rockvale mine No. 1, Cañon City Coal Company, Fremont county, toe broken by a fall of rock.

January 31—Thomas Trujillo, at El Moro mine, Colorado Coal and Iron Company, Las Animas county, hand bruised by a fall of coal.

February 1—Antonio Mino, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, head cut by a fall of coal.

February 6—James James, at Chicosa mine, Trinidad Fuel Company, Las Animas county, hand cut by a fall of slate.

February 8—Thomas Bester, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, fingers bruised by a fall of slate.

February 12—Alexander Graham, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, leg bruised by being caught by a pit car.

February 13—D. Llewellyn, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, leg bruised by a fall of coal.

February 17—Hugh Harrison, at Mitchell mine, Colorado Fuel Company, Weld county, injured by a fall of coal.

February 22—Ramon Ortz, at Sopris mine, Denver Fuel Company, Las Animas county, scalp wound by a fall of rock.

February 26—Pable Lucero, at Sopris mine, Denver Fuel Company, Las Animas county, head bruised by a fall of coal.

February 27—William Arthur, at Rockvale mine No. 1, Cañon City Coal Company, Fremont county, injured by kick from a mule.

March 1—William Wilson, at Chicosa mine, No. 2, Trinidad Fuel Company, Las Animas county, foot bruised by a fall of rock.

March 3—John Lindner, at Chicosa mine No. 2, Trinidad Fuel Company, Las Animas county, foot bruised by a fall of rock.

March 5—Joseph Casteel, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, knee-cap injured by a pit car.

March 6—John Angter, at El Moro mine, Colorado Coal and Iron Company, Las Animas county, ankle sprained by being caught under a pit car.

March 10—James Calderhead, at Chicosa mine No. 2, Trinidad Fuel Company, Las Animas county, foot injured with being run over by a pit car.

March 10—John Loftus, at Rouse mine, Colorado Fuel Company, Huerfano county, leg bruised by a pit car.

March 13—Frank Crow, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, back injured by a fall of rock.

March 15—John Howell, at Coal Creek No. 2, Colorado Coal and Iron Company, Fremont county, leg broken by a fall of rock.

Marck 15—Charles Arbuckel, at Cameron mine, Colorado Coal and Iron Company, Huerfano county, back bruised and spine injured by a fall of rock.

March 22—James James, at Chicosa mine No. 1, Trinidad Fuel Company, Las Animas connty, leg bruised by a fall of rock.

March 24—Enoch Vaughan, at Como mine No. 5, Union Coal Company, Park county, ribs broken by falling down ladder-way in air shaft.

March 29—Richard Delowry and William Barron, at Como mine No. 5, Union Coal Company, Park county, slightly burned and otherwise injured by an explosion of carbureted hydrogen gas (C. H. 4).

April 19—James Lorelt, at Chicosa mine, Trinidad Fuel Company, Las Animas county, foot bruised by a fall of rock.

April 26—William Humphrey, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, head and arm injured by a fall of rock.

April 27—Patrick Russell, at Como mine No. 5, Union Coal Company, Park county, hip bruised by being caught with a pit car.

May 15—James O'Rourke, at Sopris mine, Denver Fuel Company, Las Animas county, leg broken by a fall of coal.

May 21—Thomas Banks, at Starkville mine No. 1, Trinidad Coal and Coke Company, Las Animas county, back and legs injured by a fall of coal.

May 21—Antona Versalena, at Victor mine No. 1, Victor Coal Company, Las Animas county, hand bruised by a fall of coal.

May 22—Edward Morgan, at El Moro mine, Colorado Coal and Iron Company, Las Animas county, skull fractured by kick from a mule.

May 27—Bertie Harbin, at New Castle mine, Grand River Coal and Coke Company, Garfield county, back injured by a pit car.

June 5—W. H. Parsons, at Victor mine No. 1, Victor Coal Company, Las Animas county, hand injured by a fall of coal.

June 4—George Freil, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, foot bruised by a fall of coal.

June 7—David Delowry, at Como mine No. 5, Union Coal Company, Park county, hip bruised by a fall of rock.,

June 11—Antonio James, at Coal Creek mine No. 2 Colorado Coal and Iron Company, Fremont county, back seriously injured by a fall of rock.

June 20—Antonio Fobikoski, at Victor mine No. 1, Victor Coal Company, Las Animas county, injured by a fall of coal.

June 23—James Redmond, at El Moro mine, Colorado Coal and Iron Company, Las Animas county, back injured by a fall of slate.

July 8—Angle James, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, leg broken by a fall of rock.

July 16—Henry Steaub, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, leg broken by a fall of rock.

July 24—R. H. Richards, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, knee injured by a fall of rock.

July 28—Alexander Maxwell, at Crested Butte mine, Colorado Coal and Iron Company, received serious bodily injuries by a fall of rock.

August 25—August Able, at Chicosa mine, Trinidad Fuel Company, Las Animas county, leg broken by a fall of rock.

August 30—John Tait, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, foot bruised by being caught by a pit car.

September 4—Raphel Matinez, at Victor mine No. 1, Victor Coal Company, Las Animas county, finger cut off by car chains.

September 13—Robert Milliken, Jr., at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, hand and fingers bruised while changing car latches.

September 13—Henry Gregor, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, arm and leg bruised by a fall of coal.

September 15—Nickol Batista, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, hand bruised by being caught between a piece of coal and pit car, while loading.

September 16—Heron, at El Moro mine, Colorado Coal and Iron Company, Las Animas county, small bone of foot broken by being caught between empty pit cars.

September 19—Morgan Richards, at Rockvale mine No. 1, Cañon City Coal Company, Fremont county, ankle bruised by a fall of rock.

September 20—Thomas Cundy, at El Moro mine, Colorado Coal and Iron Company, Las Animas county, fingers bruised by being caught by a pit car.

September 24—Cero Farreno, at Victor mine No. 1, Victor Coal Company, Las Animas county, leg bruised by a fall of coal.

October 6—Thomas Samuels, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, foot bruised by being caught by a pit car.

October 21—John Livingstone, at Chicosa mine No. 1, Trinidad Fuel Company, Las Animas county, foot bruised by being run over by pit car.

October 23—Andrew Picinich, at Chicosa mine No. 2, Trinidad Fuel Company, Las Animas county, arm bruised by a fall of rock.

October 30—Nash Bryant, at Rouse mine, Colorado Fuel Company, Huerfano county, internal injuries.

October 31—William Howells, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, foot bruised by a fall of rock.

November 5—Edward Llewelyn, Thomas M. Davis and Thomas Morris, at New Castle mine, Grand River Coal and Coke Company, Garfield county, all slightly burned by gas.

November 7—John S. Snider, at Cannon mine, Cannon Coal Company, Boulder county, two ribs broken by a fall of coal.

November 8—Daniel McNeil, at Cannon mine, Cannon Coal Company, Boulder county, ankle sprained by being caught by pit car.

November 13—Thomas Lallio, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, leg bruised by a fall of coal.

November 13—John Velensky, at Cameron mine, Colorado Coal and Iron Company, Huerfano county, internally injured by a fall of slate.

November 14—Sam Johnson, at Rouse mine, Colorado Fuel Company, Huerfano county, leg broken by fall of rock.

November 15—John McGonigal, at Starkville mine No. 2, Trinidad Coal and Coke Company, Las Animas county, thigh broken by being run over by pit cars.

November 19—William Humphrey, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, thigh bone broken by a fall of slate while engaged undermining coal.

November 19—Richard Bickerton, at Chicosa mine No. 2, Trinidad Fuel Company, Las Animas county, ankle sprained by pit car.

November 21—Alex'r Pollock (mine superintendent), at El Moro mine, Colorado Coal and Iron Company, injured internally by being caught between "rib side" and mine locomotive.

November 25—B. M. Chamberlain, at New Castle mine, Grand River Coal and Coke Company, Garfield county, foot bruised by pit car running over it, on top of slope; foot had to be amputated.

November 29—Lucas Garcia, at Sopris mine, Colorado Fuel Company, Las Animas county, seriously injured by fall of slate.

December 6—Charles Hunter, at Cannon mine, Cannon Coal Company, Boulder county, leg broken by being caught between a pit car and "rib side."

December 9—Nic. Ganter, at Cannon mine, Cannon Coal Company, Boulder county, thigh bone broken by a fall of slate and fire clay.

December 15—H. S. Kenyon, at Rockvale mine No. 1, Cañon City Coal Company, Fremont county, arm broken, shoulder dislocated, leg broken in two places and foot bruised by being run over by water car.

December 15—Mick Frabrize, at Coal Creek mine No. 1, Colorado Coal and Iron Company, Fremont county, finger bruised by fall of slate.

December 17—S. W. Reynolds, at Coal Creek mine No. 2, Colorado Coal and Iron Company, Fremont county, ribs bruised and face cut by premature blast.

LAS ANIMAS COUNTY.

SOPRIS MINE.

Located five miles in a southerly direction from Trinidad. Is owned and operated by the Denver Fuel Company. The mine is worked in three separate divisions, each having two parallel entries, which are opened from the crop of the coal by "drifts," one leading south, one east, and one west, respectively. Ventilation is produced by a fan twenty feet in diameter. The mine is well ventilated, no expense being spared to properly conduct the air currents in and around the workings in a scientific manner. The stoppings used between the parallel air courses consist chiefly of stone; are massive and well built. Such a system, though expensive at the time, is the most economical in the end. This mine is the largest producer in the State, 2,000 tons having passed over its single tipple in less than ten hours. It is safe to put the daily capacity at 1,750 tons per day. The plant in all its details is modern, a "Ramsay" car-loader being used to load the coal into railroad box cars. The pit cars are run from the drifts to the railroad, a distance of 1,800 feet, by an improved system of tail-rope haulage. The management is in the hands of J. A. Kebler, manager, and Wm. J. Murray, superintendent. A portion of the production is made into coke at the company's ovens, in proximity to the mines. The coal vein is from five to six feet in thickness, and dips to the south at an angle of three to five degrees.

VALLEY MINE.

This mine was abandoned during 1890. It was opened in 1888 by the Raton Coal and Coke Company in the interest of the Denver, Texas and Fort Worth Railroad Company. The mine was extensively worked, reaching a capacity of over 500 tons per day; the vein is four feet

five inches in thickness, and is inter-stratified with four to eight inches of slate near the center, beside other impurities. Numerous "faults" run through the property; thus its prospects as a profitable producer seemed doubtful, and as better fields were to be had, the company ceased operations.

EL MORO MINE.

This mine up to the present year was the largest producer in the State, but is now surpassed in output by the Sopris mine. It is a drift opening; thickness of coal is from six to eight feet; the haulage is on the main drift, is done by a mine locomotive, which works successfully; ventilation is produced by a fan; capacity 1,200 tons per day. It is owned by the Colorado Coal and Iron Company.

CHICOSA MINE.

Is owned and operated by the Trinidad Fuel Company; consists of two separate drift openings having parallel entries from the crop of the coal. The vein is seven feet in thickness. The ventilation on late inspection was found to be rather poor; the company was notified of the fact and requested to put in a ventilating fan, which is now now being erected. The capacity of the mine is about 750 tons per day.

GREY CREEK MINE.

This mine is located six miles east of Trinidad; is opened by drifts. The coal seam is about seven feet in thickness, but is inter-stratified with a seam of shale from ten inches to two feet in thickness. The dip of the coal is about six degrees in a northerly direction. The mine is owned by the Grey Creek Coal Company, of which Mr. Delos Chappel was manager. It was leased by the Colorado Coal and Iron Company, but for some reason the operations have not been followed during 1890.

THE VICTOR MINE.

This is a new mine, located about sixteen miles north of Trinidad, and is reached by a branch of the Denver, Texas and Fort Worth Railroad, connecting with the Rio Grande Railroad at Chicosa station. It consists of three separate openings; capacity about 1,000 tons per day; thickness of vein, seven feet, dipping about four degrees in a southwesterly direction; ventilated by a furnace. There are situated near the mine 100 coke ovens. The main opening is up on the side of the gulch; the coal is run down to the railroad cars over a tramway. There is a neat little village built for the workmen, and all other improvements are substantial.

STARKVILLE MINE NO. 1.

It is situated at Starkville station, on the Atchison, Topeka and Santa Fé Railroad. It consists of parallel drift openings; the coal seam is six feet in thickness. During the past year, the work done has been chiefly in "drawing" pillars; the mine will soon be abandoned; capacity, 100 tons per day.

STARKVILLE MINE NO. 2

Is an extensive mine; its capacity is about 600 tons per day; thickness of vein, about six feet; lies at a gentle dip of from two to three degrees. The coal is hauled by a small locomotive from the mine entrance to the company's tipple and ovens, eighty-six in number, which are situated near No. 1 mine.

ROAD CAÑON MINE

Is a new opening, and is located three miles south of the Victor mine. The vein is six feet in thickness, and is opened by three separate drifts, with parallel air-courses. They have just commenced to ship coal, but will soon reach a capacity of 1,000 tons per day.

BLOOM MINE.

Located two miles south of Trinidad. Is opened by a drift; thickness of coal, six feet; capacity, twenty-five tons per day; output sold to local trade; natural ventilation.

BUTLER AND SPENCER MINE.

It is situated about two and one-half miles south of Trinidad; consists of a drift opening; thickness of coal seam, six feet; capacity, thirty tons per day; natural ventilation; output sold to local trade.

ANALYSIS OF COAL.

SOPRIS MINE, LAS ANIMAS COUNTY.

BY PROF. G. C. TILDEN.

Water	0.61
Volatile matter	33.18
Fixed carbon	57.56
Ash (brownish gray)	8.65
Total	100.00
Sulphur	0.75

VICTOR MINE.

BY PROF. R. CHAUVENET.

Water	1.26
Volatile matter	36.40
Fixed Carbon	53.10
Ash	9.24
Total	100.00
Sulphur	1.11

HUERFANO COUNTY.

ROUSE MINES.

Consist of three drift openings. They were put in operation about two and a half years ago, and now have a capacity of over 2,000 tons per day. All improvements in and around the mines are modern. The ventilation is produced by two fans, which propel a combined volume of 90,000 cubic feet of air per minute; the underground haulage is done by two tail-rope plants; two Ramsay box car loaders are used for loading the coal. The vein is about six feet in thickness; which is of good quality for domestic use. This property is owned by the Colorado Fuel Company.

PICTOU MINE.

Is situated about three miles north of Walsenburg, on a branch of the Denver and Rio Grande Railroad, and consists of three slope openings. There are two seams of coal about forty feet apart, measuring from five to six feet, six inches in thickness. The ventilation is produced by a fan 20 feet in diameter; capacity about 1,000 tons per day.

ROBINSON MINE.

This mine is situated in proximity to the Walsen mines, consists of a slope opening, the coal is about five feet, six inches in thickness; capacity about 500 tons per day; ventilated by a fan. This mine is also owned by the Colorado Coal and Iron Company.

SANTA CLARA MINE.

This mine consists of two openings on separate veins; ventilated by a furnace; capacity 500 tons per day. Is owned and operated by the Colorado Coal and Iron Company.

WALSEN MINE.

Is located one and a half mile from Walsenburg; is a slope opening; thickness of vein six feet; ventilated by a fan.

CAMERON MINE.

This mine is also opened by a slope on a three-foot vein, lower in the measures than the Walsen vein; the coal from both mines is hoisted by the same machinery; combined capacity of these mines is about 800 tons per day; are owned by the Colorado Coal and Iron Company.

ANALYSIS OF COAL.

FROM ROUSE MINE, HUERFANO COUNTY.

BY PROF. G. C. TILDEN.

