Report

Primero Mine

January 31, 1910

-:- THE PRIMERO MINE EXPLOSION -:-

PRIMERO, LAS ANIMAS COUNTY, COLORADO.

JANUARY 31, 1910.

BY GEO. S. RICE.

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LOCATION:

The "A" Primero Mine is one of several slope mines located at the town of Primero in Las Animas County, Colorado. It is about 21 miles west of the city of Trinidad on the Colorado and Wyoming Railroad, a subsidiary concern of the Colorado Fuel and Iron Company, which owns the Primero mines and others in the district. The town lies at an elevation of about 7000 feet above sea level.

GEOLOGY:

The coal worked at Primero is one of the upper seams in the Laramie series of the Cretaceous Age, and the mines are situated in the western part of what is commonly known as the Trinidad Coal Field, 10 miles or so from the extreme western rim of the basin where the coal measures turn up sharply against the foot hills of the Sangre de Cristo Range of mountains. The Primero seam outcrops at the town, and in the "A" mine dips northward on a three percent grade. The dip is fairly regular, except where disturbed by lateral folds or waves which have been accompanied by some faulting.

COAL SEAM:

The seam is from 6½ to 7½ feet in thickness. It has a columnar structure, though the face and butt cleavages are not as strongly developed as in some coals, like the Pittsburgh Seam of Pennsylvania. The faces run approximately east and west. The coal is bituminous and strongly coking.

ROOF:

The main roof is a strong sandstone, separated from the coal by black shale, short-grained and full of slips. To hold it up requires close timbering; the entries are cross-timbered and lagged.

Near the entrance of "A" mine, the sandstone comes down close to the coal, so that the one or two feet of shale intervening has been taken down, the sandstone requiring no timber for support. In going down the slope, the thickness of the shale gradually increases. In rooms off A-11, in certain of which the roof had fallen from 15 or so feet above the coal, the material exposed was all shale.

COAL SAMPLE:

A full section sample of the face coal was taken at the face of Room 2 off A-11 Entry. The measurements were as follows:

Roof - Black shale, slippy.

Coal, bright lustre, soft,.....	0'	4"	
Sulphur and slate band,.....	0'	1"	*
Coal, medium, soft,.....	0'	6"	
Black sulphur band,.....	0'	1"	*
Coal, pure, has small cubical fracture,...	1'	4"	
Slate band,.....	0'	3"	*
Coal, hard block,.....	0'	2"	
Coal, fine grained, hard,.....	1'	8"	
Coal, sulphurous,.....	0'	4"	
Coal, pure, slabby,.....	2'	0"	
Floor, (Coal, 0' 2" (Hard shale Total.....	6'	9"	

* Note; Excluded from sample.

The 3 inch slate band in the above section 2½ feet from the top thickens to 12 inches at the face of the 7th and 8th West.

-:- Proximate analysis of foregoing sample. -:-

Laboratory No. 10063-4 (average)

	Sample as received.	Moisture and ash free
Moisture	1.91	
Volatile matter	32.27	36.06
Fixed carbon	57.21	63.94
Ash	8.61	
	100.00	100.00
Sulphur	.53	.59

COAL WASHING:

The coal is mainly used to make coke. It is hauled in railroad cars to the town of Secundo which lies a few miles to the south in the valley of the Las Animas River, where it is crushed, washed and coked in bee-hive ovens. The coke is shipped to the company's steel plant at Pueblo, Colo.

MINE DEVELOPMENT:

The Primero mines have three main openings, called the West Mine, the "A" mine and the "B" or East mine, which are all slope openings. The "A" and "B" main slopes run parallel, nearly due north and about 2000 feet apart. They have been connected together by a number of cross entries but, except for one, the connection has been entirely cut off and the pillars between have been pulled. The one connection was through the 3-B Entry, turned off the "A" main slope about 2400 feet from the mouth on the right hand side. This had been sealed by a rock stopping which was not affected

by the explosion, but the first effort in recovering the mine was to blow out this stopping, from the "B" side, so as to ventilate by means of the "B" fan.

The "B" mine was not affected at all by the explosion and resumed work about one week later, after the connection had been temporarily sealed.

The West mine was not connected underground with the "A" mine and therefore was not affected.

The coal from the three mines was brought by trolley haulage to one tipple, which lay in a draw between the "A" mine and the West mine.

OUTPUT:

The output of the three mines was about 1600 tons of coal per day at the time of the explosion, though the mechanical capacity was greater.

The output of the "A" mine was about 500 to 600 tons. About 110 men were employed in this mine on the day shift.

LAYOUT OF "A" MINE:

The main slope ran down the 2 to 3 percent dip straight north for about 4200 feet; then the direction of the dip changing to about North 35° West, the slope was turned in this direction. From the turn it ran in over 800 feet at the time of the explosion, and pairs of entries had been started; A-13 and A-14 to the left and B-9 and B-10 to the right. No rooms had been turned from these entries.

An air course ran parallel with the slope on the right or east side of same all the way in.

EAST OR "B" ENTRIES:

To the east of the slope and aircourse, only two pair of entries

were being worked; B-9 and B-10 just started, and B-7 and B-8. A few rooms were being worked in a stub pair of entries off the latter.

B-1 and B-6 inclusive were worked out and closed, except for the connection through B-3 referred to.

WEST OR "A" ENTRIES:

On the west side of the slope, besides the new entries A-13 and A-14, there were three pairs of entries working; A-7 and A-8, A-9 and A-10, A-11 and A-12, together with the stub entries off same.

A-1 and A-2 and A-3 and A-4 were worked out to the crop and abandoned. A-5 and A-6, as turned off the slope, were also abandoned, but a new A-5 and A-6 were turned off the 2-south stub, A-7, and were working.

HAULAGE:

The coal was handled in wood cars of two tons capacity, with 16 inch wheels. These were hauled on the slope by main-and-tail rope which ran as far as the A-12 entry. There were branch ropes in A-7 for about 1400 feet, and in A-9 for about 1200 feet. Elsewhere in the mine, the haulage was with mules.

LIGHTING - SAFETY LAMPS:

The only system of lighting employed underground was with magnetically locked Wolf safety lamps of standard shield pattern, using benzine.

The lamps were cleaned and filled by attendants in a lamp house a short distance from the mine.

The men were checked into the mine by the lamps, but on coming out, were not under supervision to see that their lamps were immediately returned.

No open lamps were permitted, and I was informed that men entering

had their lights examined at the entrance and were occasionally examined for matches.

However, so little gas had been reported by the mine examiners for months that the operating company was about to petition the State Mine Inspector to allow the use of open lights. The safety lamps had been put into the mine following the explosion of 1907.

-:- STORY OF THE EXPLOSION -:-

The following story of the explosion is extracted almost in its entirety from an article written by Mr. R. L. Herrick and published in the March issue of Mines and Minerals. The story is well told and with apparent accuracy so far as I may judge from the information received. I have changed the wording only in a few details where I had special knowledge of the facts.

Monday, January 31, 1910, the day of the explosion was said to have been a clear warm day. About 110 men were reported to have gone into the mine on the day shift, and about 4:00 p.m., the miners of this shift began to come out of the mine. It is said that the fans were running regularly and the only incident of note reported was that several cars of the empty trip were off the track at the mouth of the main haulage slope, and were being replaced on the track under the direction of outside-foreman D. D. Dodge. About this time, pit boss David Williams telephoned to the slope engineer, probably from the station at the mouth of A-12 on the main slope. The last loaded trip had been hoisted from A-12 entry about 3:30 p.m.,

and Williams noting the delay, inquired of the slope engineer what the trouble was. When informed that the cars were off the track, he ordered the next trip of empties into entry A-8 and the loaded trip pulled out from this point. As there were 26 loaded cars waiting on the A-8 parting, it was arranged to hoist 14 on the first trip and the balance on the second. The slope engineer, Lopez, was instructed to hoist the second loaded trip slowly as it passed into the main road from A-8 in order that Williams might get aboard. When the cars on the surface were replaced about 4:20 p.m., the branch tail-and-main ropes of A-8 had already been connected to the main slope ropes so that when the empty trip went down, it was all ready to run into A-8 as soon as the signal was received by the slope engineer. In five minutes more the empty trip, as shown by the engine indicator, had reached A-8 and, on receiving the signal to go ahead, the slope engineer ran the empty trip ahead about 300 feet into A-8 when the explosion occurred. On finding the ropes jammed, he shut off the engine.

In the meantime, about 35 miners of the day shift had left the mine. One had gone home, changed his clothes, and come back, and at 4:30 p.m., stood directly in front of the haulage slope, taking with three miners who had just emerged from the slope. Outside-foreman Dodge, having finished directing the gang which placed the cars on the track, had just stepped 50 yards to the west of the slope, and J. C. Risher, assistant master mechanic, stood at the door of the machine shop 200 feet from the slope when the explosion took place. Therefore, both Dodge and Risher were close eye-witnesses of what happened. Just at the instant of the explosion, a loaded trip of cars from one of the east mines, drawn by an

electric locomotive, passed the mouth of the slope. The locomotive had barely passed when the explosion came out of the slope, striking the cars of the trip and throwing them from the track a short distance. According to Dodge and Risher, a vast volume of black smoke and dust shot out of the slope mouth, and catching the four men in its path, hurled three of them against and under the trip of cars, killing them. The fourth man, a negro, was thrown entirely over the cars and landed 100 feet south of the slope opening. Although terribly burned, at the time the article was written, it was thought he would recover. In the midst of the smoke and dust rolling from the slope mouth came a great flame which quickly subsided. The concussion of the explosion was said to have been quite great, but only a few windows were broken in the town, although in a number of houses plaster was hurled from the walls.

In a few moments, Dodge and Risher recovered from the shock and rushed to the fan, where they were soon joined by Superintendent William Kilpatrick and Dan Sullivan, boss carpenter. An inspection showed that although dirt and timbers had badly damaged the blades and blown out a portion of the casing, it could be repaired in a short time. The mouth of the main slope was blocked by a great fall, thus shutting off the normal intake. The fan at the "B" mine was not affected by the explosion and acting under instructions of Superintendent Kilpatrick, William Easton and Al Thompson ran to No. 1 east in "B" mine, accompanied by helpers and down the haulage road to a masonry air stop. Here Thompson and helpers started to tear down the masonry stopping while Easton and helpers erected a temporary stopping shutting off the "B" mine return a short distance away. The

temporary stopping had just been finished when those engaged at the masonry stopping blasted it down. Instantly the "B" fan began drawing the gases from the wrecked mine through the passage in which Easton and his helpers were traveling. Thompson and his party at once escaped into the neighboring intake while Easton and his helpers coming out the return had a race to keep ahead of the black-damp for a distance of 1700 feet to the outside. Thus the "B" fan began to draw after-damp from the wrecked mine in about 45 minutes. About three hours later, the main fan, having been hurriedly repaired, was reversed to blow fresh air down the aircourse upon which the rescuing party could advance. In other words, the "A" fan was forcing air in and the "B" fan, through the connection between the "A" and "B" mines, was pulling it out. The aircourse was free from large falls but the haulage slope was caved tight, for entrance purposes, for a distance of about 100 feet. The full efficiency of the fans was not obtained as the connections between the mines was restricted at a low point by the presence of water within a few feet of the roof.