Water	2.66
Volatile matter	36.71
Fixed carbon	51.41
Ash (light brown)	9.22
Total	100.00
Sulphur	1.373

ANALYSIS OF COAL.

FROM PICTOU MINE, HUERFANO COUNTY.

BY PROF. R. CHAUVENET.

	Lenox Seam.	Maitland Seam
Water	2.92	3.10
Volatile matter	41.18	38.12
Fixed carbon	45.36	48.58
Ash	10.54	10.20
Totals	100.00	100.00
Sulphur	1.39	2.04

FREMONT COUNTY.

ROCKVALE MINE NO. 1

Is situated at Rockvale; consists of a shaft opening three hundred feet deep; thickness of vein, three feet, six inches, and is worked very successfully on the "long wall" system; the roof is composed of heavy bedded sandstone; ventilation is produced by a "Murphy" fan, eight feet in diameter; capacity, 1,000 tons per day.

NO. 4 MINE

Is situated half a mile north from No. 1 mine, and is working the same vein, and under same conditions. The workings of both mines connect, furnishing communication as a means of ingress to and egress from the mines; capacity, 500 tons per day; ventilated by a fan; thickness of vein, three feet, six inches.

NO. 5 MINE

Consists of a slope opening; its location is one and a half miles south-east from Cañon City. The vein is six feet in thickness, and lies at an angle of from three to six degrees; ventilated by a fan; capacity, 600 tons per day. For some reason this mine has been idle during the greater part of the past year.

NO. 7 MINE

Is about two and a half miles in an easterly direction from No. 5 mine. This is also a slope opening; the vein is six feet in thickness, and lies at an angle of about six degrees; capacity, 1,000 tons per day; ventilated by a fan, twenty feet in diameter.

COAL CREEK NO. 1 MINE

Is situated at Coal Creek; is a slope opening; it has not been in active operation during the past two years, its output having greatly decreased from that of former years.

The vein is three feet, six inches; dip, three degrees; worked by room and pillar; capacity, 300 tons per day; ventilated by a fan.

COAL CREEK NO. 2 MINE

Is a little over half a mile, in a southerly direction, from No. 1 mine. It is also a slope opening; thickness of vein, three feet; worked by "long wall;" capacity, 500 tons per day; ventilated by a fan. This company, it is said, intends to sink a large shaft to the dip of their coal field, a depth of seven hundred feet.

CHANDLER CREEK MINE.

This is a new colliery, situated three miles north-west from Coal Creek, which has been opened and put in operation during the past year. It consists of a shaft sunk to a depth of 474 feet; thickness of vein, five feet, Another shaft is now being sunk, which will also be used as a hoisting compartment. The company now contemplates the erection of massive machinery and modern equipments as to insure a large output. The present capacity is about 100 tons per day.

PRENTICE MINE

Is a new opening, consisting of a shaft, situated about one mile east from Cañon City; depth of shaft, 120 feet; thickness of vein, 3 feet 6 inches; capacity, 75 tons per day. Output sold to local trade. Ventilated by a steam jet.

FLORENCE MINE

Is a new opening, situated near to Coal Creek, owned by the Cañon Fuel Company, who are now putting in a slope, and will soon commence shipping coal.

GUNNISON COUNTY.

BALDWIN MINE.

Union Coal Company. It is situated on the Denver South Park & Pacific Railroad, eighteen miles from Gunnison. The coal is reached by a shaft at a depth of 150 feet; thickness of coal is about four feet six inches, and lies at a dip of four degrees. This mine has been idle during the greater part of the past year, owing to the pass through the Alpine tunnel on the South Park being inaccessible for passage of trains. The ventilation is produced by a fan. Capacity, 500 tons per day.

ANTHRACITE MESA MINE

Is situated at the terminus of the Crested Butte branch of the Denver & Rio Grande Railroad. The vein is five feet in thickness; is a good article of anthracite; is opened by a drift at the extreme dip of the field, which point is at the elevation of about 800 feet above the valley, where a "coal breaker" of about 400 tons per day capacity, is situated. The coal is run to the breaker by a self-acting plane. The property is worked by the Colorado Fuel Company. During the past two years a great many improvements have been put in and around the mine for the economical working of the coal and the comfort of the miners, among which is the ventilating fan; also, a large building, consisting of bath rooms, reading rooms, etc. The company having spared no expense in providing for their miners' comfort. For such they deserve much credit.

CRESTED BUTTE MINE

Consists of a drift opening run in from the crop of the coal seam on the mountain side. The vein is about five feet six inches in thickness, and is a very fine quality of coking coal. The ventilation is produced by a ventilating fan twenty feet in diameter; the air courses are, throughout the mine, from

forty to sixty feet in area. The miners use exclusively locked safety lamps in all parts of the mine. Explosive gas generates to some extent in this mine. Capacity, 800 tons per day.

ANALYSES OF COAL.

GUNNISON COUNTY.

BY PROF. J. S. NEWBERRY.

Anthracite Coal.	Mesa Anthracite.	Irwin Anthracite.	Gunnison Upper Anthracite.
Moisture	1.56	2.77	0.09
Volatile matter	5.93	6.55	9.68
Fixed Carbon	88.77	84.81	81.93
Ash	3.75	5.87	8.30
Totals	100.00	100.00	100.00
Sulphur	0.48	0.79	0.547
Phosphorus	0.067	0.027	0.039

COAL CREEK.

Bituminous Coal.	Gunnison No. 1, 10 ft. thick.	Gunnison No. 2, 10 ft. thick.	Gunnison No. 3, 13 ft. 6 in. thick.
Moisture	3.803	4.93	5.23
Volatile matter	40.155	38.83	41.92
Fixed carbon	51.178	47.91	48.43
Ash	4.341	6.94	3.95
Sulphur	0.523	1.39	0.47
Totals	100.00	100.00	100.00
Phosphorous	0.029	0.054	0.080

COAL BASIN.

Bituminous Coal.	Claim E.	Claim H.	Out crop 20 foot seam.
Moisture	1.089	0.686	0.615
Volatile matter	36.647	32.682	23.532
Fixed carbon	52.956	56.036	67.030
Ash	8.981	10.140	7.993
Sulphur	0.834	0.454	0.558
Phosphorous	0.03859	0.142	0.011

CRESTED BUTTE.

BY C. A. GERHMANN.

Bituminous Coal.	Non-Coking No. 1.	Coking No. 2.	Coking No. 3.	Coke made from No. 3.
Moisture	6.53	1.17	1.94	0.05
Volatile matter	51.41	36.80	38.18	1.15
Fixed carbon	39.81	58.01	56.80	89.12
Ash	2.25	4.02	3.08	9.68
Totals	100.00	100.00	100.00	100.00
Color of ash	White	Red. brown	Salmon	Red. brown
Sulphur	0.437	0.454	not determined.	0.523

Anthracite Coal.	Warren's Semi-anthracite.	Slate Creek Anthracite.	Poverty Gulch Anthracite.
Moisture	0.64	0.72	3.47
Volatile matter	11.88	6.36	2.63
Fixed carbon	82.70	86.92	88.32
Ash	4.78	6.00	5.58
Totals	100.00	100.00	100.00
Color of ash	Red. brown	Red. brown	Red. brown
Sulphur	0.955	0.763	0.438

COAL BASIN.

BY R. C. HILL.

Bituminous Coal.	20 foot seam Upper Bench.	20 foot seam Middle Bench.	20 foot seam Lower Bench.
Moisture	1.9	1.1	1.9
Volatile mater	23.4	22.1	20.6
Fixed carbon	71.1	72.3	73.0
Ash	3.6	4.5	4.5
Totals	100.0	100.0	100.0

BOULDER COUNTY MINES.

STANDARD MINE.

This mine is located at Canfield, and is owned by Wise Brothers, who have 900 acres of land in that vicinity. Depth of shaft, 104 feet; thickness of vein, four feet; dip five degrees in an easterly direction. Capacity 150 tons per day. This mine was inspected last, on September 10, and was found in poor condition; ventilated by a fan.

JACKSON MINE

Is owned by the Jackson Coal Co.; has 160 acres of land; the vein is five feet in thickness; is mined by Harrison mining machines; depth of shaft, 130 feet; capacity, 290 tons per day. The mine has been idle during the greater part of the last year; ventilated by a fan.

DAVIDSON MINE.

Located two miles north from Louisville, is worked on lease by Geo. Prince and C. W. Shelly; thickness of vein, two feet six inches; dip fourteen degrees in a westerly direction. The output is sold to local trade; natural ventilation.

HECLAR MINE.

This is a new mine, the shaft has just reached the coal, which is six feet in thickness, and dips six degrees in a southerly direction; shaft is 145 feet deep; is situated about one and a half miles north-east from Louisville; the company is now erecting the machinery.

MARSHALL MINE NO. 2

Is at Langford, is a drift opening; thickness of vein, seven feet; capacity, 150 tons per day; dip of the measures, five degrees in a south-easterly direction; natural ventilation.

MARSHALL MINE NO 5.

This is also a drift opening; thickness of vein, nine feet; dip in an easterly direction six degrees; capacity, 250 tons per day. This company controls 3,200 acres; is ventilated by a fan.

FOX MINE.

A new slope has been sunk during the last year; thickness of vein is ten feet, which dips four degrees in a south-easterly direction; capacity, 200 tons per day; company own 160 acres; ventilated by a furnace.

BAKER MINE

Is a slope opening; thickness of vein, twelve feet; capacity, 100 tons per day; dip fifteen degrees in a north-westerly direction; ventilated by a furnace.

GARFIELD MINE.

Depth of shaft, 114 feet; thickness of vein, five feet; ventilated by a fan. Was found poorly ventilated when last inspected; capacity, 200 tons per day.

STAR MINE

Is a shaft opening, and is situated at Canfield. Depth of shaft, 105 feet; thickness of vein, four feet nine inches; capacity, 200 tons per day; ventilated by a fan.

MCGREGOR MINE.

Depth of shaft, 108 feet; thickness of vein, four feet six inches; ventilated by a fan; capacity, 200 tons per day.

CLEVELAND MINE.

Depth of shaft, 96 feet; thickness of vein, four feet six inches; ventilated by a fan; capacity, 200 tons per day; dip five degrees in a westerly direction.

STEWART MINE

Is ventilated by a fan; depth of shaft, 104 feet; thickness of vein, four feet six inches; capacity, 300 tons per day; dip five degrees in south-westerly direction.

SIMPSON MINE NO. 1.

Depth of shaft, 240 feet; thickness of vein, fourteen feet; capacity, 350 tons per day; a ventilating fan is in course of erection; the coal is mined by "Harrison" mining machines.

SIMPSON AND SPENCER MINE.

Depth of shaft, 236 feet; thickness of vein, 14 feet, and is also mined by "Harrison" machines; capacity, 500 tons per day. This mine has been put in operation during the last year. The plant is modern in every respect, being the best equipped mine in Boulder county. The hoisting and dumping appliances are capable of handling 800 tons per day.

CANNON MINE.

Depth of shaft, 240 feet; thickness of coal, 14 feet, which is divided with a stratum of slate, in places so thick that but one-half of the vein is worked; capacity, 500 tons per day. The coal is mined by the "Chouteau" mining machines; ventilated by a fan. This mine has but one shaft, through which is the only means of ingress and egress to and from its workings. On 15,000 square yards being excavated, I notified the company that in accordance with the mining law, a second opening should be made. On

consulting the Attorney-General on the matter, he informed me the company had one year in which to complete the second opening. The company is now running a communication entry to connect with the Simpson and Spencer mine No. 2. There are fifty men at work in the mine.

EXCELSIOR MINE.

Depth of shaft, 227 feet; thickness of vein, 14 feet; capacity, 500 tons per day. The coal is mined with "Harrison" mining machines; ventilated by a fan. This is a new mine.

GLADSTONE MINE.

This is a new mine, and not yet in operation, but preparations are being made to operate soon. Depth of shaft, 230 feet; thickness of vein, 8 feet.

MARSHALL SHAFT

Is situated one mile, in a north-easterly direction, from Louisville. Depth of shaft, 201 feet; thickness of coal, 3 feet 8 inches. A level is run in on the vein from the shaft to a distance of 1,100 feet, where the coal is 5 feet 8 inches. The mine has been equipped for some time, but owing to the smallness of the vein, operations have not been followed. It is expected that work will soon be commenced as a producing mine. The hoisting engines are a pair of double cylinders 12x36 inches, one Norwalk compressor 24x36 inches. The coal will be worked by machinery.

MARSHALL SLOPE

Is located about half a mile east from Louisville. The slope is run down on the vein, which lies at an angle of 35 degrees, cropping out on the surface and running parallel with a "fault" or dislocation, which has tilted the strata from a horizontal position to the above dip. At the face of the slope the dip is becoming less. Capacity, 200 tons per day.

AJAX MINE

Is located three-quarters of a mile from Louisville, in a south westerly direction. Depth of shaft, 152 feet; thickness of coal, 4 to 6 feet, which is inter-stratified with a seam of slate; capacity, 250 tons per day. When last inspected, August 11, the workings were rather poorly ventilated; natural ventilation.

ACME MINE

Is in proximity to Louisville. Depth of shaft, 120 feet; ventilated by a fan. The coal is mined by Harrison mining machines; capacity, 500 tons per day.

CALEDONIAN MINE

Lies a little north-west from Louisville. Depth of shaft, 107 feet; thickness of vein, 6 feet; capacity, 350 tons per day. The ventilation was found poor, on a recent inspection; otherwise the mine was in good condition.

ALLEN AND BOND MINE.

This is a slope opening, and has very recently been put in operation in a small way. The vein is 14 feet in thickness, but is divided with a stratum of fire-clay 2 feet 6 inches. The bottom bench of coal is 4 feet. Ventilated by a furnace. Production is sold to local trade.

ANALYSIS OF COAL.

FROM SIMPSON AND SPENCER MINE, BOULDER COUNTY.

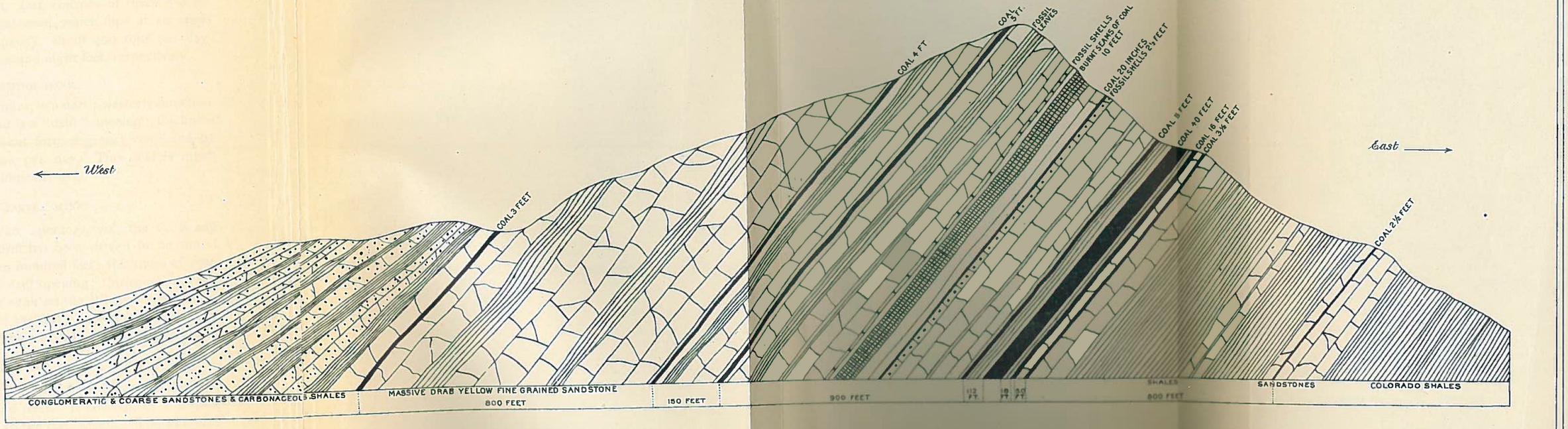
By Prof. R. Chauvenet.

Water	12.01
Volatile matter	35.19
Fixed carbon	46.24
Ash	6.56
Total	100.00
Sulphur	1.00

Section of Strata Passed through in Sinking the Acme Shaft.

Names of Strata	Ft.	In.	Intervals depth.
Surface clay & Gravel	19		
Sand and Gravel	10		
Coal	1		29
Arenaceous Slate	20		
Alternate layers of Coal and Slate	2		
Soapstone and Argilaceous Slate	28	4	
Soapstone	26	9	
Coal	4	6	107 1
Slate	2		113 7
Coal	7		120 7

Geological Section of Coalmeasures at Newcastle, Colo.



GARFIELD COUNTY.

MARION MINE

Is situated about two miles, in a north-westerly direction, from Spring Gulch, and consists of three "drift" openings, run in on the coal seam, which dips at an angle of about 45 degrees; capacity, about 400 tons per day; thickness of veins, four, six and eight feet, respectively.

SUNSHINE MINE

Is situated about five miles, in a north-westerly direction, from the Marion mine, and is a "drift" opening; thickness of vein, seven feet; dip about forty degrees; ventilated by a fan; capacity, 450 tons per day. This coal is much prized in the market for domestic use.

NEW CASTLE MINES

Consist of three separate openings, viz., the C, E and Wheeler veins. A new drift has been driven in on the C vein to a distance of seven hundred feet; thickness of coal, six feet; vein E is also a drift opening; thickness of vein, five feet; a slope is being sunk on the Wheeler vein, and is now down to a distance of 375 feet; thickness of vein, forty feet, seven of which is being worked; ventilated by a fan.

COAL RIDGE MINE

Is situated about nine miles west from Glenwood Springs, on the south side of Grand river. It consists of a tunnel, driven in at right angles to the coal seams. The entrance of the tunnel is situated about 1,000 feet above the base of the "hogback," and is driven through to the other side of the ridge, a distance of about 1,000 feet. It is eight feet wide and eight feet high. The strata and coal seams passed through, are shown in the accompanying diagram. On the east side of the tunnel, toward Pinion Basin, openings are made on the crop of the vein, their output passing through

the tunnel, connecting with a self acting plane, over which the coal is run down to the "tipple" and railroad below. The capacity is about 1,000 tons per day. The same series of veins exist here that are found in the New Castle mines, and the crop of the larger veins can there be found at Coal Ridge.

ANALYSES OF COAL.

GARFIELD COUNTY.

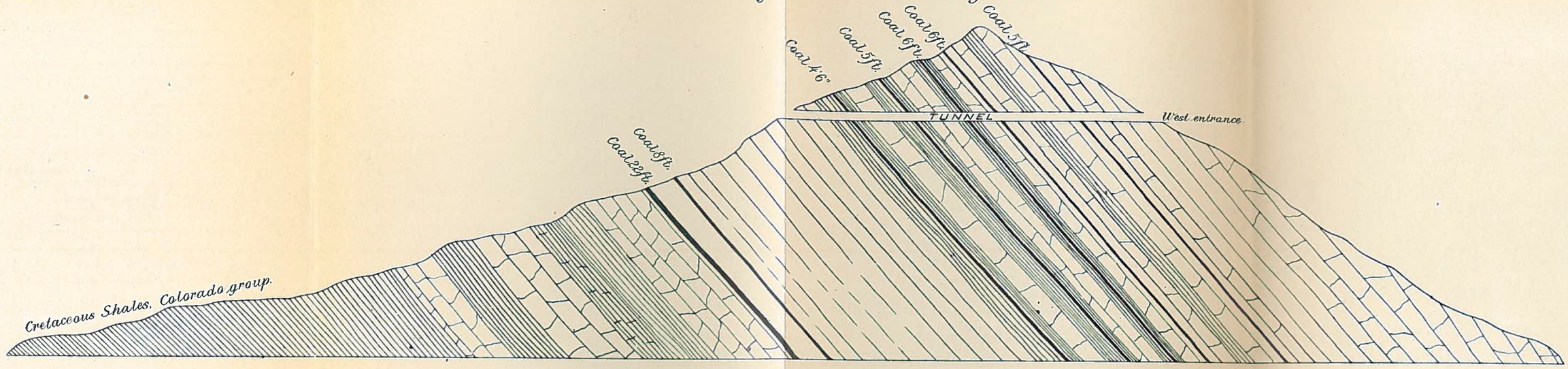
NEW CASTLE MINES.

BITUMINOUS COAL.	D SEAM. 5 FT., 6 IN.	F SEAM. 18 FEET.	E SEAM. 45 FEET.
Water	2.98	2.21	1.85
Volatile matter	42.25	39.10	41.58
Fixed carbon	50.09	49.73	48.60
Ash	4.68	8.96	7.97
Totals	100.00	100.00	100.00
Sulphur	1.022	0.832	0.609

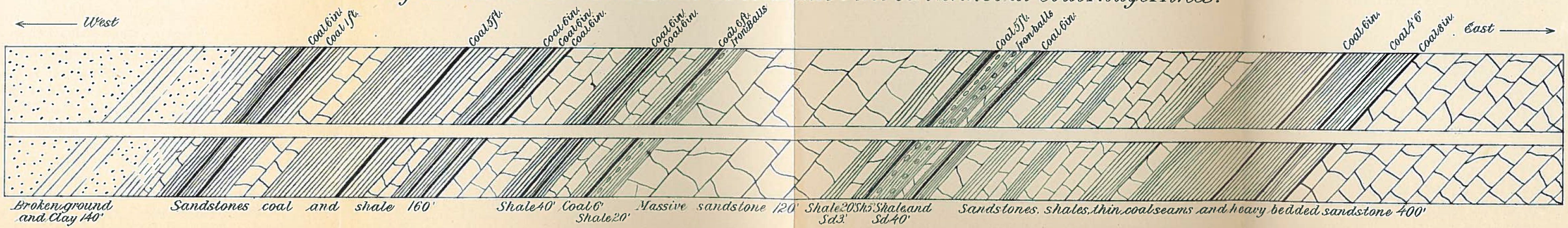
MARION MINES.

BITUMINOUS COAL.	NO. 1 SEAM.	NO. 2 SEAM.	NO. 3 SEAM.
Water	2.07	2.17	2.30
Volatile matter	39.67	39.51	35.67
Fixed carbon	55.19	51.72	56.71
Ash	3.07	6.60	5.32
Totals	100.00	100.00	100.00
Sulphur	0.916	0.602	1.521

Section of Measures through hill.



Section of Strata and Coalseams cut in Colorado Fuel Co's tunnel at Coal Ridge Mines.



COAL RIDGE MINES.

BITUMINOUS COAL.	NO. 1 SEAM SULPHUR GULCH.	NO. 2 SEAM SULPHUR GULCH.
Water	5.29	5.14
Volatile matter	40.70	40.14
Fixed carbon	49.73	51.46
Ash	4.28	3.26
Totals	100.00	100.00
Sulphur	0.546	0.580

SUNSHINE MINES.

BITUMINOUS COAL.	SUNSHINE LOWER GANGWAY.	SPRING GULCH NO. 1.	SPRING GULCH NO. 2.
Water	3.40	1.26	1.77
Volatile matter	40.32	36.95	34.63
Fixed carbon	48.82	54.89	57.24
Ash	7.46	6.90	6.36
Totals	100.00	100.00	100.00
Sulphur	——	1.216	1.018

PITKIN COUNTY.

SPRING GULCH MINE

Is operated by the Grand River Coal and Coke Company, and is situated at the terminus of the Jerome Park branch of the Colorado Midland Railroad; is a slope opening from which two veins are worked, one 5 feet 6 inches in thickness, the other being 4 feet. Three seams crop out here, named, respectively, "A," "B," and "C." "A" is 12 feet, "B" is 5 feet 6 inches, and "C" 4 feet. "C" is the top vein. The three seams lie about 50 feet apart. The dip is about 45 degrees; capacity about 400 tons per day. The greater portion of the output of this mine is made into

coke at the company's ovens, 200 in number, situated at Cardiff, Garfield county, 16 miles south from Spring Gulch mine.

PARK COUNTY.

COMO MINE NO. 1.

Union Coal Company. On June 11, 1889, about two o'clock p. m., the timbers in the air-course, parallel to the main slope, at a point 150 feet from the surface, took fire. It appears that two men were engaged putting in timber, and had retimbered the air-course throughout down to the point above stated, where the pillar between the slope and air-course was only two feet in thickness, and was even broken in places, through which the fire ignited the slope timbers. About two p. m. the men went to the surface for a supply of timber, and on returning, twenty minutes later, they were astonished to find the timbers on fire, but how the same had been ignited never could be ascertained.

Mr. King, superintendent, and Mr. Ramsay, pit-boss, were on the ground, and Ramsay immediately went down the air-course and undertook to throw what little water he found running down the air-course on the burning timbers, but the current of air being great, the fire made such rapid progress the water had no effect in extinguishing the fire. They then had a line of hose run from the boiler tank, but it was too short to reach the fire. They soon had a bucket-line formed and got down the course, but the timbers gave off such intense heat that it changed the air-current from a down-cast to an out-cast, thus they were driven from the air-course, and it was with difficulty that some of the workmen reached the surface, being nearly overcome with the gases from the fire.

From the first, the smoke was so thick and the heat so intense that it was impossible to get the workmen from

below by way of the slope; fortunately, however, the second opening prescribed by law was in good condition, and *all* the men, after some hard climbing up a 45-degree pitch, reached the surface in safety.

The pumps in the mine were left running so as to furnish water to fight the fire. The main pumps, however, stopped working thirty minutes after the men left the mine, and it was impossible to return. Being out of water, the superintendent had the mine closed up at all points to isolate the air from the fire, and turned in the capacity of steam from the boilers into the air-course. Next day, after getting a good supply of water, hose and pumps, the mine was re-opened and another fight on the fire made. For a time all went well, and just when their efforts were about to be crowned with success the valve rod of the pump broke. In forty-five minutes afterwards the flames burst from the mouth of the slope forty feet in the air. To save the numerous buildings in proximity to the fire they were obliged finally to cave in the slope and air-course with giant powder. After this *all* openings were tightly closed and steam turned into the slope through a 3-inch pipe. The mine has never since been re-opened. This is the second time this mine has been ruined by fire. The first fire occurred in 1886, and was caused by spontaneous combustion in the "gob." The mine then was allowed to fill up with water, which was the cause of *great damage* and cost the company about $50,000, it is said, to put the mine in working condition, which no doubt discouraged them from again undertaking the re-opening of the workings in 1890. The vein is 7 feet in thickness, and lies at an angle of 45 to 50 degrees; was worked by "stopes" from the main levels; capacity of the mine was 250 tons per day.

COMO MINE NO. 5

Is opened by a slope. The vein is from four to six feet in thickness; dip about forty degrees; ventilated by a fan; capacity, 350 tons per day. Owned by the Union Coal Company.

COMO NO. 6.

A new opening on a vein four feet in thickness, and is situated about two miles, in a southerly direction, from No. 5. The slope is down on the vein 250 feet; the dip is about thirty-five degrees.

WELD COUNTY MINES.

BROWN MINE

Is situated about two miles from Eaton, in a north-easterly direction. Depth of shaft, 73 feet; thickness of coal, three feet, which dips three degrees in a south-easterly direction; ventilated by natural means; hoisting done by horse power; output sold to local trade; work but two or three men. The mine has no railroad connection.

A. S. EATON MINE.

Located two and one-half miles north-east from Eaton. Depth of shaft, 62 feet; thickness of coal, three feet eight inches, and dips three degrees in a south-easterly direction; hoisting done by horse power; output sold to local trade; work three men; the mine has no railroad connection.

COAL DRAW MINE

Is seven miles north-west from Eaton. Is a slope opening; thickness of coal, two feet ten inches; work only a few men. Production sold to local trade. Mine has no railroad connection.

MITCHELL MINE

Is situated on the Burlington & Missouri Railroad, in the Erie district; shaft opening; thickness of vein, 5 feet 6 inches; ventilated by a fan; capacity, 400 tons per day. Company owns 500 acres.

BOULDER VALLEY EXTENSION MINE

Is in proximity to the town of Erie. Depth of shaft, 65 feet; vein, 7 feet, 6 inches; is divided in the center by a stratum of fire-clay, 3 feet in thickness, which is said to be of a good quality for brick making, etc; capacity of coal, 150 tons per day.

LA PLATA COUNTY.

LA PLATA COAL COMPANY'S MINE

Is situated two and one-half miles in a south-easterly direction from Durango. It consists of a tunnel opening which is driven through rock for some 200 feet and intersects three veins of coal, named respectively the Jumbo, the Fairmont and the Porter La Plata. The dip of those veins is about thirty-six degrees, and are from three to eight feet thick, but are interstratified with seams of "slate" and "bone." A very good class of improvements have been made with a view of handling a large output. The company own their side track from the main line, and also run their own locomotive. F. K. Atkins, of Denver, is vice-president; F. O. Blake, of Durango, is general manager. This mine is ventilated by a fan.

SAN JUAN MINE.

This mine is situated half a mile south-west from Durango. The vein crops out upon the mountain side on an incline of about 2,000 feet from the base; the vertical height gained in this distance is a little over 800 feet. The coal seam is three and a half feet in thickness and lies at a regular dip of five degrees. The coal is run down a self-acting plane to the railroad.

THE PORTER MINE

Is situated a short distance from Durango. The coal is about three feet in thickness, and is overlaid with sandstone. It is of a good coking quality. Some improvements and development has been made during the year, and it is said that the mine will soon have railroad connection. There are various other openings along the crop of the veins which produce a few tons of coal to local trade.

ANALYSES OF COAL, LA PLATA.

PORTER MINES.

BY PROF. G. C. TILDEN.

BITUMINOUS COAL.	Porter Seam No. 1.	Peacock Seam No. 2.	Graden Seam No. 3.
Water	0.63	2.49	2.94
Volatile matter	34.70	34.31	35.63
Fixed carbon	57.30	51.98	50.65
Ash	7.37	11.22	10.78
Totals	100.00	100.00	100.00
Sulphur	0.737	1.68	1.53

LA PLATA MINE.

BITUMINOUS COAL.	Fairmont Seam, upper section, 4' 8".	Fairmont Seam, lower section, 4' 6".	Porter La Plata Seam.
Water	1.21	1.30	1.11
Volatile matter	39.72	39.70	36.54
Fixed carbon	51.02	54.78	51.69
Ash	8.05	4.22	10.66
Totals	100.00	100.00	100.00
Sulphur	.....	.....	1.450

BITUMINOUS COAL.	San Juan mine.	Carbonero mine.
Water	1.12	1.16
Volatile matter	37.30	34.33
Fixed carbon	54.69	52.69
Ash	6.89	11.82
Totals	100.00	100.00
Sulphur	0.864	1.22

JEFFERSON COUNTY.

WHITE ASH MINE

Was inundated by water breaking in from the old Loveland mine, on the ninth of September, 1889. Depth of shaft, 730 feet; thickness of vein, from 7 to 8 feet; angle of dip, 85 degrees to perpendicular.