RESCUE WORK:

In the meantime, the call for help had gone out to the neighboring mines, to which a prompt response was made. Division Superintendent James S. Thompson quickly organized a relief party at Trinidad and started for Primero on a special train, which picked up a number of expert mining men on the way. By the time the two fans had partially restored ventilation near the entrance to the mine, Superintendent Thompson had organized the first rescue party, consisting of Joseph Ball, Superintendent of the second division, Superintendent Chas. Chambers of Sopris, Superintendent Wm. Morgan of Piedmont, mine inspector for C. F. & I. Co J. B. Manley, Superintendent

Thomas Lee of Frederick; Superintendent Jas. Wilson, of Starkville; Bob McAlister, A. C. Larson and others. Shortly after the arrival of the first party from Trinidad, a party from the neighboring Cokedale mines of the American Smelting and Refining Co., arrived, led by Manager Baylis and Superintendent Burt Lloyd, bringing with them three Draeger helmets. The Trinidad party had brought four helmets with them and the following morning, two more arrived from the Stag Canon Fuel Co. of Dawson, New Mexico, in charge of Jas. B. Morrow, the company expert in rescue work with these helmets.

Shortly after 9:00 p.m., the fans had restored ventilation sufficiently to allow the first rescue party under Superintendent Thompson to start into the mine through the aircourse. The party advanced about 2400 feet down the aircourse to entry B-3 and B-4 on the right and on the opposite side of the main slope to A-7 and A-8 by 2:00 a.m. About 14 bodies were recovered up to this time, all found on the main slopes and all badly burned, indicating that the men were on their way out when killed by the explosion. Several of the rescue party were overcome by gas and carried out unconscious, among them being Superintendent Thompson. Division Superintendent Joseph Ball then assumed leadership and continued the work of exploration up entries A-7 and A-8. A-7 was found fairly clear of after-damp, and though there were many falls, it was not blocked as was the case in A-8. Rapid progress was made until near the diagonal haulage road leading from A-7 into A-8 rope road. Before reaching this point, there was a large amount of timber found strewn along the road, and at the haulage road, the standing timbers were found to be on fire. Portable

chemical extinguishers were sent for and the fire was soon put out.

The main siding was located on A-8 just outside the haulage crosscut. As it was probable that men would be on this double parting prior to the explosion, the party went through the crosscut and turned back east. Here were found the largest group of bodies recovered. The rescuers passed over the bodies of a number of mules and six men; an electric flash light was turned on the face of each body as it was passed. As the light was flashed on the face of the seventh body, the man's eyes opened, and he sat up and spoke. This was Leonardo Virgen, a Mexican, beyond whom lay eight bodies, and beside him his dead Mexican buddy, with whom Virgen said he had conversed but a short time before. The body of this man was still warm at the time. Virgen walked part of the way out, but then was overcome, and was carried out the greater part of the way to the entrance. He was the only man recovered alive.

By Tuesday morning, the workings off A-7 and A-8 had been thoroughly explored and in all, about 28 bodies recovered. That morning, E. H. Weitzel, Manager, Fuel Department, of the C. F. & I. Co. arrived from Pueblo, together with State Mine Inspector John D. Jones and Deputy Inspector Griffiths, also Superintendent David Griffith of the Fremont County mines, and Thomas Jolley, pit boss of the Victor [illegible] Fuel Co.'s mine at Delagua.

The drainage of the black-damp from the lower portion of the mine progressed slowly. The ventilation was not on one current of air and the exit was restricted in the passageway between the "B" mine and the "A" mine, which as previously stated, was said to be half full of water. The temporary brattices put up hastily, leaked badly under the heavy pressure put on

them by the fans. Not until Wednesday morning, February 2d, had the brattices been erected as far as the mouth of B-4 and B-5 and of the opposite A entries, 9 and 10. By this time, about 40 bodies had been recovered and all hope of rescuing any living had been abandoned, although the exploratory work was continued with unabated energy. Before this time, the work had been thoroughly organized into three eight-hour shifts and a record of all persons entering the mine was kept, together with the number of the safety lamp carried in by each individual. Up to Thursday morning, about 50 bodies had been recovered from the mine. A house to house canvas by the company established the total loss at 75, not including Virgen and the negro who was burned at the slope entrance.

THE SURVIVOR'S STORY:

Virgen's story told at the inquest is that he and his partner and nine Koreans had been at work in the rooms off the second south blind entry off A-7. They were on their way out of the mine and had reached A-7 entry and possibly a little beyond it, going east toward the haulage crosscut, when the explosion occurred. Picking themselves up in a dazed condition, Virgen said the entire party retreated to some room he cannot locate, where the air was good---probably close to his own working place, if the dinner buckets dropped at intervals along the blind No. 2 south are any indication. Virgen said that after a wait of a number of hours, the Koreans become impatient to get out and at intervals made several sallies forth but were driven back. Finally, a little after midnight, so he estimated, five of the Koreans made a final sally from which they did not return. After waiting about an hour, the two Mexicans and four Koreans assumed that the five

Koreans had succeeded in their effort to escape and decided to follow them. "Taking the same route as before, they probably reached A-8 through one of the crosscuts above the diagonal haulage crosscut, which must have been impassible, owing to the small fire there." (The foregoing statement is made by Herrick. It is by no means certain that the fire would have prevented their running through quickly, inasmuch as the fire was in the standing timber and arose from the red-hot coke thrown against the timber. If the ventilation was destroyed by the explosion, it is quite probable that this merely smouldered and did not burst into flame until fresh air was forced in when the ventilation was partially restored.) Outbye the haulage crosscut in A-8 on the double parting, Virgen and his party came upon the bodies of the Koreans who had preceded them, and becoming suddenly overcome by afterdamp, they fell down. This was close upon 2:00 a.m. Virgen fell upon his back, his buddy upon his face. Virgen was picked up about 2:30 a.m., so he had probably not been in the noxious atmosphere of this place more than 30 minutes, and as before stated, his buddy had probably expired only a few moments before his own rescue.

RESCUE APPARATUS:

Nine sets of Draeger helmets were on the scene of the disaster by Tuesday morning, the day after the explosion. At this time, the exploration work was being pressed forward along the main haulage slope toward A-9 and A-10, and owing to the slowness with which the afterdamp was cleared, progress was halted. The C. F. & I. Co. and the Cokedale Co. had only recently received their apparatus and it had never been unpacked until it arrived at Primero, where there was no one conversant with its proper assembly and use.

In spite of this lack of knowledge, Superintendent Bert Lloyd and fire boss Mark Brown, of Cokedale, early in the morning, donned their apparatus and advanced to the limit of good air, but were stopped by Superintendent Thompson. An investigation of their discarded apparatus later by Mr. Morrow, who arrived at 8:30 a.m., showed that several important valves, washers, etc. of the sets were found loose, so if the wearers had entered the afterdamp with them in that condition, they would probably have been overcome.

(The foregoing statement about rescue apparatus is also quoted from Mr. Herrick.)

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-;- INVESTIGATIONS OF MINING ENGINEERS OF THE U. S. GEOLOGICAL SURVEY -:-

Notice of the Primero explosion appeared in the daily papers of the following morning, February 1st. The writer, who was in Chicago at the time, telephoned to Washington, and, obtaining permission, left that afternoon for Primero. He was joined at Kansas City by Mr. L. M. Jones, who had been enroute to McAlester, and to whom he had wired at St. Louis.

Primero was reached the morning of February 3d. At that time, the work of recovering and searching the mine was going on systematically under the company forces and Mr. John D. Jones, Chief Mine Inspector of Colorado. The writer continued his investigations until the evening of February 9th. Mr. Jones remained until February 5th, Mr. J. W. Paul reaching Primero from Pittsburgh on that date, and returning the evening

of February 7th.

Some portions of the mine were difficult to explore. In the main slope, inbye A-8, some timber was down and in the vicinity of A-11, there were heavy falls from 4 to 6 feet in depth, with the timber considerably tangled. The same condition was found for 1/4 mile in A-7 and A-8, and much worse in A-9, A-10, A-11 and A-12, where the falls were frequently 7 or 8 feet above the floor of the road. In a few rooms, the falls were from 15 to 20 feet high in places.

In general, there did not appear to have been a large amount of lateral movement, but there was sufficient to blow out the timbers, thus allowing the roof to come down. This action naturally was assisted by the partial or complete vacuum following the explosive wave.

In this report, every detail of movement and heating observed will not be given, but only the more important facts to show the general direction of movements.

MAIN (NORTH) SLOPE:

At the mouth of the slope, there was a very heavy fall blocking the entrance 15 feet or more high. Previous to this explosion, the mouth of the slope had been of double height, due to a previous explosion in this mine which occurred on January 23, 1907.

In cleaning up this fall, the burned bodies of six men were found under it in more or less mangled condition.

When the writer arrived, the fall still blocked the mouth of the slope and the aircourse was used for entering. The former rock stoppings, in the crosscuts between the slope and the aircourse, down to the 12th entry had all been blown out toward the aircourse. The crosscuts had been tem-

porarily bratticed at the time of the writer's inspection. In passing down the main slope, except at the mouth, the evidence of extreme violence was not so noticeable, except for the scarring of the sides, until A-7 entry was reached. No coke was observed through this stretch, although 100 feet outside of the mouth of the mine and 30 feet off to one side of same, there was a telephone pole which showed loose coke crust on the side facing the entrance. As previously mentioned, four men, who were outside but in line with the explosion, were burned.

Evidently the velocity of the explosive wave was too great to allow deposition of coke.

After leaving the mouth of the slope, the roof is high, due to the draw slate being down as a result of the previous explosion. The main roof above is strong so that it was not affected by the last explosion.