NORTH WHITE ASH

Has been opened during the past year, and is situated about one mile north-west from Golden; depth of shaft, 325 feet; thickness of vein, 4 feet; capacity, 75 tons daily; the output is sold to local trade.

GOLDEN CO-OPERATIVE SHAFT

Is situated one and a half miles north from Golden. Depth of shaft, 130 feet; thickness of vein, 10 feet; angle of dip, 80 degrees; capacity, 25 tons per day.

ROCKY MOUNTAIN NO. 1

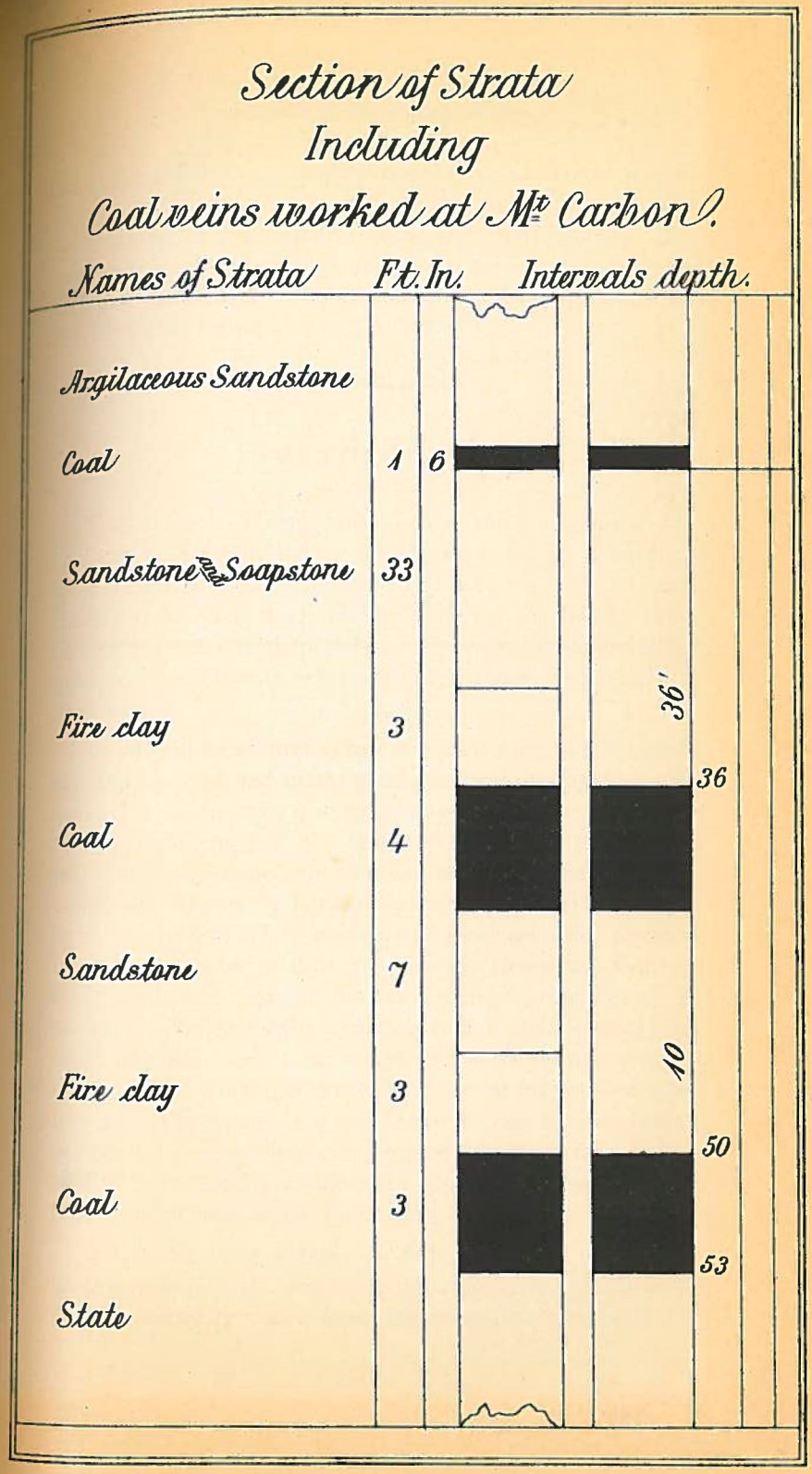
Is situated two and one-half miles from Golden in a northerly direction. Depth of shaft, 175 feet; thickness of vein, 4 feet; angle of dip, 85 degrees.

ROCKY MOUNTAIN NO. 2

Located three miles north from Golden. Depth of shaft, 175 feet; thickness of vein, 4 feet; angle of dip, 80 degrees. The above three mines belong to Church Brothers, who have in the vicinity of the mines, a large brick-work, where they manufacture a fine quality of pressed brick. The output of the mines at present is principally used at the company's brick works.

MOUNT CARBON MINE

Is located south-west from Denver, on the Morrison branch of the Union Pacific Railroad. The veins there are



an extension of those worked near Golden. There are two veins worked, three and four feet respectively; also, a vein of fire-clay, of good quality, three feet in thickness. The coal output is sold principally to local trade; the fire-clay is shipped to Denver brick yards. This property is owned by Benjamin Prince.

VENTILATION.

The subject of ventilation is the most important one that can be brought before mining men, for in connection with it depends the health and in cases the lives of men. Therefore as such it should be carefully studied by those having entrusted to them the practical management of either coal or metalliferous mines—though more particularly in coal mining.

It will not be assuming too much for me to state that in my experience I find many good practical mining men who remain in the mist, as it were, relative to the science of ventilation, believing that they must first reach a standard in mathematics as to be able to solve the algebraical problems, which are frequently noticed in connection with the subject. Such a belief is certainly a great mistake, for in a very short space of time the average foreman of mines could sufficiently master the fundamental principles as to be able to scientifically ventilate mines after systems the most improved and best suited to the safety and general health of the workmen, and also the best interests of mine owners. There are a great many works in circulation, written by able mining men, any of which would be valuable to those having ambition to educate themselves in the principles of ventilation and mining in general.

It is of course necessary, in order to enable one to ventilate underground workings with any degree of efficiency and economy, to understand the principles governing the

atmosphere, and fundamental rules relating to pneumatics, so far, at least, as the same applies to currents of air, rest and motion.

The atmosphere is an invisible gaseous matter, surrounding the earth, distinguished by the name of air. Its composition is about 79 measures of nitrogen gas, 20.96 of oxygen gas, 00.04 of carbonic acid, and a truce of water. It is an elastic fluid, and exerts pressure upon the earth, or any substance on which it rests, and, like all other bodies, has weight. In many text-books the height of the atmosphere is given as being about 45 miles, but from the observation of luminous meteors, whose true character as cosmical bodies was established a few years ago, it is inferred by good authority that the height of the great sea of air is as much as 120 miles, and that, in an extremely attenuated form, it may even reach 200 miles. The pressure of this vast column of air, at sea level, is about 14¾ pounds per square inch, but diminishes in density as we ascend to high altitudes. The weight of air, loss in density and the altitudes of two given points, can be determined by the barometer. Though this instrument is of simple construction, and nothing very technical relative to its readings, yet there are many who fail to understand it, and a simple explanation of its construction and working may not be out of place here, seeing that its association with the ventilation of mines, if properly understood, would be valuable. If a piece of pipe, 36 feet long, with a stopper at one end, is filled with water, and the stopper end placed in a tub of water, then remove the stopper, the water inside the tube will fall until it reaches the height of 34 feet above the face of the water in the tub, and would then remain still, for the reason that the atmospheric pressure above stated would be pressing directly on the face of the water in the tub, which would support the weight of the water in the pipes, thus furnishing for us a crude barometer. Now, as a water barometer would be a very unhandy instrument for convenience, another liquid is taken, namely mercury

which is practically 13½ times as heavy as water. Therefore, 34÷13.5 equal, say, 2′ 6″; thus, the reason that mercury is taken to fill the tube of a barometer, is obvious. The mercurial tube is filled, and placed in a vessel containing a quantity of mercury by the same process, and acting in the same way as that described in the case of the tub and column of water in the pipe. A cubic inch of mercury (under ordinary temperature) weighs .4908, which is taken as a constant multiplicand in finding the pressure of the atmosphere. For example, if the height of the mercury registered 27.5 on the graduated tube, then 27.5×.4908=13.49 pounds pressure. The average barometical column, at sea level, is about 30 inches, but varies somewhat in its readings from light and heavy atmospheres. It also varies a little with the rise and fall of the thermometer, the barometer falls one inch on 872½ feet of ascent, thus, in such a distance, we lose .4908 pounds atmospheric pressure, or, practically speaking, one-half pound for each 900 feet. The elasticity of the atmosphere is noticed by the way it expands and contracts, when subjected to pressure, heat and cold. The mean pressure, as before stated, is 14¾ pounds, which is the elastic force of one atmosphere. But, if a cubic foot of this air be put under a pressure of 29½ pounds to the square inch, it will be compressed into one-half its former volume when it would be under a pressure of two atmospheres; if under a pressure of three atmospheres, it will be reduced to one-third, and if under a pressure of four atmospheres, it would occupy but one-fourth of its original space. Air is 813.67 times lighter than water, yet air can be compressed to such a degree that its weight would equal water, the necessary pressure being 5½ tons per square inch, but the moment the pressure is removed the air will expand and become again equal to one atmosphere. Thus, it will be seen, that the elasticity of air is greater than other material substances.

The principal gases found in coal mines are chiefly nitrogen, oxygen, carburetted hydrogen, carbonic acid, carbonic oxide, and sulphuretted hydrogen. The specific gravity of nitrogen is .9703, being a trifle less in weight than air; it is noted for diluting and modifying the oxygen. Though resembling air in its general properties, it is easily distinguished from it by its not supporting combustion; in the case of respiration, however, this particular diluant seems to be essential; no animal could live healthily for any considerable period of time in pure oxygen, and no other diluant known to chemistry could be substituted for the nitrogen, without producing poisonous effects.

Oxygen, as before stated, forms 26.96 per cent. of the atmosphere; its specific gravity is 1.105, being a trifle heavier than air; it is noted for premoting combustion and respiration, and when the percentage of oxygen diminishes, the air becomes injurious to health. Dr. Angus Smith, who has given much attention to the subject, gives the following figures, showing the volume per cent. of oxygen: sea shore of Scotland, 20.99; tops of Scottish hills, 20.98; in sitting rooms, feeling close but not excessively so, 20.89; backs of houses and closets, 20.70; in metalliferous mines, 20.424; when candles go out, 18.50; when it is very difficult to remain in the air many minutes, 17.20. I have personally detected in high places in the mines of Coal Creek, Fremont county, and the New Castle mines in Garfield county, of this State, gas which extinguished the light of my lamp and produced a feeling of suffocation, the cause of which I attribute to a low percentage of oxygen, thus, leaving a part of the nitrogen in a free state, and being somewhat lighter than air; it lay next the roof, and doubtless it was free nitrogen which extinguished the light and produced the feeling above stated. I am of the opinion that the fatal accident which occurred to a miner named John Smyth, in the New Castle mine, Garfield county, was caused by this gas. He had been up in his chute but a short time when he fell to the bottom of it dead.

CARBONIC ACID GAS.

The specific gravity of this gas is 1.524, or one-half heavier than air (under one atmosphere); is composed of 28 parts carbon and 78 oxygen, and is produced in mines by the breath of persons, combustion of lamps, explosions of powder and the fermentation of animal and vegetable substances. This gas is very injurious to health when diffused in the air beyond its due proportion, and according to Dr. Angus Smith, he found the air at the following places contaminated, thus: In the London parks, it was .0301; on the Thames, .0343; in London streets in summer, .0380; during fogs in Manchester, .0679; in overcrowded workshops it rises to .3000; in the worst part of theaters, .3200; and in Cornwall mines, 2.5000 per cent. In all coal mines it exists to a greater or less quanty, but in badly ventilated mines it is found to a serious degree. It is a poisonous gas and endangers life when the air contains 8 per cent. of it, and about the same percentage will extinguish lights. When this gas forms from one to two parts of the air, its effects cause headache, languor and a general depression. Its weight being heavier than air, it is therefore found in its purest state in low places.

In the mines of the Erie district, before ventilating fans were introduced, I have found it necessary in badly ventilated parts, to hold my light near the roof where the air was less diffused with it, thus enabling the combustion of the light to continue, but on lowering the light near the floor it was immediately extinguished, and at such a point for the same reason matches could not be ignited, and life itself could only have existed a short time in air contaminated to such a degree. A painful accident occurred in an old shaft in this district, which was quite shallow, yet contained near the bottom to an excessive degree, this poisonous gas. The man seeing a few joints of stove pipe lying at the bottom, which had evidently been used for ventilating purposes when the shaft had been in operation, went down on the timbers for the purpose of securing the pipe, but on

reaching the bottom he was overcome with the gas and soon died. A great many accidents have occurred through the effects of carbonic acid gas, which could have been prevented if miners would only use a little precaution. The average miner well knows that this gas (known by them as "black-damp,") is invariably in old shafts; worked out and abandoned portions of mines, and when necessary to enter such places, a light should be first lowered into the shaft before any one descends, and even should the light burn, it is well to throw a few buckets of water down.

Carbonic oxide (unlike carbonic acid), will burn in the air or oxygen, with a blue flame, forming carbonic acid. It is an extremely poisonous gas, being capable of displacing the oxygen in the blood, owing to the formation of a compound with the hexoglobin with which the oxygen is ordinarily combined. Its effects on animal life are much more deleterious than that of carbonic acid. Air containing 8 or even 10 per cent. of carbonic acid, can be breathed for a short time without very serious effects, but the inhalation of air containing a much smaller amount of carbonic oxide acts almost instantly upon the system as a narcotic, which will soon produce unconsciousness and result in death unless restorative measures are at once taken. This gas is frequently met with in some of the mines in Boulder county, where the fine coal and debris in the "gobs" are subject to spontaneous combustion, and where a large amount of blasting powder is used in blasting the coal. Probably one of the worst features of this gas is that there is no trustworthy method of detecting it, for a lamp will burn amidst a deadly atmosphere. It is composed, by weight, of 57 per cent. oxygen and 43 per cent. of carbon; its specific gravity is 9.76. It is well for a miner to expect the presence of this gas when blasting in coal or rock, especially when the quantity of powder has been unable to remove the coal or rock intended. Sulphuretted hydrogen, (H_2S) is a colorless gas, and like carbonic oxide, a light will burn well in an atmosphere capable of causing serious results.

Its effects produce sickness, giddiness and loss of feeling, but is not considered so fatal as carbonic oxide. It can be detected easily by its disagreeable smell, even when in very small quantities. It is found chiefly in old worked-out portions of coal mines, and more especially when partly filled with water.