The overcast over the slope at A-7 had been burst and the pieces thrown both ways, apparently by an explosive wave coming up the slope. In A-8 entry, as will be mentioned hereafter, the general effect of the explosion was inward.

In passing down the slope from A-8, the first important piece of evidence was in the first crosscut. Coked dust had been driven into a crevice in the rib facing north.

Farther down the slope at the parting, a short broken post showed coke scale on the outbye side. Near this point in the parting which was disused, the body of a man had been found badly mashed, his bowels hanging out. Another body was also found near this point. Five bodies had been found in the main slope at or near the mouths of the 7th and 8th entries,

but their condition was not known to the writer.

At the inner end of this parting near the entrance to A-9, there were the remains of some boxes, also a couple of surveyor's tapes badly twisted. One of these boxes was said to have belonged to the rope cutter and the other, a fireman's box, contained the surveyor's tapes.

In the curved rope road leading into A-9 entry, there was a tail-rope sheave carried by light frame and two posts, placed at the north rib. The explosion had broken the posts and carried them with attached frame through which the rope was looped, about 20 feet inbye, the sheave being carried a few feet farther than the frame.

In the haulage crosscut to the B-6 entry, which enters the main slope between the mouths of A-9 and A-10, there was a damaged car which, according to Mr. Manley, the inspector of mines of the company, had been damaged by the explosion.

The gate of the car had been torn off and thrown 10 feet beyond the car toward B-6. It therefore seemed evident the force had gone in that direction. Three bodies were found in B-6 near the mouth at the main slope aircourse, and two others in the aircourse just outbye from B-6.

At the mouth of A-10 entry, there was an overcast over the slope with stone side walls. Pieces of the wall had been carried into A-10 entry but no pieces were observed in the crosscut leading to the slope aircourse. A roof lagging piece over the overcast and parallel with the slope had been broken upwards.

Inbye the overcast and up to a point half way to A-11, the evidence of the explosion in the main slope was slight and conflicting. No

coke was observed and the force manifested by the collars still standing was sometimes inward and sometimes outward. The situation was complicated by the fact that in the previous explosion (1907), the movement in this portion of the slope was said by Mr. John D. Jones, to have been inward.

About half way between A-10 and A-11, there was a swamp and the ribs and timbers nearby were damp. This was also said to have been the condition before the last inspection. The running of the cars through the swamp was said to have splashed water on the ribs and to have kept them wet. From the swamp inward to the 11th, there had been a heavy fall of roof, destroying the evidence of the explosion. The fall extended past the mouth of A-11 and as far as A-12.

On the cutoff curve leading into A-12, there was a sheave frame and collar leaning outbye and on the curved rib (northeast rib) a stick had been driven from inbye behind a prop and a telephone wire caught around it, the free ends of the wire being carried outbye.

In the straight road into A-12, there was little violence shown; an overhead sheave and frame was undisturbed. There were six dead mules in this immediate vicinity and the bodies of two men. A short distance within A-12, six more bodies had been found.

In the main slope inbye the mouth of A-12, there was not much violence. 100 feet from A-12, the main slope turns 30 degrees to the left or southwest, but a blind stub runs on straight north. Some water barrels for watering the mules stood by a trough alongside the east rib. The first barrel was swung around by a slight blast that had struck it, apparently coming down or into the slope.

Going further down the slope, a short blind stub entry turns to

the left. There was a fall at the mouth; apparently the timber had been blown into the stub. Beyond this point as far as A-13 and A-14 entries, there was no disturbance and the slope was quite wet; the timber also was damp with a fungus growing on same.

One hundred feet inbye the turn in the slope above mentioned, there was a small amount of coked dust on the inbye side of three posts. Except for this isolated point, there were no indications of flame noted between the mouth of A-12 and A-13.

At the time of the investigation of the writer, water lay in the 13th and 14th entries, and the head of the slope, and as it was evident the origin of the explosion was not in these entries, they were not examined by the writer, but a statement of later examinations by Mr. John D. Jones follows on a subsequent page.

MAIN SLOPE AIRCOURSE:

As mentioned in the story of the explosion, the fan which stood at the mouth of the aircourse and in direct line with it, was not materially injured by the explosion, although it was stopped running by timbers which were thrown into same. The connecting conduit was damaged and had to be repaired. In the aircourse, although there was some timbering at the mouth, there was very little thrown down and there were only a few light falls. The rock from the stoppings in the crosscuts between the aircourse and the slope had been blown into the aircourse and across to the opposite rib in some cases.

Two bodies were found in the aircourse not far from the outside. Like the others in the mouth of the slope, the men were evidently on their way out of the mine when the explosion occurred.

No flame was observed issuing from the fan or aircourse at the time of the explosion. There was no evidence of heating near the mouth of the aircourse, although there was considerable dry dust driven hard into the posts, collars and corners of the ribs on the inbye exposures. Five bodies were reported to have been found on the aircourse between B-2 and B-3.

The writer observed no positive evidence of heating in the aircourse until the cutoff to B-3 was reached. This cutoff had not been completed but was left as a blind stub driven southeast about 100 feet with no crosscut connections. In this stub on either rib, there was a considerable amount of coked dust of the bright granular character.

In the crosscut opposite B-3 and leading to the main north slope, there was a little more coked dust on the north ribs on exposures facing south or outbye. The evidence indicated that flame had crossed from the main north into the aircourse and entered the stub spoken of. At the time of my investigation, the aircourse beyond this point was shut off by brattice in order to allow the air to return through B-3 to the "B" mine fan. The intake air at this time was forced down the aircourse to this brattice, thence over to the main slope and around the mine. Normally, the fan was run exhausting and sucked the air straight out of the aircourse.

Beyond this point, investigation of the aircourse was not made by the writer, since other investigations showed that the movement and flame from the explosion was from the west side and, from the evidence, could not have originated on the east side. (Investigations of the State Inspector and others had confirmed this.) The aircourse was more or less moist

and, as no hauling was done through it, there was practically no dust along the road. What dust there was appeared to be mixed with shale and rock dust from the roof. In general, it may be said that there was nothing for the flame to feed upon in the aircourse.

A-1, 2, 3, 4, 5 and 6.

These entries were worked out to the outcrop and the room pillars were supposed to be drawn. There was no evidence of flame having entered this worked out area, but the brattices were down and they were said to have been blown down by the explosion.

A-7:

A-7 was an intake aircourse. The overcast at the mouth was destroyed by the explosion and bricks and timber were blown inward. In general, A-7 did not show much evidence of the present explosion, except that the stoppings between A-7 and A-8 were blown toward A-7, and dry wall stoppings in many of the old rooms were pushed in to more or less extent, and a few thrown bodily inward. The roof in A-7 was frequently down, but this was generally the result of the 1907 explosion. These old, as well as new falls, extended for a distance of 1600 feet up to where a haulage crosscut from A-8 entered A-7 and the track ran in from there, thence through A-7 to where a pair of entries turned off to the south. Up to this haulage crosscut, there appeared to have been little or no dust in A-7, in spite of its being the intake and there was no evidence of heat until near the vicinity of the haulage crosscut. Here there was much coked dust on the collars and they had been set on fire by it. As mentioned in the preliminary story, the fires were discovered by the first exploration party and were put out with portable chemical extinguishers.

A little beyond the haulage crosscut, coke evidences ceased and there was nothing to indicate that flame penetrated this entry beyond this point or into the south entries off same. In fact, there is evidence to the contrary. There were 11 men who had been working in the south entries off A-7. As told in the preliminary story, the sole survivor, Virgen, stated that these men were coming out of the mine and were near the haulage crosscut spoken of when the explosion occurred. They went to their working places for a while and successive parties tried to get out, all of them being finally overcome and dying, except Virgen.

It was not immediately apparent just why the explosion, which showed so much heat in the vicinity of the haulage crosscut, should have died away in A-7, as there was considerable dust beyond the haulage crosscut, also in the south entries for a distance of several hundred feet up to where there was a swamp, but a sample of the road dust in Room 47 contained a large percentage of shale dust as hereafter mentioned.

A-8:

This was the haulage road, and a branch tail and main rope entered this entry to a parting which began about 1200 feet in from the mouth. For 300 feet in A-8, little violence was noted. At this point was the head of a trip of empty cars. This trip of cars was the one mentioned as being hauled in when the explosion occurred. The two front or inbye cars were off the track.

No coked dust was noticed on the entry timbers, until the trip of cars was reached. At a point about 350 feet from the mouth, a right hand post showed coke on the outbye face only. On many of the posts in the

vicinity, there was dust on the inbye faces. Just beyond the post with the coke mentioned above, there was a tail rope sheave support bent inbye; that is, it was swung about 6 inches inbye, pivoting on the post. A hundred feet beyond this, there was coke on the inbye face of a post or leg, but just inbye, the posts showed coked dust on both faces. The trip contained about 16 cars. From the end of the trip in going inbye, the coke showed on the inbye sides of almost all the posts. The entry was closely timbered. Fifty feet inbye the trip, the timber had been set on fire, but subsequently had been extinguished by the gases. Beyond this, another sheave frame had been knocked two feet inbye. Still further in, there was a great fall 25 or 30 feet high, which extended for a considerable distance and which could not be penetrated. The evidence is not positive, but general appearances suggested the timbers had been blown inbye, allowing the fall of roof to occur.

The fall could be passed only by going around through A-7 and the haulage crosscut spoken of. It extended to within 600 feet of the haulage crosscut. In going inbye from the fall toward the crosscut, the timbers showed coked dust on the inbye faces. There was a long double parting, beginning about 300 feet outbye the haulage crosscut and extending toward same. On the outer end, there was a trip of 15 loaded cars, which were intact, except for falls on the fourth and fifth cars. At about the middle of the parting on the empty track, there were seven mules heaped together. It was in this vicinity that Virgen and 15 bodies were found.

At the inner end of the parting, there was an empty trip of cars. The last two cars had been forced inbye over frogs and switches and had each lost a wheel. Just inbye the parting switch was the haulage crosscut several

times referred to.

There were many evidences of heat in the vicinity of the haulage crosscut. Passing the latter, there was found considerable coked dust on the timbers on the inbye faces; a little further in it showed on both faces; still further in, there were spatters of coke on the outbye faces where the flame had evidently died away. This was at a point several hundred feet inbye the haulage crosscut and where the road became damp; beyond there was a swamp. Farther in, there was another parting on which there was two loaded cars. Two sprags, laying crossed on top of one of the cars, were evidently undisturbed or unmoved by the explosion. There was much fine soot and dust covering the cars. A live mouse was noted at the east end of this parting, but there were three dead mules on the parting, so that it was evident that the mouse had been further inbye at the time of the explosion.