It is generated by the action of oxygen dissolved in water with timber undergoing decomposition, and in many other ways in a mine. Carburetted hydrogen gas is the lightest of all known hydro-carbons. Its specific gravity is .555, or a trifle over half of the weight of air, and is composed of 75 per cent of carbon and 25 per cent. of hydrogen. It is found in greater or less quantities in most coal mines, and rises to the highest points of the workings, and must be searched for next to the roof and in displacements where "falls" have taken place. Its presence can not be detected in the air until it forms over 3 per cent. of its volume. By an experienced eye it can be detected on the light of a safety lamp when one part of the gas is mixed with twenty-five parts of air, the flame being surmounted by a bluish colored cap. When one to fifteen, it will explode and burn in a safety lamp; one to nine, is its most explosive mixture; one to seven, it is less explosive; one to four, it will not explode, but, to the contrary, it will extinguish lights. The light of the safety lamp is enclosed by a wire gause of 784 apertures to the square inch. When the lamp is brought into contact with "fire-damp" ($C.H._4$) the gas rushes through the fine wire gauze and immediately ignites and burns inside. The chill of the gauze prevents the flame from passing through to ignite the gas outside of it. It will be noticed that 3 per cent. of this death-destroying agent can be in the air and be harmless enough, too, so long as the current is sweeping around the workings, but let the ventilation be cut off for a time, causing a scarcity of air, while the same percentage of gas is emitting from the strata, and it will be seen that the mixture would soon reach an explosive point. Some serious explosives have

occurred in mines where little or no gas had ever before been detected, *i. e.*, not detected with a safety lamp, though in the same mines the air may have contained as much as 3 per cent. of carburetted hydrogen. Thus in all mines where gas has been detected, even in very small quantities, great care should be exercised relative to proper ventilation.

From the foregoing pages it will be noticed that the noxious gases met with in coal mines are many and varied, and demand close attention in keeping the workings well ventilated. A sufficient volume of air to properly ventilate the most extensive and gaseous mine is capable of being circulated through the workings by several modes, but chiefly by mechanical contrivances, the most modern and economical system being by the ventilating fan, which has many points in its favor over the furnace. In shallow mines, the furnace gives poor results, owing to the shortness of the heated column in the up-cast shaft, as the air heated in passing through the furnace scarcely ascends with any rapidity before reaching the surface, while to the contrary, a fan gives its best results in a shallow shaft, owing to the minimum amount of frictional resistance; thus, in our mines, which consist chiefly in drifts, slopes and shallow shaft openings, the fan is therefore the most effective, reliable, economical, safest and most convenient for propelling air in and around the workings. The ventilating current in a gaseous mine should *never* be produced by a furnace, for under the most favorable circumstances it is a source of danger, and should, in such cases, be prohibited by *law*, and the superintendent who would keep up with the times should prevail against their use in shallow shafts. The ventilating power of a furnace is the motive column or difference of weight of air in the down-cast shafts.

For every degree the furnace increases the temperature in the up-cast, the air will expand 1.459 of its volume; thus it can be readily seen that the current of air produced depends on the length of the heated column. The motive column is ascertained by dividing the difference of the

temperature in the intake and outcast shafts by the sum of 459 and the temperature of the outcast shaft, and multiplying the quotient by the depth of the intake shaft in feet. For illustration, we will assume the depth of the shaft at 500 feet and the temperature of the intake at 60° and the outcast at 115°, thus, $115 - 60 \div (459 + 115) \times 500$ feet$=47.9$ feet, which is the motive column.

The ventilating fans of different makers vary somewhat in their construction and detail, still their principal parts are about the same. The proportions of a well constructed fan are that the inlet through the fan be about one-half of its diameter, the vanes from one-fourth to one-third the diameter of the fan in size, which should be well braced and bolted to angle iron, forming "vanes" and squares connecting with the "spiders," leading from the "hubs" on the shaft. I have noticed some annoyance arising from weak shafts, in various fans, but more particularly in connection with the "Murphy" fan. Fans are, in emergencies, run at a higher velocity than probably intended by the maker, thus a little added to the diameter of some fan shafts is necessary. Fans should be placed a short distance to one side of the air shaft, and should be so situated and constructed under such conditions as will insure them, as far as possible, from destruction by fire or explosion. The fan itself, if properly built, is reasonably safe from disarrangement, and stoppage from it is not likely to occur, but the engine furnishing the power to propel it, being liable to breakages, a duplicate engine should, at all gasous mines, be kept in reserve with steam fittings and other connecting parts in readiness, so that one engine could be attached to the crank-shaft of the fan without delay when the other gives out.

In the eyes of the experienced, nothing could more readily display the lack of sufficient knowledge in a foreman, relative to the subject of ventilation, than to find small neglected air-ways; numerous trap doors conducting the entire volume of air around and throughout the work-

ings of an extensive mine, in one division, thus subjecting the current to such a degree of frictional resistance that it takes the major portion of the ventilating power applied to overcome counteracting forces, even though they may have in circulation a fairly good current of air.

The improved system of ventilation in splitting the air, and reducing the length of air-courses, is a subject of great importance and should receive close attention by mine foremen. There should never be less than two parallel entries, and for each person employed, 100 cubic feet of air per minute should be the minimum quantity of air found circulating through the workings of a non-gaseous mine; but in mines generating explosive gas, as much as 500 cubic feet for each person may be necessary to render the emitting gases harmless. Sudden outbursts of gas sometimes in mines occur. Such, however, in this State are rare, and when they do occur it is to a slight degree. In such mines, the exclusive use of the safety lamp should be followed. The variations of the atmosperic pressure exert an influence on the pressure of the gas emitting from the strata, and though meterological instruments may be used to a degree, and warnings furnished by them from light and heavy atmospheres, yet it is not safe to put too much reliance in them. Carburetted hydrogen is much more sensitive to a light atmosphere than the barometer, and may be found emitting profusely from the strata some time before any fall in the barometer is perceptible. It is much safer at all times to depend on frequent inspections, strict discipline in carrying out the rules of the company, due vigilance on the part of well-informed, sober foremen, competent fire-bosses and a perfect system of ventilation. Those are the better safeguards, at all times.

NEW COAL FIELDS.

But very little has been said and doubtless but very little known relative to the Mount Gunnison coal fields, which is situated between Mount Gunnison, Beckwith and Guero, on Coal creek, located geographically between longitude 107° 15′ and 107° 30′ west, and latitude 38° 45′ and 39° north, in Gunnison county, Colorado.

During the summer of 1890, I made an inspection of this field, and was greatly pleased to find in it as valuable a coal property for its size as I have ever seen.

The coal bearing territory of this district may be said to occupy an area of about 25 to 30 square miles, which is surrounded by high mountain ranges. The delineation or contour of the lands along the abrupt banks of Coal creek, and the gulches running through the property are such as to disclose to view the various coal seams.

My examination commenced at a point on Coal creek, about 2¼ miles north or below the junction of Coal and Cliff creeks. Here at water level, on the east side of the creek is disclosed a coal vein 5 feet, 4 inches in thickness, exposed to view along water grade for a distance of 150 feet, and notwithstanding the action of the water and weather upon it for years, the coal retains a bright lustre, is compact, hard and without any trace of impurities. The roof over the coal consists of laminated sand-stone, making a good roof for economical mining; the floor consists of gray argilaceous slate. The strata lies nearly horizontal, a slight dip being perceptible in a northerly direction. In quality this coal is equal, if not superion to the celebrated Cañon City coal.

For convenience, and to be intelligently understood in describing the numerous coal veins, I will begin by classing the above as vein "A," and follow southward up Coal

Creek, noting the location of each vein in its order, alphabetically.

VEIN "B."

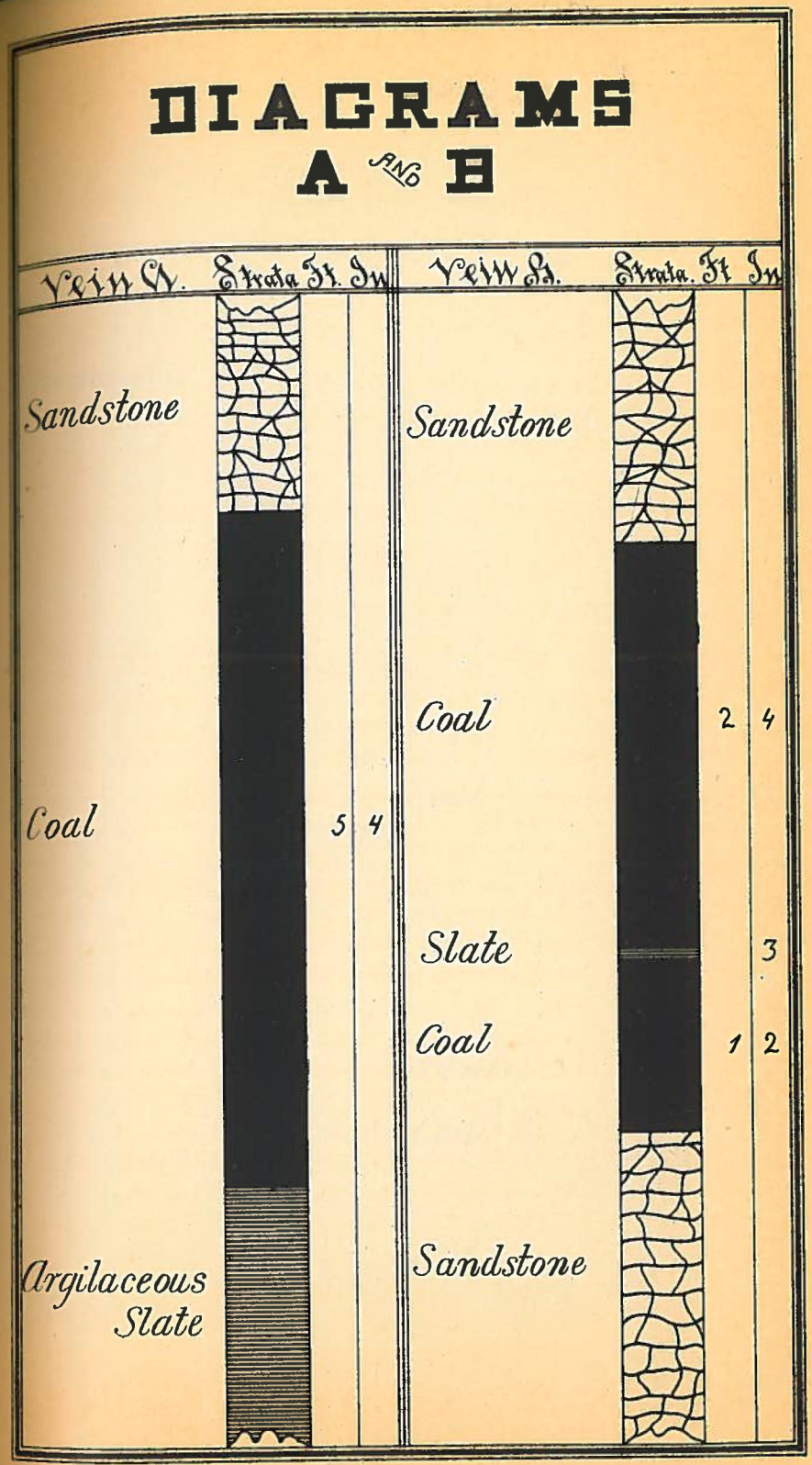
At a vertical distance of 50 feet from, and in proximity to vein "A," is situated a tunnel driven in on coal seam "B" some 40 feet, showing 4 feet of coal. As the tunnel had caved in, it was impossible for me to enter and make an examination, but I removed the surface from the crop of the coal, which disclosed a vein 3 feet 6 inches in thickness, as shown in Diagram "B." From what I saw, I would judge the coal to be of a very good domestic quality.

VEIN "C."

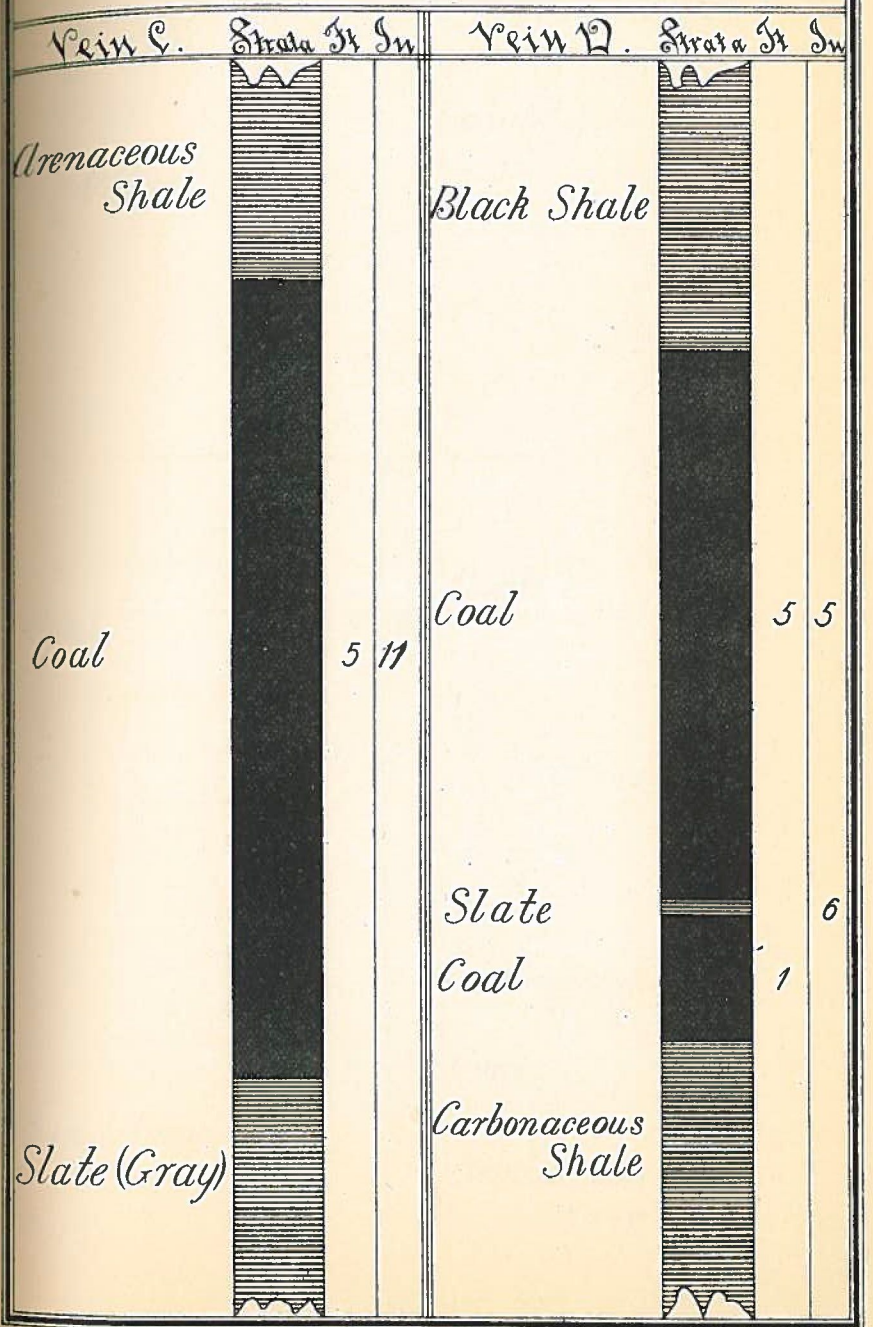
At a point about 250 yards, in a north westerly direction from the mouth of Cliff creek, and on the west side of Coal creek, at an elevation of about 80 feet above its bed, there is a tunnel run in 50 feet on a very fine vein, measuring 5 feet 11 inches, of absolutely clean coal, which I believe to be a remarkably fine quality of domestic fuel. It is very compact in texture, hard and bright. I witnessed this coal burning in a cook stove on the property, and was very favorably impressed with it. For grates, ranges, cook stoves and furnaces it will, in my opinion, when introduced on the market, be received with much favor. The roof and floor of this vein consists of dark drab shale; the strata lie nearly horizontal (a level of the dip in the 50 feet tunnel being one foot). This opening is in proximity to the line of the preliminary survey of the Denver & Rio Grande Railway, beginning from its main line at Delta station.

VEIN "D."