The evidence in A-7 and A-8 entries showed quite conclusively that the explosive wave had entered the pair of entries from the main slope and had died away at a point about 1700 feet from the slope or a little beyond the haulage crosscut between the two entries.

A-9 :

There was a branch tail rope running into A-9 to a parting about 1200 feet inbye. It has already been mentioned that in the curved entrance into A-9, there were some broken props with sheave frame attached thrown inbye about 20 feet. Supplementing this evidence, a little further in there was a sheave frame with the arms bent or broken inward.

Beginning about 400 feet inbye the mouth, there were evidences now and then of coked dust on the inbye facing exposures of timbers and rib

corners. There were also a few collars tipped and bent inbye. A collar on the tail rope parting had coke on the inbye side, yet in a crosscut nearby the body of a man was found unburned. There were two other bodies found at the inner end of the parting, the condition of which was not learned.

The evidence of the explosive wave having passed inward was so unmistakable that investigation was not carried by the writer inbye the main parting where, in addition to the bodies that had previously been found, there were a number of dead mules.

In the last pair of stub entries which were turned off A-9 about 3200 feet from the slope, four bodies were found, the condition of which was not learned.

A-10:

This entry is the parallel of A-9. It was the return airway of the pair, A-9 being the intake.

Rooms were turned off A-10 all the way to the face but these were finished, except that the pillars had not been pulled and no one was working in them at the time of the explosion. No bodies were found either in the entries or rooms.

At the mouth there was an overcast over the main entry. As mentioned previously, in describing the evidence in the main slope, pieces of the rock wall across the mouth of A-10, which was the side wall of the overcast, had been burst into A-10; some of the pieces were carried 50 feet inward.

The door in the haulage crosscut from A-9 to A-10 was blown against the north rib of A-10, indicating the force had come from A-9. This crosscut was nearly in line with the curved entrance of A-9.

About 400 feet inbye from the mouth of A-10, there was a crosscut in which the board stopping had been partially blown in from A-9. In No. 15 (?) room off A-10 through which air was traveling at the time of the investigation, a collar near the mouth showed a loose but thick scale of coked dust on the south exposure. The same was observed at the mouth of the next room. In an adjacent room, there was a collar 50 feet inside the mouth on which there was coked dust, this deposit being also on the south side of the collar; but in the next room, the first collar had some loose particles of coked dust on the inbye or north exposure. In the 9th crosscut from the main slope or about 1000 feet inbye, also inbye No. 20 room, a board stopping was buldged and partly broken from A-9 toward A-10.

The 4th north stub entry off A-11 was holed through into No. 20 room. A brattice, which had been erected across the opening, was reported to have been thrown by the explosion some distance into the room, indicating the force came from the direction of A-11, but this explosive wave appeared to have died away in the old rooms, Nos. 15 to 20.

A-10 was not investigated beyond No. 22 Room, as it was apparent that the explosive wave was not strong further in and there was known to be nobody working in the entry.

The general conclusion to be drawn from the evidence shown in the outer part of A-10 was that the explosive wave burst the overcast wall and threw it into A-10 entry but did not penetrate to any great extent. The main wave entered A-9 which was the main haulage road and passed inbye on same, breaking some of the stoppings toward A-10. As regards the connection between rooms 15 to 20 and No. 4 south entry off A-11, it seems apparent that some of the explosive wave passed from A-11 into this group of rooms,

but it is not clear that this connection was important in carrying the explosion from A-11 to A-10, although the stopping in the 9th crosscut was blown toward A-9. In A-10 outbye from this connection, there is no evidence to indicate a movement toward the mouth of A-10.

A-11:

The curved entrance into A-11 was blocked by falls. In general, the falls through A-11 were extremely heavy most of the way to the face, destroying very much of the evidence. The rooms and stub entries off A-11 showed coke on the inbye faces. Four bodies were found in the room pillar workings at the inner end of the second (south) blind. These bodies were said to be badly burned.

As previously stated, the evidence through A-11 was largely destroyed by the timbers having been blown out and the roof falling in some cases 6 to 8 feet high. The general effect appeared to have been an outward movement. Near the head of A-11, there were six rooms. The inner four were working, but it is claimed that there was no one in them at the time of the explosion. In room 4, the face was partly undercut, but no holes were drilled and the coal was left up. Between two crosscuts on the left rib, there was a stick and a half of Aetna B powder covered with papers; also a tin box marked "Dupont blasting cap, XXX." This box contained 13 explosive caps or detonators, the kind used with fuse. This box of caps or detonators was exposed to discharge from a fall of roof.

A full section sample of the coal face was cut in this No. 4 room. Considerable coke had been deposited in this room and a force through a crosscut from Room 5 was indicated by props which had been thrown over the track. On the opposite side (east rib), pieces of timber had been driven

into pockets in the rib. There was also coked dust in these pockets. Outbye the first crosscut, there was loose coked dust on the inbye faces of props. The second crosscut to Room 5 was blocked by a fall in this crosscut; there was a little coked dust on the ribs.

In the first crosscut spoken of, there was a post standing alongside the rib with a prop wedged in behind it as though coming from Room 5. There was also a piece of canvas caught around the post, the ends trailing east. There was coke on the standing post mentioned and on an adjoining one on the sides facing Room 5.

Room 5 had a very heavy fall inbye the first crosscut. This fall was 25 feet or more high. This room, on the first exploration, contained too much methane to enter. After the erection of the brattices between A-11 and A-12, the gas was swept out, except on top of the fall. This room worked toward a roll. From the roof fall outward to the mouth of Room 5, a distance of about 50 feet, the posts were heavily plastered with loose coked dust on the inbye faces. At the neck of the room, timbers had apparently been driven outward, but great violence was not shown.

Room 6 was not driven as far in as Room 5 and was said to have been driven up to the roll and stopped. There was a fall in this room but no gas was noted at the normal roof level. There was only one crosscut, that into Room 5. This was heavily coated with coked dust, as was also the rib of Room 6 above the level of the crosscut roof, which was not the full height of the coal. There was heavy plastering of coked dust on the inbye faces of the props in Room 6 between the crosscut and the mouth.

In A-11 entry, there appeared to have been a movement either way from the mouth of Room 5. In the last crosscut, which was at the face of

A-11, there was a mass of fine dust, evidently brought out after the explosion and deposited here against a projection. (See analysis of sample, page Behind this projection; that is, facing A-12, there was a thick mass of coked dust. On a roof projection facing A-11, there were coke crusts also. Samples were gathered of the coke and dust in this vicinity. (See analysis pages).

General indications were that Room 5 off A-11 was the point at which the explosion started, in spite of the fact, not known to the writer at the time of the investigation, that the room was said to have had no one working in it at the time of the explosion. There had been two men in this room, but their bodies were reported to have been found at the mouth of the mine.

A-12:

At the mouth of the curved road into A-12, there was a heavy fall. Inbye this, the movement was plainly outward. As already mentioned (page 18) there was a telephone wire, the loose ends extending outbye, coiled around a loose prop which had been driven inbye, behind a standing prop on the northeast rib. On the straight entrance to A-12, a post on the south rib had a heavy coat of coked dust on the outbye side. There were heavy falls in A-12 entry and in consequence, the movement was difficult to determine. Inbye the fourth stub or blind entry, there was a piece of canvas caught around a post and trailed outward. Further inbye the timber had gone outbye without question. In Rooms 2 and 3 off A-12, a group of rooms turned inbye the blind entries and 1000 feet from the main slope, timber at the mouth had been driven inward into the rooms. The evidence of coke was somewhat conflicting, but generally, at the mouth of the room, was on the inbye side of

the props; that is, on the side opposite from the entry. There was no one in these inner workings of A-12 at the time of the explosion. Five bodies were found near the mouth of the entry and three who were said to be burned, in the first blind or stub entry. There were heavy falls in the first and second blind entries and considerable conflicting evidence, apparently caused by explosive waves traveling in either direction.

A-13 and A-14:

Mr. John D. Jones, Inspector of Coal Mines of Colorado, informed me of his investigations in the workings off the head of the main slope. As he gives his views of certain phases of the explosion, his letter is quoted in full, as follows:

"From the mouths of A-11 and A-12, the explosion traveled north and south through both the Main and aircourse, and east into B-7 and B-8. This district (B-7 and 8) being wet and perfectly destitute of any elements to supply the explosion, the force which was quite strong at the entrance and due only to the expansive power of the explosion in A-11 and A-12, gradually weakened as it sped east and it completely died away at a distance of about 400 feet. The faces of the first and second blinds, which were in 190 feet, off B-7, were undercut to a depth of from 5 to 6 feet, each with three holes drilled and the powder and fuse already prepared for the shot firers. These places, although only 390 feet from the mouth of A-12 and the Main North, where the force was most terrific, were not the least disturbed. The two who worked in this last blind were killed on their way out.

That the force traveled north along the Main from A-12 was made evident by huge timbers thrown several feet in that direction at the intersection of the Main and the haulage passage from B-7 to A-12. The Main North from A-12 to A-13, as before stated, was wet and muddy and consequently there were no cokings nor any other indications of heat having existed at any point in this locality. Yet, it is evident, from the cokings found in A-13, that the temperature was sufficiently high to carry the explosion from one place to the other over this wet zone. The disturbed timber in the intervening space between A-12 and the east entrance to A-13 pass-by showed a slight tendency, but not enough for positive assurance, of an inward force. From there in to the face of A-13 (400 feet) which part was heavily caved, the position of the disturbed

timber showed that the final movement was outward. A loaded car standing on the Main North, between A-13 and A-14, had the bumpers of its north end heaped with slack and small chips of wood, which was conclusive evidence that the force was outward from A-14. There was no one working in A-14, and the only way I have to account for the forces being outward from the faces of these places is as follows:

A-13 and A-14 are in only about 450 ft. from the Main North. The chain pillar between the two entries is 80 feet wide. In A-13 is a pass-by 300 ft. long, which begins about 50 ft. from the entrance and ends 100 ft. back from the face. This pass-by is driven in the chain pillar and has three cross cuts connecting with A-14. The explosion traveled from A-12 to the east end of the pass-by in A-13, but the quantity of dust gathered was not enough to destroy all the oxygen in the air. When the explosion reached within close proximity of the face of A-13, it was supplied with increased quantities of dust and probably an atmosphere containing some percentage of firedamp, and aided by both these elements of destruction, the explosion suddenly was magnified and it quicklyspread backward from the face to absorb the unconsumed oxygen of its former trail and thus brought about the outward pressure. From the pass-by the explosion went through the crosscuts to A-14, and thence outward. While I do not believe that the explosion started in this vicinity, yet I must say that, had this particular district been a strong generator of fire damp, the conditions would have been very favorable for a gas explosion, as the face of A-13 was 196 feet and A-14 221 ft. inside of their last crosscut.....There was very little damage done to B-9 and B-10. The direction of the force was inward as the door in the haulage crosscut between B-9 and the Main North was blown east several feet. The track-layer was killed in B-9. All other employees of B-9 and B-10 were reported to have been out of the mine.

In first blind off A-12, the force was inward. The entry was caved heavily with small intermittent spaces between the rooms left partially intact. Room No. 5, where two bodies were found, stood intact in its entire length, and all its props were thickly coated with bright coke, mostly on the inner side. Room No. 7 was badly caved."

Mr. Jones, in a letter dated May 31st, states:

"The second body of A-13 was also found in the undercutting at the face of the crosscut to A-14. If you remember I informed you in my last letter that on Feb. 12th, I reached the face of A-13 and found a body in the undercutting. There was about 2 feet of water at the face and the roof falls reached within 3 feet of the face. I went to the edge of the water and noticed the shoulder of the body above the surface of the water. Of course this body was immediately taken out. The other body not being visible at the time, we thought it was under the falls near the powder box, and after all of the falls were removed and the entry cleaned to the face, it was found to be in

the undercutting at the face and was originally underlying the first body. No doubt the deceased had been in the act of undermining at the time of the accident."

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-:- SUMMARY OF EVIDENCES RELATING TO PATHS TRAVERSED BY EXPLOSIONS -:-

The manifestations of heat and force in the main slope from A-10 are plainly outward toward the mouth of the slope. In the west side entries between A-1 to A-10 inclusive, the manifestations are inward in each case. On the east side of the main slope from the face to the outside, the movement and manifestations are from the slope toward the east side. On the main slope between A-10 and A-11, the evidence is not conclusive either way. There is in fact surprisingly little evidence of heat in that locality. In-bye A-12, the movement is plainly inward toward the face of the slope.

In A-11 and A-12, the movement is generally outward and the manifestations are stronger in this respect as the heads of the entry are reached. At the head of the pair of entries, the movement has been from A-11 toward A-12. The evidences appear to fix the source of the explosion near the head of A-11, and in particular to Room 5 off A-11, which is the next room to the last one turned. The latter, Room 6, is turned off at the face of A-11, and opposite a crosscut to A-12.

As previously stated, Room 5 works toward a faulting which had already stopped Room 6. The two men who worked in this room had started out but were caught by the explosion near the mouth. Furthermore, apparent-

ly no one was in the head of either A-11 or A-12 or was within 1000 feet of same at the time of the explosion as no bodies have as yet been found, and all 75 have been accounted for according to the company's records.

Room 5 contained a methane mixture soon after the explosion, and even a week later it showed on top of the large fall in this room, which was 20 feet or so in height, and prevented one going much beyond the first crosscut.

Leaving for the time the question of how the explosion originated, if we assume Room 5 to have been the scene of the origin, the flames swept out of this room into A-11, also into the adjoining rooms. One explosive wave passed through the last crosscut to A-12 and another outward on A-11. A branch of the explosion passed up the 3d and 4th south entries off A-11, and thence through a connection, spread through Rooms 20 to 15 off A-10. It is not clear whether this branch explosion died away before reaching A-10 or not. Another branch explosion entered the 1st and 2d blind or south entries off A-11, where a severe secondary explosion was caused, as indicated by the large amount of coked dust in the rooms.

The main wave continued along A-11 and a parallel wave along A-12, blowing down the timber and causing heavy falls. On reaching the slope, the explosion branched in three directions; one part passed directly across the slope and aircourse into B-7, where it died away, another passed north down the slope and nearly died away on the damp wet ground, only carrying sufficient flame to ignite dust and possibly a small percent of methane at the head of the A-13 and A-14 entries. The main part from both A-11 and A-12 passed outward on the slope, causing heavy falls just outbye these entries.

At this point the wet ground of a swamp was encountered which probably accounted for the lack of intensity outbye the fall for a distance of several hundred feet. However, on reaching A-10, the pressure was strong enough to burst the overcast and throw some of the material into A-10 to the right, and on entering a crosscut just beyond to the left, it tore a gate off a car which stood in the crosscut.

From this point outward, the explosion spread from the slope into the various entries on its way to the mouth of the mine. The stoppings between the slope and the aircourse were all more or less demolished and thrown toward the aircourse.

As the aircourse had little or no dust, and moreover, was on the return air side so that whatever dust existed was dampish, the flame did not pass through the aircourse to any extent, and apparently not at all outbye B-3 cutoff.

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-:- NOTES REGARDING GENERAL CONDITION OF MINE -:-

COAL DUST:

Although the condition of the wrecked roads was not favorable to judging what amount of coal dust was present along the passage ways prior to the explosion, from areas which were beyond the explosive wave, there would seem to have been a good deal of more or less dry dust in the mine. The coal was undercut before being shot and in cutting, the coal is of a

nature as to make considerable fine dust; that is, it breaks up into fine particles, as was evidenced by the clouds of dust surrounding the surface tipple while coal dumping was going on.

The mine made only a little water which was handled by an electric pump. The sump was located near A-12 entry. A 3-inch pipe line led up the main slope aircourse to the mouth. At intervals of several hundred feet, branch lines led through the crosscuts to the main slope with taps on the end so that the slope could be sprinkled by means of hose. In other parts of the mine, the roadways were sprinkled by tank cars. The inner parts of A-7 and A-8 were naturally damp. The "B" entries were said to be damp; also the main slope below A-10. In other portions of the mine, there were swamps in a few places.

The roadways were kept more or less watered, but owing to the dryness of the climate and scarcity of water, it is probable that not nearly enough water was used to render the dust inert when an explosion was well started.

Along the entries there was probably not an undue quantity of dry dust, but the amount required to carry an explosion from one point to another is very little, particularly when there is a slight percentage of methane in the mine air.

A number of samples of road dust and of coked dust were taken at various points in the mine as shown in the following table; the first analysis being that of a full section sample of the coal seam at the face. It was taken for purposes of comparison with the road dust and coked dust analyses.

Laboratory No. 10063-4; Full section of coal at face, as mined.

	Sample as received.	Moisture and ash free
Moisture	1.91	
Volatile matter... ...	32.27	36.06
Fixed carbon	57.21	63.94
Ash...	8.61	
	100.00	100.00

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Laboratory No. 10051; unburned coal dust from last crosscut, between A-11 and A-12 entries.

Moisture	3.54	
Volatile matter... ...	24.53	36.34
Fixed carbon	42.97	63.66
Ash...	28.96	
	100.00	100.00

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Laboratory No. 10052; Road dust from Room 47, A-7 entry - beyond area affected by explosion.

Moisture	3.47	
* Volatile matter... ...	21.23	40.51
Fixed carbon	31.17	59.49
Ash...	44.13	
	100.00	100.00

* Note - Probably contains water of crystallization of clay in ash, thus affecting carbon. Volatile ratio as determined by proximate method of analysis.

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Laboratory No. 9949; Coked dust from prop at mouth of Room 6, A-11 entry, near supposed origin of explosion.

Moisture	4.13	
Volatile matter... ...	18.38	24.03
Fixed carbon	58.12	75.97
Ash...	19.37	
	100.00	100.00

Laboratory No. 9948; Coked dust from prop in last crosscut between A-11 and A-12 entries.

Moisture	6.62	
Volatile matter... ...	20.49	26.91
Fixed carbon	55.66	73.09
Ash...	17.23	
	100.00	100.00

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Laboratory No. 9947; Coked dust from outbye side post in A-8 Entry at limit of explosion in this entry.

Moisture...	4.99	
Volatile matter.. ...	12.68	21.90 *
Fixed carbon	45.22	78.10 *
Ash...	37.11	
	100.00	100.00

* This carbon-volatile ratio is interesting as indicating more complete combustion where the explosion died away. The ash content is also higher than that of coke samples near origin.

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In the foregoing tables, one of the chief points of interest attach to the large percentage of ash in the road dust from Room 47. If the same large percentage of ash was present in the road dust in A-7 and A-8 where the explosion died away, it might be a fair inference that it was due to the large amount of foreign matter present that the flame was blanketed and put out.

The interesting feature of the coked dust analyses as compared with the coal analysis is the increase in fixed carbon relative to the volatile. It is hardly safe to figure upon the ash content shown in the several analyses of coked dust, inasmuch as there is probably foreign matter present. This isstrikingly the case in comparing analysis No. 9946 of coked dust with

analysis No. 10051 of unburned dust gathered from a point close by, the unburned dust having a larger amount of ash, although the fixed carbon-volatile ratio is the same as that of the analysis of coal from the face; relative to the fixed carbon, the volatile matter in the coked dust had decreased from 57 percent of the fixed carbon in the unburned dust to 37 percent in the coked dust. A still greater reduction is observed in analysis No. 9947.

FIRE DAMP:

Although this mine used Wolf locked safety lamps which were installed after the previous explosion in 1907, the management was contemplating taking them out if permission of the State Inspector of Mines could be obtained. The management claims that very little gas was found in the daily inspection, so little in fact, that they had no fear of its presence. What little was made, it was stated came mainly from the roof.

In going around the mine subsequent to the explosion, no blowers were noticed. There was more or less methane in the air up on top of the falls in a few rooms in which there was no circulation and where the falls were high, notably in Room 5 off A-11. The small total quantity of methane generated by the mine was indicated by analyses of samples of the return air taken on February 9th, nine days after the explosion, when there was about 85,000 cu. ft. of air per minute in the ventilating current. The average of several samples showed:

CO_2	0.33
O_2	20.40
CH_4	0.18
N	79.09

It will be observed that even at this time, not all of the after-damp was out of the mine, but the methane content would probably be either normal or possibly a little in excess of normal. The total quantity generated would be 156 cu. ft. per minute. On a minimum explosive basis, say 5½ percent, this would make 2800 cu. ft. of firedamp per minute. While the percentage of the total current was insignificent, if this quantity is concentrated and comes from a few places, as suspected, it might readily be a source of danger upon any interference with the normal ventilation in the respective district.