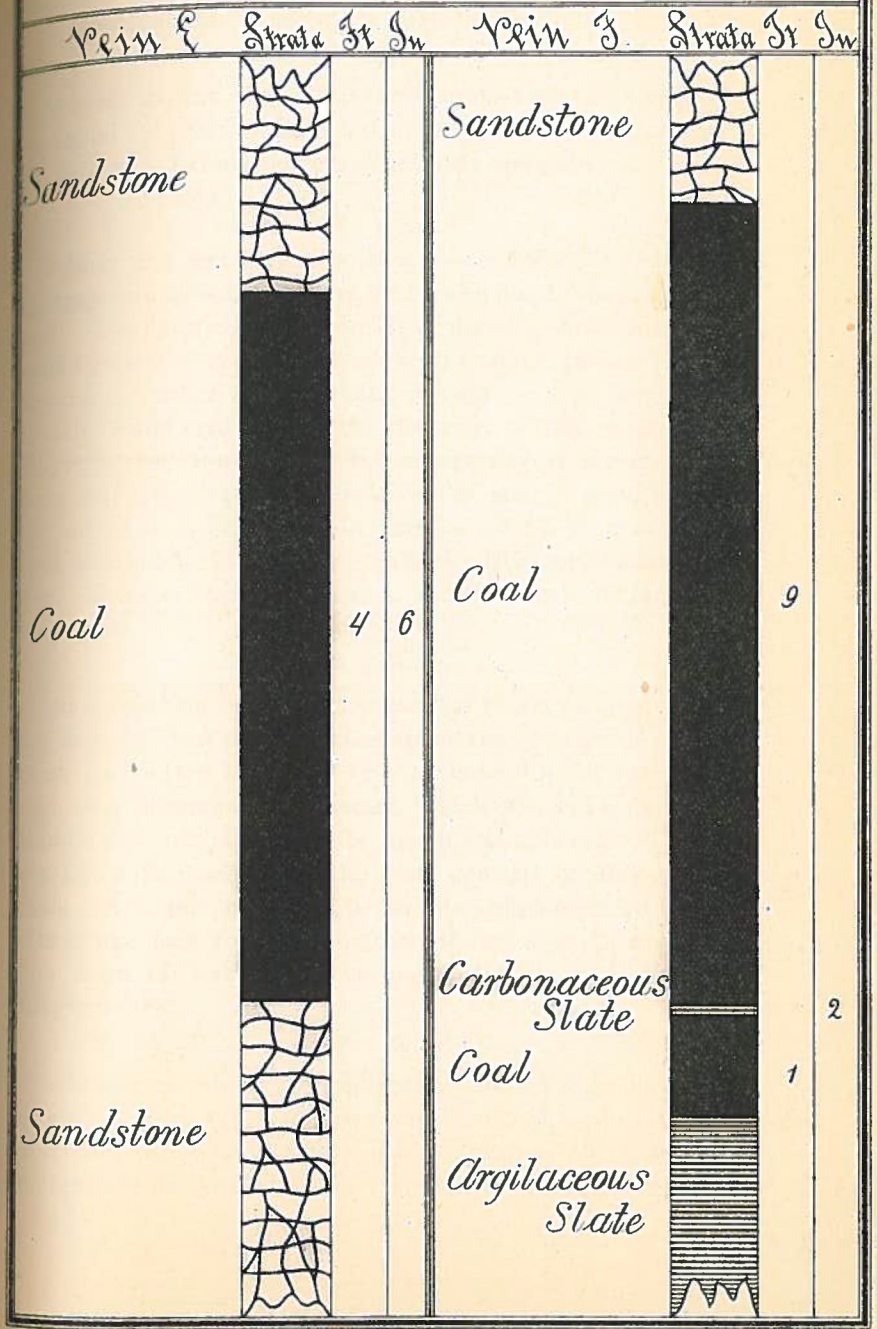
About a quarter of a mile above the mouth of Robinson creek, situated on the east side of Coal creek, and 30 feet above its bed, a tunnel is driven in on a coal seam to a distance of about 100 feet, showing a good vein, measuring 6 feet 5 inches in thickness, which contains a seam of slate, as shown in Diagram "D." This coal breaks up very



DIAGRAMS C AND D



DIAGRAMS E AND F



much like anthracite; it is very hard and bright, and will doubtless be found, when in practical use, to be one of the very finest domestic coals in the State, and will, to a degree, take the place of anthracite.

About 30 feet above this vein crops two 3-foot veins, separated by 3 feet of slate, but as they were covered over by slide rock I could not examine them minutely.

VEIN "E."

About 250 feet vertically above vein "D," there is an opening on a 4-foot, 6-inch vein of exceedingly hard, clean coal. The floor and roof consist of massive sandstone. I would expect this coal to run high in fixed carbon. Its fracture and other characteristics remind me very much of Scotch "splint coal" (after the character of raw smelting). About 75 feet above vein "E," an opening, it is said, had been made, disclosing a 10-foot vein of coal of good quality, but as it is now caved-in and buried up to a degree with slide rock, I could not make a satisfactory examination. Some of the coal found in the slide material looked very good.

VEIN "F."

At a point on the east side of Coal creek, at about 250 feet above its bed and six miles above the junction of Cliff creek, is located a 10-foot vein of hard, bright, lustrous coal, of a bituminous character, which will coke, and be found a very desirable fuel for steam and other use. It is overlaid with sandstone; the floor consists of dark gray shale. A tunnel is driven in on the vein about 40 feet. About one foot from the bottom of this vein, there is a thin seam of black carbonaceous material as shown in Diagram "F."

VEIN "G."

Anthracite—About 35 feet above vein "F," is located another 10-foot vein of remarkably fine coal, anthracite in character, having about the required degree of hardness, though not the bright lustre common to anthracite. It is

overlaid with three feet of shale, over which lies 10 feet of sandstone, which retains the appearance of heat from the overlying trap sheet immediately above them, which is 25 to 30 feet in thickness, from which agency the anthracitic change in the coal has been caused.

VEIN "H."

Anthracite—About 300 yards north, and on the same geological horizon as vein "G" and doubtless the same vein, is located an opening in which a tunnel is driven in on the vein forty feet, which measures eight feet in thickness, is remarkably free from impurities, is very hard and campact in texture, lustrous in appearance, and breaks with a conchoidal fracture; altogether a fairly good article of anthracite.

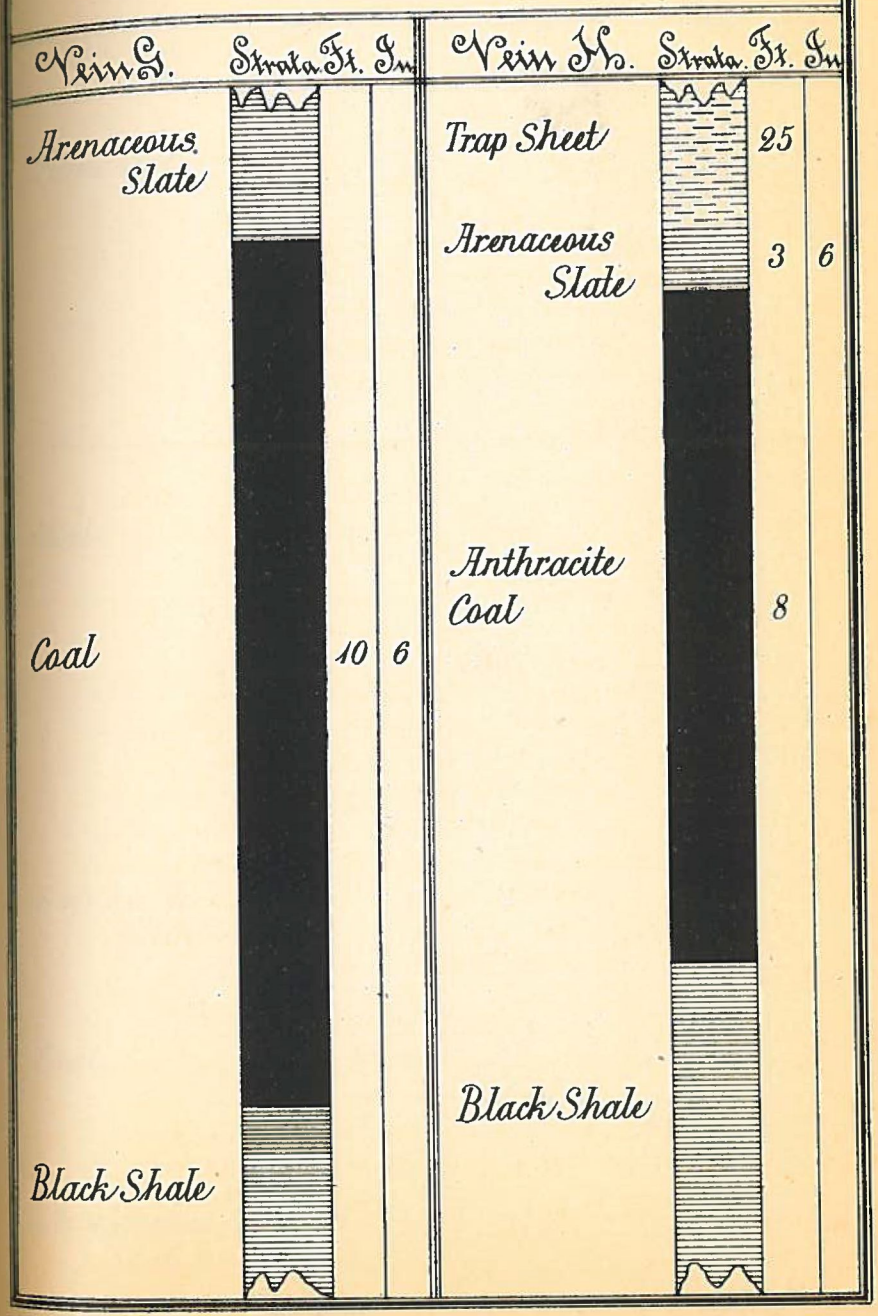
VEIN "I."

On the west side of Kauffman gulch, about half a mile from its junction with Coal creek and fifty feet above bed of gulch, is located a vein of 13 feet 6 inches of first-clas coal, which is free from all impurities and has a smut mining 3 inches in thickness, situated in the vein about 4½ feet from the floor. I have never in all my experience witnessed a vein of coal that could be so economically mined. It is truly an ideal coal vein, having all the natural advantages for economic mining that could be desired. The floor is composed of a firm carbonaceous slate, from which the coal parts freely. The roof consists of a massive sandstone many feet in thickness, without any perceptible joints or beds, which stands out in bold relief over the crop of the coal seam. It would be difficult to picture in our mind's eye a more ideal coal vein.

VEIN "J."

On the south branch of Kauffman creek, near to its source, is situated a vein of good coking coal 4 feet in thickness, which is over-laid with a black slate roof and under-laid with a compact carbonaceous shale. The dip

DIAGRAMS G AND H



DIAGRAMS
I AND J

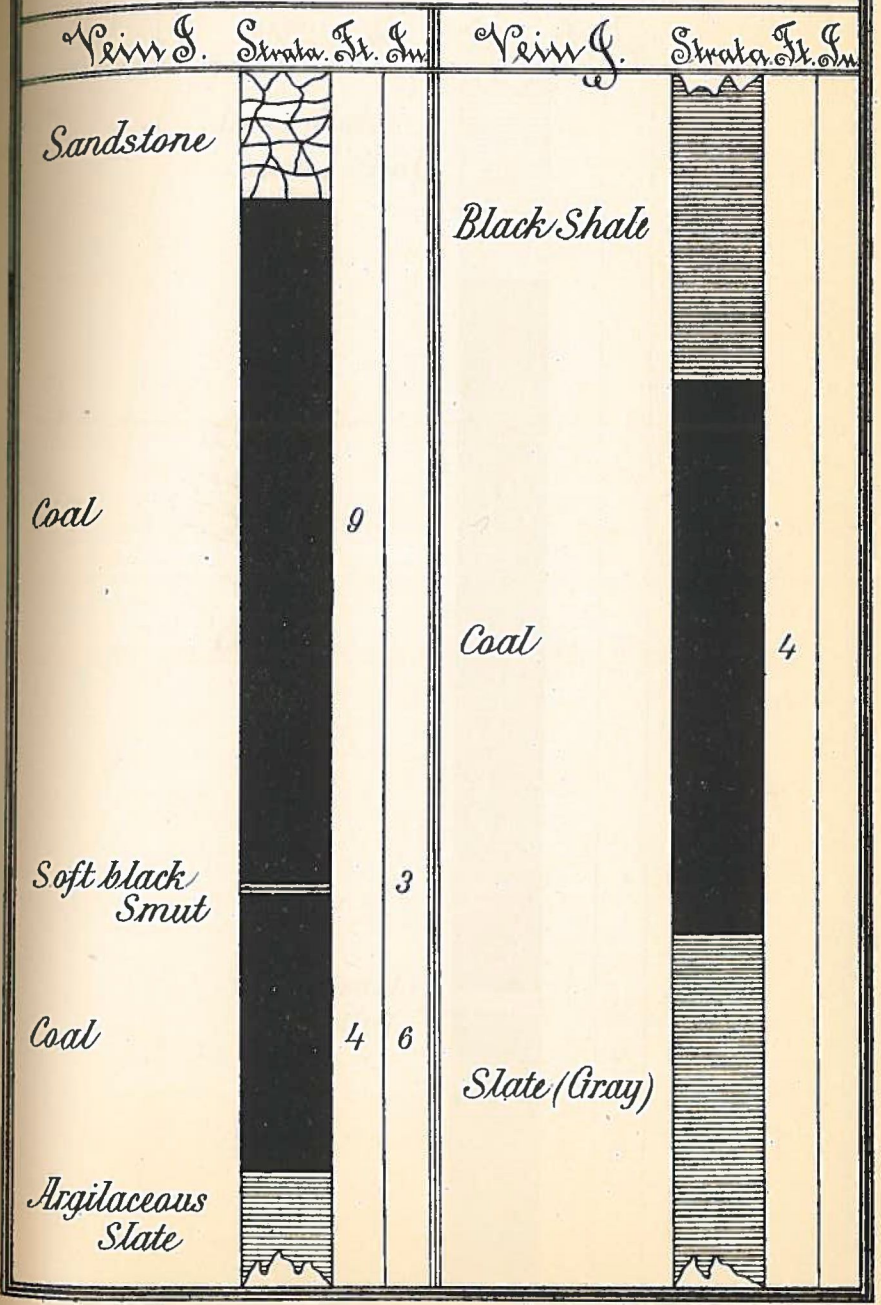
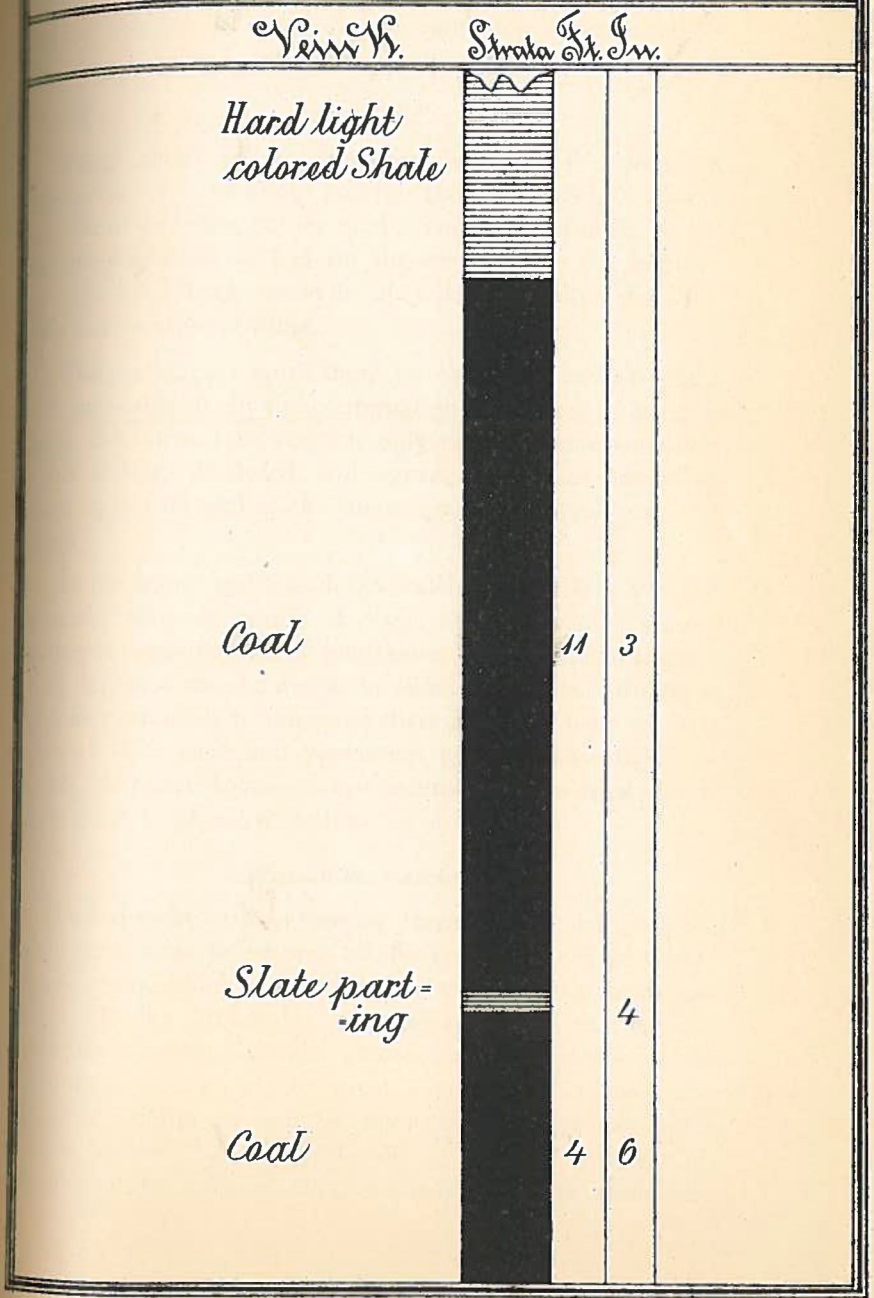


DIAGRAM K


Vein K.
Strata Ft. In.
Hard light colored Shale
Coal
11
3
Slate part-ing
4
Coal
4
6

here is 15 degrees, being somewhat heavier than at other points of the field. A tunnel is driven in on the vein from 75 to 100 feet, in which an accumulation of water lies at the face, it being below water-level.

VEIN "K."

From about 300 to 400 yards in a southerly direction from vein "J," and about 200 feet above the creek bed, over 15 feet of excellent coking coal is shown in a tunnel, which is driven in some 50 feet on the vein. Some fair samples of coke have been made in a "coke pit" taken from the two last mentioned veins.

The preliminary work done on this field settles beyond all reasonable doubt the continuation and extent of the coal beds, and taken into account only the economic workable veins already disclosed, will aggregate a thickness of at least 75 feet of coal of the finest grade and quality in the State.

In reporting upon such an extent of territory and the distance between points of disclosure of the coal seams, makes it probable that I may have, in my hurried inspection, reported the same vein at different points. But it is also as reasonable to infer that there are other beds covered up with slide rock and vegetation, which I have failed to locate, therefore I believe the estimate of the total thickness given to be conservative.

GEOLOGICAL REMARKS.

This district of coal bearing territory may be geologically termed as belonging to the Laramie or Post Cretaceous series, which is the principal coal bearing formation of the Rocky Mountains, wherein are found the various varieties of bituminous and anthracite coals common to the carboniferous age of the great Appalachian fields. At point of location of vein "A" the alternating beds of shales and sandstones lie at a gentle dip in a northerly direction, of about two to four degrees up along Coal creek, the

country consists of elevated rolling lands, rising in places forming plateaus, with numerous ravines, sloping to the river bed. At the junction of Cliff and Coal creeks, the crest of the mountains, is composed of igneous rocks towering up with vertical cleavage or needle-shaped peaks. Directly under them the sedimentary rocks lie horizontally showing no perceptible disturbance or tilting by the apparent eruptive rocks mentioned, thus indicating that such intrusive matter had overflowed from dykes at a point where the sedimentary strata may have been broken some distance from the line of the intrusive material, which is of the same porphoraceous character as that which constitutes the intrusive sheet overlying the anthracite coal bed. Such can be noticed appearing to view at intervals between the mouth of Cliff and Kauffman creeks, (along the east side of Coal creek), but is somewhat better defined near the latter. The fact that the sedimentary strata flank the line of igneous rocks, without any change in their degree or direction of dip, would bear out the theory that they are overflowed to some extent. Such being the case, it would be reasonable to infer that the quality of the coal seams lying in proximity to such intrusive matter will be greatly benefited from the heat and pressure. Commencing at a short distance above the junction of Cliff creek, a portion of the eastern base of Mount Gunnison rises from the west side of Coal creek, continuing to a point beyond the mouth of Kauffman creek, thus the coal measures throughout this distance are cut off. On the east side of Mount Gunnison, and commencing at the mouth of Kauffman creek, a plateau of 6 to 8 square miles in extent forms the most valuable and principal part of the coal territory.

Throughout a portion of this plateau, the intrusive matter above referred to forms into a uniform sheet, capping the coal measures and converting the vein lying it proximity to it into an anthracite of fairly good quality. This trap sheet can be seen standing out boldly about 300 feet

above water grade, at a point south of Kauffman gulch, and forms a continuous, well-defined wall on both sides of Coal creek, dipping regularly at an angle of about 8 degrees northward and down the creek, disappearing under its bed and the allavial deposits. Owing to the extreme hardness of the igneous rock forming the trap-sheet, it has not decomposed with the same regularity by the action of the weather as the sandstones and shales, thus, its bold outline can easily be traced around on the exposed sides of the plateau and along the sloping banks of the creek, clearly demonstrating the regularity of the coal formation and its extent in area.

At points where the anthracite vein is disclosed, and along the continuation of its crop where not covered up with alluvium and vegetation, the intrusive sheet can be noticed, varying somewhat in distance from the vein. In places it appears close over the vein, while at other points intervening strata consisting of sand, rock and shale come in between it and the vein, as shown in Diagram "H," where 3 feet 6 inches of arenaceous shale lies immediately over the coal; this shale is changed to a degree from its original character through the influence of heat from the over-lying sheet. Here the metamorphic transformation of the vein has been very complete, as the coal shows a good article of anthracite. About 300 yards south of this point there is in addition to the slate, ten feet of sandstone between the coal and the intrusive sheet, and the metamorphism of the vein has not been so complete, still it is fairly good anthracite. The igneous overflow or intrusion, so far as can be seen, covers an area of at least two square miles, and it is quite reasonable to infer that it penetrates a much greater area of the measures, where it is hidden from view, awaiting future prospecting to discover. And while in parts where an overthickness of sedimentary rocks may intervene between the intrusive sheet and the vein, preventing its transformation to a degree of completeness by destroying the metamorphical influence of the intrusion, still, in my

opinion there are quite a body of anthracite coal existing there, which time and future development will doubtless disclose.

ANALYSES OF COALS.

FROM COAL CREEK.

VEIN "A."

	PER CENT.
Moisture	3.16
Volatile matter	38.13
Fixed carbon	55.36
Ash (buff)	3.35
	100.00

VEIN "C."

	PER CENT.
Moisture	4.91
Volatile matter	39.08
Fixed carbon	52.41
Ash	3.60
	100.00

VEIN "D."

	PER CENT.
Moisture	1.56
Volatile matter	21.43
Fixed carbon	70.16
Ash	6.85
	100.00

VEIN "F."

	PER CENT.
Moisture	7.41
Volatile matter	41.11
Fixed carbon	47.18
Ash	4.30
	100.00

VEIN "H."

	PER CENT.
Moisture	1.51
Volatile matter	8.58
Fixed carbon	82.76
Ash	7.15
	100.00

VEIN "I."

	PER CENT.
Moisture	5.33
Volatile matter	42.30
Fixed carbon	49.82
Ash	2.55
	100.00

VEIN "J."

	PER CENT.
Moisture	1.43
Volatile matter	20.99
Fixed carbon	71.63
Ash	5.95
	100.00

VEIN "K."

	PER CENT.
Moisture	1.91
Volatile matter	29.41
Fixed carbon	64.83
Ash	3.85
	100.00

COAL MINES.

AN ACT TO AMEND CHAPTER SIXTEEN OF THE GENERAL STATUTES OF THE STATE OF COLORADO, ENTITLED "COAL MINES," APPROVED FEBRUARY 24, 1883.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. That said chapter XVI. be amended so as to read as follows: SECTION 1. That the owner or agent of each coal mine or colliery in this State, employing ten or more men, shall make, or cause to be made, within six months after the passage of this act, an accurate map or plan of the workings of such coal mine or colliery, on a scale not exceeding one hundred feet to the inch, showing the bearings and distances of the workings, with the general inclinations of the stratum, and any material deflections in such workings, and the boundary lines of such coal mine or colliery, which shall be kept for the use of the Inspector, at the office of the said mine in the county where such mine or colliery is located, and which shall be kept up every three months; and shall also deposit a true copy of such map or plan with the Inspector of Coal Mines, and with the recorder of the county in which said coal mine or colliery is situated, to be filed in their respective offices; and said owner or agent shall cause, on or before the tenth day of January every year, a statement of the workings of such coal mine during the year past, from the last report to the end of the December month just preceding, to be marked on the original map or plan of said coal mine or colliery; *Provided*, If the owner or agent of any coal mine shall neglect, or refuse, or for any cause fail, for the period of one month after the time prescribed, to furnish said map or plan as hereby required, or if the Inspector shall find, or have reason to believe, said plan or map is inaccurate in any material part, he is hereby authorized to cause a correct map or plan of the actual workings of such coal mine or colliery to be made at the expense of the owner thereof, the cost of which shall be recoverable from said owner by an action, as in cases of other debts, and shall cause a copy of the same to be filed in the office of the recorder of the county in which said coal mine or colliery is situated.

SEC. 2. It shall not be lawful, after six months from the passage of this act, for the owner or agent of any coal mine, wherein over fifteen thousand square yards have been excavated, to employ or permit more than fifteen persons to work therein, except in opening shafts or outlets, unless there are to every seam of coal worked in each mine at least two separate outlets, separated by natural strata of not less than one hundred feet in breadth, by which shafts or outlets, distinct means of ingress or egress are always available to the persons employed in the mine, and air shafts, in which are constructed and maintained ladder ways, shall be deemed and held to be an escape shaft within the provisions of this act, and no escape shaft be required; but it is not necessary for the two outlets to belong to the same mine; the second outlet need not be made until fifteen thousand square yards have been excavated in such mine, and to all other coal mines, whether opened and worked by shafts, slopes or drifts to such openings or outlets, must be provided within twelve months after fifteen thousand square yards have been excavated therein; and in case such outlets are not provided as herein stipulated, it shall not be lawful for the owner or agent of such mine to permit more than fifteen persons to work therein during each twenty-four hours. In case a coal mine has but one shaft, slope or drift for the ingress or egress of the men working therein, and the owner thereof does not own suitable surface ground for another opening, he may select and approximate any adjoining land for that purpose, and for approach thereto, and shall be governed in his proceedings in appropriating such land by the provisions of law in force providing for the appropriation of private property by corporations, and such appropriation may be made whether he is a corporator or not; but no land shall be appropriated under the provisions of this act until the court is satisfied that suitable premises can not be obtained by contract upon reasonable terms. Escapement shaft or other communication with a contiguous mine, as aforesaid, shall be constructed in connection with every vein or stratum of coal worked in such coal mine or colliery, as provided herein.

SEC. 3. In all cases where the human voice can not be distinctly heard, the owner or agent shall provide and maintain a metal tube from top to the bottom of the slope or shaft, or a telephone connection suitably adapted to the free passage of sound, through which conversation may be

held between persons at the bottom and at the top of the shaft or slope; also, the ordinary means of signaling to and from the top and bottom of the shaft or slope; and in the top of every shaft shall keep an approved safety gate and an approved safety catch, and sufficient cover overhead on every carriage used for lowering and hoisting persons; and the said owner or agent shall see that sufficient flanges or horns are attached to the sides of the drum of every machine that is used for lowering and hoisting persons in and out of the mine, and also, that adequate brakes are attached thereto; the main link attached to the swivel of the wire rope shall be made of the best quality of iron, and shall be tested by weights satisfactory to the Inspector of Mines of the State; and bridal chains shall be attached to the main link from the cross pieces of the carriage; and no single link chain shall be used for lowering or raising persons into or out of said mine; and not more than five persons for each ton capacity of the hoisting machinery used at any coal mine shall be lowered or hoisted by the machine at any one time.

SEC. 4. The owner or agent of every coal mine or colliery, whether shaft, slope or drift, shall provide and maintain for every such mine an amount of ventilation not less than one hundred cubic feet, and such additional number of cubic feet as may be ordered by said Mine Inspector, per minute per person employed in such mine; and also an amount of ventilation of not less than five hundred cubic feet per minute for each mule or horse used in said mine, which shall be circulated and distributed throughout the mine in such a manner as to dilute and render harmless and repel the poisonous and noxious gases from each and every working place in the mine; and break-throughs or air-ways shall be driven as often as the Inspector of Mines may order, at the different mines inspected by him; and all break-throughs or air ways, except those last made near the working faces of the mines, shall be closed up and made air-tight by brattice, trap-doors or otherwise, so that the current of air in circulation in the mine may sweep to the interior of the mine, where the persons employed in such mine are at work; and all mines governed by this statute shall be provided with artificial means of producing ventilation, when necessary to provide a sufficient quantity of air, such as fanning, or suction fans, exhaust steam furnaces, or other contrivances of such capacity and power as

to produce and maintain an abundant supply of air; but in case a furnace shall be used for ventilating purposes, it shall be built in such a manner as to prevent the communication of fire to any part of the works, by lining the upcast with an incombustible material for a sufficient distance up from the said furnace. All mines generating fire-damp shall be kept free from standing gas, and every working place shall be carefully examined every morning with a safety lamp, by a competent person or persons, before any of the workmen are allowed to enter the mine; and the person making such examination shall mark on the face of the workings the day of the month; and in all mines, whether they generate fire-damp or not, the doors used in assisting or directing the ventilation of the mine shall be so hung and adjusted that they will shut up of their own accord and can not stand open; and the owner or agent shall employ a practical and competent inside overseer, to be called a "mining boss," who shall keep a careful watch over the ventilating apparatus, and the air-ways, traveling-ways, pumps, timbers and drainage; also, shall see that, as the miners advance their excavations, that all loose coal, slate and rock overhead are carefully secured against falling in or upon the traveling-ways, and that sufficient timber, of suitable lengths and sizes, is furnished for the places where they are to be used, and placed in the working places of the mines; and he shall measure the ventilation at least once a week, at the inlet and outlet, and also at or near the face of all the entries; and the measurement of air so made shall be noted on blanks furnished by the Mine Inspector; and on the first week day of each month the "mining boss" of each mine shall sign one of such blanks, properly filled, and forward the same by mail to said Mine Inspector, a copy of which shall be filed at the office of the coal company, subject to inspection by miners.