EXPLOSIVES:

A permissible explosive, Aetna B, was introduced into the mine two months prior to the explosion. Up to that time, 40 percent dynamite had been used. At first, the use of Aetna B was not made compulsory, but about two weeks prior to the explosion, an order was issued by the management that only Aetna B should be used and no shots employing other explosives would be fired by the shot firer. The explosive was given to the miners generally after 5 o'clock in the evening and taken home by them. Five to fifty pounds were issued in accordance with their desires. The sticks of explosive were carried in sacks by the miners when they went into the mine in the morning.

EXPLODERS:

The management stated that XXXXX caps, Hercules brand, with fuse were issued to the miners. Nevertheless, a box marked "Dupont Blasting Cap, XXX" and containing 13 caps was found by Mr. Jones and the writer in Room 4 off A-11. (See page 27) It is certainly desirable that XXXXX caps should be used to ensure complete detonation of the explosive.

METHOD OF PREPARING SHOTS:

The miners drilled the holes and left the necessary amount of explosive (1 to 1-1/3 sticks) with fuse and cap attached near the drill hole and convenient for the shot firer to handle.

After the miners went out of the mine, the shot firers made their rounds. Each hole was supposed to be carefully examined by a shot firer who used a bar for this purpose. Improper holes were not charged. Properly placed holes were charged, tamped, and fuse fired by the shot firer by means of a smouldering lamp cotton.

CAUSE OF EXPLOSION:

A presentation of theories. In the absence of direct evidence, the cause of the explosion can only be conjectured. If we allow that it originated in Room 5 off A-11, as indicated by the evidence, and if as seems apparent at the present time,(there was no one in this room or vicinity at the time of the explosion) we must assume the origin was due to either natural agencies or delayed human agencies. The following hypotheses are suggested:-

First:- that a heavy fall of roof occurred, liberating methane and while falling, sparks were thrown by friction of the rock against the sheared side, igniting the methane, which would be mixed with air by the fall. There have been instances in other mines where sparks have been observed by reliable witnesses during falls of roof. Also several explosions have occurred in England when no one was in the mine, which have been attributed to a similar cause. Mr. Thompson, division superintendent of the Colorado Fuel and Iron Co. reports an explosion at the Sopris Mine,

Colorado, several years ago, of unexplained cause, when no one was in the mine and methane was noted only after the explosion.

Second:- that the men who have been working this room had ignited a feeder of gas in some way not apparent, since they were provided with locked safety lamps, and later a fall of roof had thrown a body of gas upon the flame. This cause seems unlikely.

Third:- that the miners had prepared shots in this room and had fired the fuse, and that these shots had caused a dust explosion. This seems the least likely, inasmuch as the miners would not have had a chance to get as far as the mouth of the mine before the shots went off, with any ordinary length of fuse. There was no object in their using this procedure since the shots would be set off by a shot firer as soon as the shift was over. Moreover, they were using a permissible explosive which would not have been likely to have ignited coal dust, or a small percentage of gas.

Fourth:- that a fall of roof liberated a body of methane and subsequently or simultaneously a piece of rock at the edge of the fall dropped on a box of exploders which ignited the methane. There was ample coal dust in the room which would have been thrown into the air by the fall, to form,with the burning methane and air, all the elements necessary to start a dangerous explosion. This hypothesis, which to the writer seems the most plausible one, had these supporting features for foundation:-

(a) There was a heavy fall in the room.

(b) There was undoubtedly methane brought down by this fall, inasmuch as considerable gas continued to show after the explosion so that there must have been a large feeder in the roof.

(c) There were large masses of coked dust on props and ribs.

(d) In the adjoining room (4), a tin box of exploders was found alongside of the rib entirely unprotected. It would require only a small rock dropping from the roof to explode the caps, and it is known the flame from such exploders will ignite methane or fire damp when fired independent of explosive and tamping.

It is barely possible that further light may be thrown upon this matter when the fall in Room 5 is cleared up.

In connection with the investigation in this room, in a letter from Mr. E. H. Weitzel, Manager Fuel Department, C. F. & I. Co., dated February 21st, Mr. Weitzel states:-

> "With reference to the question of the origin of the Primero explosion, would say that after careful examination of all of the mine by our best men in connection with the State Mine Inspector, Mr. Jones, it seems to be the concensus of opinion that the explosion originated, as you state, in Room 5 off A-11 entry. In looking over the fire boss reports for the month of January, I find that there was gas found but once in this section of the mine in the month of January and that was reported in Room 5 off A-11 entry on January 29th, and noted as clear at 9:00 a.m. In checking over the condition of things, I learned that this was about the only time they ever found any gas in this locality and that on the 31st of January, the pillars had all been cut across in these six rooms so that they presented practically a longwall face; that no falls had occurred and it seems impossible that sufficient gas could have accumulated at this point to have caused the explosion. Personally, I am inclined to think that the explosion was started in some manner by the careless handling of explosives. We are now prosecuting the cleaning up as rapidly as possible and hope to determine the originating cause when the faces of these rooms are reached."

CONCLUDING REMARKS:

The mine as a whole was well administered. The system of mining and the layout of the mine was generally good. The use of locked safety

lamps prevented criticism on this score, but although the lamps were checked in and out at the lamp house, there was apparently no one stationed at the mouth of the mine to subject the safety lamps to a final inspection, as is the custom abroad and in gassy mines of certain districts in this country.

The explosives employed at the mine at the time of the explosion were permissible explosives, but the system of distribution was apparently not good, inasmuch as there was no check on the amount of explosives that a man might carry in, as each miner carried in his own explosives in sacks; also there was no certainty that other explosives than those allowed by the management might not be brought in with the permissible explosives. That this was done in the case of exploders was shown by the finding of a box containing XXX exploders instead of XXXXX, which were required by the management.

The method of storing the explosives underground was also faulty, as it led the men to do as they pleased in this regard, as shown by the loose sticks and adjacent box of exploders in Room 4, A-11. The system of firing by fuse in a mine which had been considered gassy was not good, inasmuch as ordinary fuse spits and will ignite fire damp, aside from a risk of igniting gas by use of smoldering lamp cotton employed by the shot firers.

The system of inspection holes by shot firers, having them charge the holes, tamp them with clay, and fire them when the miners were out of the mine, was excellent.

In view of the many careful precautions taken, it would seem that very little additional would make the method of firing shots ideal; namely, to place the handling and storage of explosives underground entirely in the

hands of the shot firers and to have them fire the shots with electric detonators and battery. A letter from Mr. Weitzel, dated
states that this procedure has now been adopted for this mine and will be extended to other mines of the Colorado Fuel & Iron Company.

The system of watering the mine or of rendering the coal dust inert appears to have been inadequate. With the shortage of water that exists in that portion of Colorado, and assuming that more water could not be readily obtained, it will be advisable for the operating company to test out some of the other means of rendering coal dust inert; namely, the use of calcium chloride in granulated form, applied dry in the goaves and inaccessible places, in order to supplement the sprinkling; also to experiment with the use of rock dust, or possibly powdered adobe, which could be more easily obtained.

It appears to the writer that the employment of adobe might, if successful, provide an easy method for the mines of southern Colorado and New Mexico in rendering coal dust inert. The adobe would have to be dried and then powdered by putting through crushers and rolls. In view of the unlimited quantity available in the vicinity of the mines, it could probably be supplied at low cost. The powdered adobe could be distributed along the roadways and thrown on the sides where there was opportunity for the lodgement of coal dust; also placed overhead on canvas shelves as at Altofts, England. The results of experiments at Altofts, England, at Lievin, France, and to a limited extent, at Pittsburgh, indicate the value of an inert dust which not only dilutes the coal dust, but also exercises a cooling and a smothering effect upon the flames.

Unless coal dust in such a mine as Primero can be made inert, there is always liability to recurrence of similar disasters, no matter what precautions may be taken in regard to gas and explosives, although unquestionably the reduction of the dangers from these sources by the use of locked safety lamps and permissibles eliminates a large share of the risk.

In closing, the writer cannot but remark on the courtesy with which the Mining Engineers of the United States Geological Survey were received by the operating company - every facility being given for investigation by Mr. Weitzel, Mr. Thompson and other officers of the company. The writer also desires to acknowledge the kind and valuable assistance given by Mr. John D. Jones, State Mine Inspector, during the investigation and subsequently in giving much valuable information by correspondence.

Respectfully submitted,

Geo S Rice

Mining Engineer.

Pittsburgh, Penna.,
July 29, 1910.

S

Correspondence

02/01/1910 - 05/25/1912

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

TECHNOLOGIC BRANCH.

REFER TO FILE NO.

Feb 14 1910

Dear Schabacker

Your telegram received this morning, Meantime I had a talk with Dr Holmes at Washington over the phone - I inclose telegrams for my files please show to Mr Roberts unless he has seen original - If Mr Paul did not receive my telegram about the apparatus I suggest he be wired to on the train so he can send it back and not leave the station more or less crippled I hope to get back inside of a week or ten days. will certainly by the latter time although will not reach Pueblo till Thursday; Mr Paul will probably not get there till Friday or Saturday on account of connections

4 return cards carried away by mistake

Yours truly G K Gilbert

DERICK K. COPELAND, President.
JNCAN UPHAM, Treasurer.

ALBERT BALL, Mechanical Engineer.
THOMAS W. FRY, Secretary.

SULLIVAN MACHINERY COMPANY,

GENERAL OFFICE
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KNOXVILLE, TENN.
NEW YORK.
PITTSBURG, PA.
ST. LOUIS, MO.
SALT LAKE, UTAH.
SAN FRANCISCO.
SYDNEY, N.S. WALES.
EUROPEAN AGENCY,
25 Rue Raffet, PARIS, FRANCE.

IN REPLY REFER TO

ST. LOUIS, MO. Feb. 1, 1910.

Mr. Geo. S. Rice,

Trinidad, Colo.

Dear Sir:--

Your telegram to Mr. Jarvis, reading, "If possible tell Jones that Holmes wires to proceed to McAlester instead of Colorado", was received too late to catch Mr. Jones. Mr. Jones was in our office in the morning, but we have no idea where to reach him this afternoon.

Yours very truly,

SULLIVAN MACHINERY COMPANY

P. F. Jarvis

BLW

SULLIVAN MACHINERY COMPANY,

GENERAL OFFICE
RAILWAY EXCHANGE
CHICAGO, U.S.A.

WORKS:
CLAREMONT, N.H. CHICAGO, ILL.

Cable Address:
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EL PASO, TEX. SALT LAKE, UTAH.
JOPLIN, MO. SAN FRANCISCO.
COBALT, ONT. SYDNEY, N.S. WALES.

EUROPEAN AGENCY,
25 Rue Raffet, PARIS, FRANCE.

IN REPLY REFER TO

ST. LOUIS, MO. February 1, 1910.

Mr. Paul,
c/o U. S. Geological Survey,
Arsenal Grounds, Pittsburg, Pa.

Dear Sir:--

I have received three telegrams addressed to Mr. L. M. Jones, the first two in care of Mr. A. J. Moorehead and the third in my care, as follows:

"Immediately upon arrival at McAlester proceed to Trinidad Colorado to join me."

"Disregard my wire requesting you to proceed to Trinidad."

"Disregard my wire requesting you to proceed to Trinidad."

These telegrams are all signed "Paul".

Mr. Jones left this office to call upon Mr. Jenkins, of the Western Coal & Mining Company, and upon trying to reach him there, I found he had left there also.

Mr. George S. Rice telephoned me from Chicago earlier this morning, requesting that Mr. Jones meet him at Kansas City tomorrow morning en route to Trinidad, which instructions were passed on to Mr. Jones by me. I assume this is in accordance with the later plan decided upon, and am advising you in regard to the matter, so that you may be familiar with Mr. Jones' movements.

I am sending the telegrams on to Mr. Rice at Trinidad together with copy of this letter for his information,

Yours truly,

P. F. Jarvis

PFJ-BLW
K-GSR

ACS/NB

REFER TO FILE No.

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

TECHNOLOGIC BRANCH

Pittsburgh, Pa., Feb. 2, 1910

Mr. Geo. S. Rice,

Primero, Colo.

My dear Mr. Rice:

Referring to your telegram of yesterday, I sent the bottles and cans to Mr. Paul before receiving your telegram. In all, I sent nine bottles and twelve cans.

I enclose herewith a supply of gas and coal sample cards, also some franked envelopes which I thought might be of some use to you.

Yours very truly,

A. C. J. Schabacker.

Mr. Rutledge with the Knoxville outfit is now at Drakesboro, Kentucky, where they had quite a disaster. Mr. Cavanaugh of this station was sent there to assist him.

COLORADO FUEL AND IRON COMPANY,
PUEBLO, COLORADO.
FUEL DEPARTMENT.

E. H. WEITZEL,
MANAGER.

February 4, 1910.

Mr. G. S. Rice,

Cardenas Hotel,

Trinidad, Colo.

Dear Sir:-

I am mailing you today under separate cover blue print of our Primero mine.

Will you kindly acknowledge receipt.

Yours very truly,

E. H. Weitzel

JLM-F

Chicago, February 12th, 1910.

Mr. H. M. Wilson,
Washington, D. C.

My dear Mr. Wilson:-

I reached here this morning from Denver. I was rather used up by severe work at Primero. The conditions of falls in the entries made it the most difficult mine to investigate that I have ever encountered and I kept at it very busily while there and was kept up rather late every evening in visiting with the operators.

The visit there and at Denver brought some fruit. Mr. J. H. Van Houten of the St. Louis & Rocky Mountain Fuel Company, the largest operator in New Mexico, has practically decided to buy a set of helmets. He is also going to install permissible explosives and will fo low out some of the suggestions made him in the matter of safety. The Victor Fuel Company of Colorado and the American Fuel Company of New Mexico (Gallup) the officers of which are personal friends of mine, expect to purchase five sets of apparatus for each company. The Rocky Mountain Fuel Company of Colorado also expects to purchase a set of apparatus. The Colorado Fuel & Iron Company already has a set of Draeger apparatus but had made no particular provisions for training. I emphasized this point with Mr. J. S. Welburn, president, whom I saw in Denver, and he and the other operators mentioned I think now fully realize the importance of such training.

The several operators are all anxious that the survey establish a station at Trinidad, Mr. Van Houten of course desires it at Raton, but there is no question but what Trinidad is the proper place from every standpoint. Since the various operators were getting apparatus and as they all seem to be impressed with the importance of training with it, I did not think it was a proper time to propose a joint station as at McAllister. I believe that the presence of an active mining engineer trained to the apparatus could, with the several private stations proposed, accomplish quiet as much good. The companies mentioned probably mine three fourths of the coal in New Mexico and Colorado of the total being mined. I do not say that if we had funds it would not be desirable to have a Government station, but it is not as urgent as the presence of a mining engineer for general instruction and investigative purposes.

Mr. Van Houten raised an interesting point, namely, that we should try to give instruction to the uneducated miners in the

fundamental principles of mining. In other words, establish classes for such instruction.

Per my telegram I was finally able to locate what I believed to be the site of the origin of the Primero explosion, namely, in room 5,11 A entry. Mr. Jones, the State Inspector, and who by the way is one of the ~~best~~ ablest inspectors I have met, was with me during a large part of the investigation. There was a tremendous fall of roof in room 5 and gas on top. What ignited the gas, which we believe to be the originating explosion, is a question. They employed shot fires, use permissible explosives (Aetna B) and locked safety lamps. The accident happened just as the men were going off duty but an hour before the shot firer began. The one unsatisfactory point in the shot firing system was the use of fuse, and this required that the miner crimp the detonater on the fuse. There is a possibility that while doing this the cap was exploded. Another possibility is that the fall of roof, which threw down gas, exploded a box of caps. A third possibility is that a lamp was broken in the presence of gas. I fear that the exact cause may never be known on account of the great fall of roof. I was desirous, if possible of running down the cause inasmuch as it was thought to be a mystery and the company felt they had done everything possible. The investigation proved, however, that the main part of the explosion was due to coal dust and in making this inert was and is something that should be done.

I discussed with Mr. Welburn the various remedies. He pointed out that there was a great scarcity of water and a great dryness of air. I agreed with this and suggested that the experiments with calcium chloride might help the situation. It also occurred partly as a suggestion of Mr.Van Houten that there was one means to remedy the situation in the arid country, namely, to introduce adobe dust into the mines after the Altofts method. I am very anxious that we shall try this out in an experimental way.

I secured a considerable number of samples of coal dust and a sample of the seam and of the various kinds of coke, all of which I think be of great value. I have arranged with the operators out there to get a considerable number of additional samples for Dr. Frazer's work.

Yours very truly,

EWP

GSR/ACS

Pittsburgh, Pa., February 16, 1910.

Mr. E. H. Weitzel, Manager,
Fuel Department,
C. F. & I. Co., Pueblo, Colo.

My dear Mr. Weitzel:

I returned yesterday from my Colorado trip, having stopped at Denver and saw some old friends, among them Mr. Welborn. I find I was negligent in not having acknowledged the blue print of your Primero mine which you sent to me while I was staying at Trinidad. It is of great assistance. If it is not asking too much, I will be very greatly obliged if you will send me a fresh copy inasmuch as I was obliged to use the one you sent to me in the mine and it is in very ragged condition.

After going over the ground very carefully, I am fully satisfied that the explosion originated in Room 5 off 11-A Entry. Unfortunately, as you know, this room is caved very high. Mr. Jones, State Inspector of Mines and myself climbed up on the fall until gas was encountered at a level about 20 feet above the level of the floor. This was on February 9th. I understood from your local men that the gas had been down to the neck of the room soon after the explosion. This was the only place in which I encountered any appreciable amount of gas throughout the whole mine. Of course it does not follow that the gas was the originating cause but it is strongly suggestive by the general conditions. In room 2 off this same entry, we found a stick and a half of explosive and a box containing 13 caps originally containing about 50 caps. This was placed close to the East

rib of the room. There are several possibilities; First, that there was a sudden burst of gas, either from the roll which this room was working towards or from the roof and that a lamp in imperfect condition yielded; Second, that a fall of roof which brought down gas broke the glass of the lamp and so caused ignition; third, that one of the miners in crimping cap on fuse exploded same, which ignited gas or dust,or both; fourth, that a box of caps was set off by a fall of rock.

It does not seem probable that a shot could have been fired in view of your precautions to prevent shooting except by shot firers.

It is to be hoped that when the room is cleared up and the four bodies supposed to be in same are recovered, that the evidence will show what happened. It is certainly very unfortunate to have any mystery connected with the origin of an explosion since not knowing the causes, we cannot take preventative measures.

Whatever the originating cause, I am satisfied that propagation throughout the mine was by coal dust. I took a number of samples of coal dust and will be glad to let you know what results we obtain as to their explosibility in certain laboratory testing.

I regret that I did not have an opportunity of seeing you again and talking over preventative measures for coal dust. I discussed it somewhat with your President, Mr. Welborn. He pointed out the scarcity of water for general humidifying. I suggested that at least the mine had better be sectionized; that is, sections three or four hundred feel long should be thoroughly dampened.to confine any explosion to limited areas.

Another matter which I discussed with him was the possibility of applying the Altofts (England) method of using shale dust to blanket

the flame and sectionize the mine by such means;that in your case you had a material which seemed applicable, namely, adobe dust. We have not had an opportunity for experimenting in this line ourselves but I am satisfied that the method is very promising.

A third plan is to use calcium chloride to lessen the amount of water required. We are not making some experiments in this part of the country, but I am not able as yet to give you any decided figures or statement as to its advocacy.

I will let you know the results of our analyses as soon as they have been made. If there is any further information that it is in my power to give, I will be very glad to give it.

Very truly yours,

Mining Enginer.

copy to Mr. Wilcox

GSR/ACS

Pittsburgh, Pa., February 18, 1910.

Mr. C. H. Weitzel,

Denver, Colo.

My dear Mr. Weitzel:

Supplementing my letter of a day or two ago, I understood that your engineering department was preparing a map showing the location of the bodies that had been found in the Primero Mine. If this is the case, will you be kind enough to send me a copy?

Yours very truly

Mining Engineer.

GSR/ACS

Pittsburgh, Pa., February 18, 1910.

Mr. John D. Jones,
State Mine Inspector,
Denver, Colo.

My dear Mr. Jones:

I reached Pittsburgh, via. Denver and Chicago, on Tuesday, and have since been trying to catch up with the accumulated mail and other matters.

When I was in Denver, I noticed that the paper reported that you had called upon two more of your inspectors to go to Primero, and the paper conjectured that there was something unexpected shown.

I have very much wondered what the further results of your investigation were. I presume that you made no further discoveries as yet in connection with Room 5, 11-A Entry on account of the tremendous falls. I shall be interested in knowing the results of your investigations in the first and second blinds off 12 A, and in the face of the main slope and 13-A and 14-A. Was it in 14-A that the drill was found in the drill hole? Any additional light that you may be able to throw on the matter I will be very glad to know about.