SEC. 5. No person shall be knowingly employed as an engineer or mining boss, or take charge of any machinery or appliance whereby men are lowered into or hoisted out of any mine, but an experienced, competent and sober person, and no person shall ride upon a loaded wagon or cage used for hoisting purposes in any shaft or slope. No young person under twelve years of age, or woman or girl of any age, shall be permitted to enter any coal mine to work therein, nor any person under the age of sixteen years, unless he can read and write.

SEC. 6. All safety lamps used for examining or working coal mines shall be the property of the owner of the mine, and shall be under the charge of the agent thereof. The term "owner" in this act shall mean the immediate proprietor, lessee or occupier of any coal mine or colliery, or any part thereof; and the term "agent" shall mean any person having, on behalf of the owner as aforesaid, the care and management of any coal mine or colliery, or any part thereof.

SEC. 7. All boilers used in generating steam in and about coal mines and collieries shall be kept in good order, and the owner or agent, as aforesaid, shall have said boilers examined and inspected by a competent boiler-maker, or other well qualified person, as often as once every six months, and the result of such examination shall be certified, in writing, to the mining inspector; and every steam boiler shall be provided with a proper steam gauge, water gauge and safety valve; and all underground, self-acting or engine planes, or gangways, on which coal cars are drawn and persons travel, shall be provided with some proper means of signalling between the stopping places and the ends of said planes or gangways; and sufficient places of refuge, at the sides of said planes or gangways, shall be provided, at intervals of not more than fifty feet apart; and there shall be cut, in the side of every hoisting shaft, at the bottom thereof, a traveling way, sufficiently high and wide to enable persons to pass the shaft, in going from one side of the mine to the other, without passing over or under the cage or hoisting apparatus.

SEC. 8. Whenever loss of life, or serious personal injury, shall occur by reason of any explosion, or of any accident whatsoever, in or about any coal mine or colliery, it shall be the duty of the owner or agent thereof to give notice to the Mine Inspector, and if any person is killed thereby, to the coroner of the county, also; and the Inspector shall immediately go to the scene of said accident and render such assistance as he may deem necessary for the safety of the men, and shall ascertain, by the testimony before the coroner, or by taking other evidence, the cause of such explosion or accident, and file record thereof in his office.

SEC. 9. In all coal mines in the State the miners employed and working therein, the owners of the land, or

other persons interested in the rental or royalty of any such mine, shall at all proper times have full right of access to, and examination of, all scales, machinery, or apparatus used in or about such mine; to determine the quantity of the coal mined, for the purpose of testing the accuracy of all such scales, machinery or apparatus; and such land owners, or other persons, may designate or appoint a competent person to act for them, who shall, at all proper times, have full right of access to, and examination of, such scales, machinery or apparatus, and seeing all weights and measures of coal mined, and the accounts kept of the same; but not more than one person, on behalf of the land owners, or other person interested in the rental or royalty, jointly, shall have such right of access, examination and inspection of scales, weights, measures and accounts at the same time, and that such person shall make no unnecessary interference with the use of such scales, machinery or apparatus; and the miners employed in any mine may, from time to time, appoint two of their number to act as a committee to inspect, not oftener than once in every month, the mine and the machinery connected therewith, and to measure the ventilating current, and if the owner, agent, or manager so desires, he may accompany said miners, by himself, or two or more persons whom he may appoint for that purpose. The owner, agent, or manager shall afford every necessary facility for making such inspection and measurement; but the said miners shall not in any way interrupt or impede the work going on in the mine at the time of such inspection and measurement.

SEC. 10. Any miner, workman, or other person, who shall intentionally injure any shaft, lamp, instrument, air-course or brattice, or obstruct or throw open air-ways, or open a door and not close it again, or carry lighted pipes or matches into places that are worked by safety lamps, or handle or disturb any part of the machinery, or enter any place of the mine against caution; or who willfully neglects or refuses to securely prop the roof of any working place under his control, or disobey any order givin in carrying out the provisions of this act, or do any other act whereby the lives or the health of persons, or the security of the mines or machinery is endangered, shall be deemed guilty of a misdemeanor, and upon conviction, may be punished by a fine of not less than twenty-five dollars nor more than two hundred dollars, or may be imprisoned in the county jail

not less than thirty days, nor more than one year, or may be punished by both such fine and imprisonment, at the discretion of the court.

SEC. 11. In case any owner or agent disregards the requirements of this act, any court of competent jurisdiction may, on application of the Inspector, by civil action in the name of the State, enjoin or restrain the owner or agent from working or operating such mine with more than twelve miners underground during each twenty-four hours, until it is made to conform with the provisions of this act. And such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent, authorized by law for the matter complained of in such action.

SEC. 12. For any injury to person or property occasioned by any violation of this act, or any willful failure to comply with its provisions, by any owner or lessee or operator of any coal mine or opening, a right of action against the party at fault shall accrue to the party injured for the direct damages sustained thereby, and in any case of loss of life by reason of such violation or failure, a right of action against the owners and operators of such coal mine or colliery, shall accrue to the widow and lineal heirs of the person whose life shall be lost, for like recovery of damages for the injury they shall have sustained.

SEC. 13. The provisions of this act shall not apply to or affect any coal mine in which not more than ten men are employed underground during each twenty-four hours, but on the application of the proprietor, or of the miners in any such mine, or when the Mine Inspector may deem it necessary, said Mine Inspector shall make, or cause to be made, an inspection of such mine, and shall direct and enforce any regulations in accordance with the provisions of this act, that he deems necessary for the safety and health of the miners.

SEC. 14. That the board of examiners, heretofore appointed under the provisions of this act concerning coal mines, approved February 24, 1883, and amended by this act, shall hold their office for and during the time for which they were appointed, to wit: until January 1, A. D. 1887. And it shall be the duty of the board of examiners to meet at such time, and at such places within this State, as may be directed by the Governor of this State, and examine

such persons as may present themselves for examination, touching their qualifications for the office of Mine Inspector, as provided in this act, and shall inquire into their character and qualifications, and shall certify the names of such persons as they shall find to be competent to fill such office of Mine Inspector, to the Governor, which list of names, so certified, shall be placed on file in the office of the Secretary of State. Members of such board of examiners shall, before entering upon their duties, take and subscribe the following oath, viz. We, the undersigned, do solemnly swear (or affirm) that we will perform the duties of examers of applicants for appointment of Inspector of Coal Mines, to the best of our abilities, and that in recommending or rejecting said applicants, we will be governed by the evidence of qualifications to fill the position under the law creating the same, and not by any consideration of political or personal favors; that we will certify to all whom he may find qualified, according to the true intent and meaning of the act, and none others, to the best of our judgment. The qualifications of candidates for said office of Inspector of Mines, to be inquired into and certified by said examiners, shall be as follows, namely: They shall be citizens of the United States, of temperate habits, of good repute as men of personal integrity, shall have obtained the age of thirty years, and shall have had at least one year's experience in the working of coal mines of Colorado, and five years of practical experience in the working of coal mines in the United States, and have a practical knowledge of mining engineering, and of the different systems of working and ventilating coal mines, and of the nature and properties of the noxious and poisonous gases of mines, particularly fire-damp. The board of examiners shall receive six dollars per day, and same mileage as is allowed to members of the legislature, to be paid out of the State treasury, upon the filing of the certificates of the examining board in the office of the Secretary of State, as hereinbefore provided. As often as vacancies in said office of Inspector of Mines shall occur, by death, resignation, or malfeasance in office, which shall be determined in the same manner as in the case of any other officer of the State government, the Governor shall fill the same, by appointment, for the unexpired term, from the names on file in the office of the Secretary of State, as hereinbefore mentioned as having passed examination. On January 1, A. D. 1887, and every four years thereafter, the Governor shall appoint

one reputable mining engineer, of known ability, and shall notify the judges of four of the judicial districts of the State, within which coal mines are being operated, to each appoint one reputable coal miner, of known experience and practice, from their respective districts, and the five so appointed shall constitute a new board of examiners, whose duties, term of service and compensation shall be the same as those provided for by this section; and from the names that may be certified by them, the Governor shall appoint the Inspector of Mines provided for in this act. Nothing in this act shall be construed to prevent the re-appointment of any Inspector of Coal Mines. The Inspector of Coal Mines shall receive for his services an annual salary of two thousand dollars, and ten cents per mile mileage for all distances traveled in the dischaege of his official duties, to be paid monthly by the State Treasurer; and said Inspector shall reside in the State, and shall keep an office at the capitol, or other building, in which the offices of the State are located. Each Inspector is hereby authorized to procure such instruments, and chemical tests, and stationery, from time to time, as may be necessary to the proper discharge of his duties under this act, at the expense of the State, which shall be paid by the State Treasurer, upon accounts duly certified by him and audited by the proper department of the State. All instruments, plans, books, memoranda, notes, etc., pertaining to the office, shall be the property of the State, and shall be delivered to their successors in office.

SEC. 15. The Inspector of Coal Mines shall, before entering upon the discharge of his duties, give bond in the sum of five thousand dollars, with sureties, to be approved by the judge of the district court in which he resides, conditioned for the faithful discharge of his duty, and take an oath (or affirmation) to discharge his duties impartially and with fidelity, to the best of his knowledge and ability.

SEC. 16. No person acting as manager or agent of any coal mine, or as a mining engineer for any coal mining company, or to be interested in operating any coal mine, shall at the same time act as an Inspector of Coal Mines under this act.

SEC. 17. The Inspector of Coal Mines, and his deputy, shall devote the whole of their time to the duties of their office. It shall be the duty of the Inspector, or his deputy, to enter into and thoroughly examine all coal mines in the

State in which more than ten men are employed, at least once each quarter, to see that all the provisions of this act are observed and strictly carried out, and the Inspector, or his deputy, or both, may enter, inspect and examine any coal mine in the State, and the works and machinery belonging thereto, at all reasonable times, by night or day, but so as to not unnecessarily obstruct or impede the workings of the mine; and the owner, or any agent of such mine, is hereby required to furnish the means necessary for such entry and inspection. The Inspector shall make, to the Governor of the State, a biennial report, which shall show the number of coal mines and development on the same, during each year, and of persons employed in and about each mine, and the extent to which the law is obeyed, the progress made in the improvement sought to be secured by the passage of this act; the number of accidents and deaths resulting from injuries received in coal mines; as, also, statistics showing output of coal and development made annually at each mine, with all facts concerning the production and transportation of coal to market, and other facts of public interest coming under the provisions of this act; which record shall be filed in the Inspector's office. The Secretary of State is hereby authorized to have printed two thousand copies of said biennial report, at the expense of the State, for distribution to Members of the Legislature, mine owners, superintendents, and others interested in coal mines; said report shall be printed on, or before, December 31, preceding the biennial session of the Legislature, and the Inspector is hereby authorized to employ a deputy inspector, and such clerical assistance as may be required in his office, whose salaries shall not exceed two thousand (2,000) dollars in any one year, which shall be paid out of any moneys appropriated for that purpose on certificate of said State Inspector of Coal Mines, showing the services rendered and the amount thereof; and, on presentation of such certificate to the State Auditor by the person entitled thereto, he shall issue his warrant on the State Treasurer for the amount thereof, to be paid out of any appropriation as aforesaid; and the said Inspector shall be allowed the further sum of ten cents per mile mileage for all distances actually traveled by him, or his deputy, in the active discharge of their official duties, but the total sum of such mileage allowed for the mileage expenses of both such Inspector and his deputy shall not exceed the sum of two thousand five hundred dollars in any one year. It is

further hereby enacted that any balance of the above appropriation which may remain after paying the salary of the deputy inspector and his mileage, as hereinbefore provided, shall be applied to the hire of clerical assistance for the Inspector and for necessary office expenses.

SEC. 18. That the owner, agent or lessee of each coal mine or colliery in this State employing ten or more men, shall, when working in close proximity to an abandoned mine or part of a mine containing water or fire-damp, cause bore holes to be kept at least twelve feet in advance of the coal face and sides of all working places, in such mine or colliery known to be approaching old and abandoned workings. Side holes to be not more than ten feet apart; and said owner or agent shall cause all abandoned shafts, air shafts, slopes, slack piles or cave holes to be securely and safely fenced off; and in all bituminous and ligaite coal mines coming under the provisions of this act, the State Inspector of Coal Mines shall have the authority to compel the owners, agents or lessee of coal mines to remove any or all fine coal or slack which may accumulate in the working places or gobs, and where gob-fires or spontaneous combustion are known or even suspected to exist, a careful inspection shall be made daily of the workings by the mine boss or another competent person, and if an increase of temperature be localized in any part of the gobs or other places, prompt action shall be taken to remove the heated gob or debris, or extinguish the fire by water or other contrivance; but if the fire has already reached such proportions that it is impossible to extinguish it in that way, then it shall be the duty of the superintendent, or mine boss in the absence of the superintendent, to at once build suitable stoppings of double walls of a concave shape, and at least two feet apart, with ends top and bottom, built into cuttings made into the coal or rock, and the center between the walls to be filled in with sand or other fine earthy matter, which shall be closely tamped, so as to fill up all cracks and crevices, the outside of said walls to be carefully plastered with lime and cement, so as to completely isolate the fire from air. Should combustion still be suspected to be going on, then steam, where practicable, shall be injected towards the fire from pipes in connection with boilers, and passing through said walls or stoppings, or to flood with water the site of the fire; and that in all coal mines known to generate explosive gas, that the owner or agent

shall provide and adopt a system by which water under pressure or otherwise shall be sprinkled and make damp all accumulations of fine coal dust from time to time that may accumulate on any haulage road. Also, that no owner or agent shall use any part of the underground workings of such coal mines as a magazine for the storage of gunpowder or any other kind of blasting agent; on all underground roads where coal is hauled by machinery, and where the grade will average more than six (6) feet to the hundred (100), and which are used for traveling ways for men, double draw-bars shall be attached to the bottom or other parts of every car, so that two separate couplings may be used to connect each and every car lowered or hoisted on any road coming under this act, and that the hooks which connect with the draw-bar of the car shall be so constructed, with a clevice or other contrivance, so as to prevent them from becoming detached while the cars are in motion on the slope; also, that double chains, with approved safety hooks shall be attached to the socket of the hoisting ropes; *Provided*, That any appliance other than those herein required may be used in the construction and hoisting of cars which may accomplish the same result with equal safety and security to life and limb.

SEC. 19. The mining boss, or other competent person, shall make daily inspection of ropes, chains, cages and other hoisting appliances, guides and shaft timbers, and make a record of such daily inspection in a book, kept at the office in the mine, for that purpose, and the fire boss shall keep a daily record of any defects in the ventilating appliances, and any standing gas that may be found in said mine, designating the entry and room in which said gas is found. Each of the records herein required to be kept, shall be open at all times to the Mine Inspector's and miners' committee's inspection, and a copy thereof shall be filed in the office of the said Mine Inspector on the first Monday of December of each year.

SEC. 20. The neglect or refusal to perform the duties required to be performed by any section of this act, or the violation of any of the provisions hereof, shall be deemed a misdemeanor, and any person so neglecting or refusing to perform such duties, or violating such provisions, shall, upon conviction, be punished by a fine of not less than one hundred dollars, nor exceeding five hundred dollars at the

discretion of the court, and all penalties recovered under this act shall be paid into the treasury of the State.

SEC. 21. All acts or parts of acts inconsistent with the provisions of this act, are hereby repealed.

SEC. 22. An emergency exists; therefore, this act shall take effect and be in force from and after its passage.

Approved April 8, 1885; amended April 2, 1887.