The chemical laboratory here is somewhat crowded and it may be another week or ten days before I have reports about the mine air and the samples of coal dust, etc. As soon as I have these reports, I will be glad to send you copy.

Yours very truly,

Mining Engineer.

HE COLORADO FUEL AND IRON COMPANY,
PUEBLO, COLORADO.
FUEL DEPARTMENT.
E.H.WEITZEL,
MANAGER.

February 21st, 1910.

Mr. Geo. S. Rice,
Mining Engineer,
United States Geological Survey,
Pittsburgh, Pa.

My Dear Mr. Rice:-

I have before me your favor of Feb. 16th and 18th and have arranged to send you another copy of the Primero mine map under separate cover.

We are preparing a map showing location of the bodies but as there are eleven yet to be found and they are under large falls of rock it will be impossible to complete this map for some time. Will, however, arrange to send you a map when it is completed.

With reference to the question of the origin of the Primero explosion, would say that after careful examination of all of mine by our best men in connection with the State Mine Inspector Mr. Jones, it seems to be the concenus of opinion that the explosion originated, as you state, in room 5 off of 11-A entry. In looking over the Fire Boss reports for the month of January I find that there was gas found but once in this section of the mine in the month of January and that was reported in room 5, off 11 entry on January 29th and noted as clear at 9:00 A.M. In checking over the condition of things in these rooms with our Fire Boss and our Inspector Mr. Manley, I learned that this was about the only time they ever found any gas in this locality and that on the 31st of January the pillars had all been cut across in these six rooms so that they presented practically a long wall face; that no falls had occurred and it seems impossible that sufficient gas could have accumulated at this point to have caused the explosion. Personally I am inclined to think that the explosion was started in some manner by the careless handling of explosives. We are prosecuting the work of cleaning up as readily as possible and hope to determine the originating cause when the face of these rooms are reached.

Would you care to have me advise you when we reach the neck of these rooms on the entry so that you could be present when the faces are reached? Would be pleased to know the results of your analysis and any further suggestions that you have to make in regard to measures of safety.

I must ask you to treat the above as strictly confidential especially that part referring to the probable cause as it is merely a guess and we hope that when the faces of these rooms are reached to be able to determine exactly what took place.

Yours truly,

E H Weitzel

EHW-B

Office of

State Inspector of Coal Mines

Capitol Building

DENVER, COLO. Feb. 25, 1910.

Mr. Geo. S. Rice,

U.S.G.S.

Pittsburg, Pa.

Dear Sir:-

Your letter of the 18th inst. received and in reply I will quote from my report on the Primero explosion covering the localities you refer to and which read s as follows:

"From the mouths of A-11 and A-12, the explosion traveled north and south through both the Main and air course, and east into B-7 and B-8. This district (B-7 & 8) being wet and perfectly destitute of any elements to supply the explosion, the force which was quite strong at the entrance and due only to the expansive power of the explosion in A-11 and A-12 gradually weakened as it sped east and it completely died away at a distance of about 400 feet. The faces of the first and second blinds, which were in 190 feet, off B-7, were undercut to a depth of from 5 to 6 feet, each with three holes drilled and the powder and fuse already prepared for the shot-firers. These places although only 390 feet from the mouth of A-12 and the Main North, where the force was most terrific, were not the least disturbed. The two men who worked in this last blind were killed on their way out.

A-13 & A-14 That the force traveled north along the Main from A-12 was made evident by huge timbers thrown several feet in that direction at the intersection of the Main and the haulage passage from B-7 to A-12. The Main North from A-12 to A-13 , a part

Office of
State Inspector of Coal Mines
Capitol Building

DENVER, COLO.

G.S.R. (2)

as before stated,was wet and muddy and consequently there were no cokings nor any other indications of heat to have existed at any point in this locality. Yet, it is evident, from the cokings found in A-13 , that the temperature was sufficiently high to carry the explosion from one place to the other over this wet zone. The disturbed timber in the intervening space between A-12 and the east entrance to A-13 pass-by showed a slight tendency, but not enough for positive assurance, of an inward force. From there in to the face of A-13 (400 ft.), which part was heavily caved, the position of the disturbed timber showed that the final movement was outward.. A loaded car standing on the Main North, between A-13 and A-14, had the bumpers of its north end heaped with slack and small chips of wood, which was conclusive evidence that the force was outward from A-14. There was no one working in A-14, and the only way I have to account for the forces being outward from the faces of these places is as follows:

A-13 and A-14 are in only about 450 ft. from the Main North. The chain pillar between the two entries is 80 ft. wide. In A-13 is a pass-by 300 ft. long, which begins about 50 ft. from the entrance and ends 100 ft. back from the face. Th This pass-by is driven in the chain pillar and has three cross cuts connecting with A-14. The explosion traveled from A-12 to the

OHN D. JONES
INSPECTOR

DAVID J. GRIFFITHS, DEPUTY INSPECTOR
FRANK OBERDING
A. B. TIBBITS, SECRETARY

Office of
State Inspector of Coal Mines
Capitol Building

DENVER, COLO.

east end of the pass-by in A-13, but the quantity of dust gathered was not enough to destroy all the oxygen in the air. When the explosion reached within close proximity of the face of A-13, it was supplied with increased quantities of dust and probably an atmosphere containing some percentage of firedamp, and aided by both these elements of destruction, the explosion suddenly was magnified and it quickly spread backward from the face to absorb the unconsumed oxygen of its former trail and thus brought about the outward pressure. From the pass-by the explosion went through the cross cuts to A-14, and thence outward. While I do not believe that the explosion started in this vicinity, yet I must say that, had this particular district been a strong generator of firedamp, the conditions would have been very favorable for a gas explosion, as the face of A-13 was 196 ft. and A-14 221 ft. inside of their last cross cut, while they should have had at least three cross cuts within such a space, and such an omission in itself reflects discredit on the mine official . There was very little damage done to B-9 and B-10. The direction of the force was inward as the door in the haulage cross cut between B-9 and the Main North, was blown east several feet. The tracklayer was killed in B-9. All other employes of B-9 and B-10 were reported to have been out of the mine."

JOHN D. JONES
INSPECTOR

DAVID J. GRIFFITHS, DEPUTY INSPECTOR
FRANK OBERDING
A. B. TIBBITS, SECRETARY

Office of
State Inspector of Coal Mines
Capitol Building

DENVER, COLO.

G.S.R. (4)

In first blind of A-12, the force was inward. The entry was caved heavily with small intermittent spaces between the rooms left partially intact. Room No.5, where two bodies were found, stood intactin its entire length, and all its props were thickly coated with bright coke, mostly on the inner side. Room No.7 was badly caved."

I hope this will give you the additional information you desire. Should further light be thrown on the matter disclosing more evidence ,I shall be glad to let you know.

Thanking you for your interest in the matter,I am with best regards,

Yours very truly,

John D. Jones.

State Inspector of Coal Mines.

GSR/ACS

Pittsburgh, Pa., March 1, 1910.

Mr. E. H. Weitzel, Manager,
Fuel Department,
C. F. & I. Co.,
Pueblo, Colo.

My dear Mr. Weitzel:

I have your letter of February 21st and another copy of the Primero mine map. I thank you very much for the information and will keep it confidential as you suggest.

I will be very much pleased if you will let me know when you are likely to reach the 5th room off 11-A Entry in clearing up the mine. While I may not be able to come myself, it is possible that we will have a representative in that district in a short time, and if I knew the time, I might be able to make one arrangement or the other.

Very truly yours,

Mining Engineer.

Copy to Mr. H. M. Wilson

GSR/ACS

Pittsburgh, Pa., March 1, 1910.

Mr. John D. Jones,
State Inspector of Coal Mines,
Denver, Colo.

Dear Sir:-

I have your letter of February 25th containing details about the Primero explosion. I thank you very much for your trouble and kindness in preparing this for me. It helps me considerably in my report.

If anything occurs to me on studying the matter further, I will be glad to write you about it, and I hope to have some additional information from you when you have a chance to see the head of Room 5 off 11-A Entry.

Yours very truly,

Mining Engineer.

GSR/ACS

Pittsburgh, Pa., March 5, 1910.

Mr. John D. Jones,
State Inspector of Coal Mines,
Denver, Colo.

My dear Mr. Jones:

I enclose herewith copies of gas analyses Nos. 9928 and 9929 of the return air of the Primero Mine taken in your presence February 19, 1910. These were duplicate samples as you will recall, and I do not quite see why there should be so much variation in the CO_2 determination. I presume for our purposes we must average the two analyses.

The quantity of CH_4, while apparently rather small after considering the volume of air passing amounts to a good deal in the aggregate. Taking the average figure, 18/100 percent, it means 160 cubic feet of pure methane is discharged into the mine every minute. With an 8 percent mixture, this would make an explosive mixture of 2000 cubic feet per minute.

If you should care to do so some time in the future, I will send you some sampling bottles and you can see if it continuess to make gas to about the same extent.

I have not yet had reports of the coal and coke analyses. When I receive them, I will see that copies are sent to you.

Yours very truly,

Mining Engineer.

Encl.

Copy to Mr. H. M. Wilson

GSR/ACS

Pittsburgh, Pa., March 5, 1910.

Mr. E. H. Weitzel, Manager,
Fuel Dept., C. F. & I. Co.,
Pueblo, Colo.

My dear Mr. Weitzel:

I enclose copies of two analyses taken on February 19th. These were duplicate samples taken in the presence of Mr. John D. Jones, State Inspector, to whom I am sending copies of the analyses at his request.

These samples were taken in the return air near the fan. While the percentages of methane seem small, as there was about 88,800 cubic feet of air passing, it means that there was an average (the two samples were supposed to be duplicates) of 160 cubic feet of methane discharged into the mine per minute. With an 8 percent mixture, this would make 2000 cubic feet of explosive gas mixture produced by the mine per minute.

I have not yet had reports of the analyses of the coal and coke. When I receive them, I will send you copies.

Yours very truly,

Mining Engineer.

Encl.

Copy to Mr. H. M. Wilson

GSR/ACS

Pittsburgh, Pa., March 5, 1910.

Mr. H. M. Wilson,

Washington, D.C.

My dear Mr. Wilson:

I enclose copies of two letters relative to gas samples taken at Primero, Colo. I have sent them direct on the understanding that I am allowed to do so so that they may be of guidance in the safe conduct of the mine.

When I have received the analyses of the road dust and coke, is it proper to submit them directly or shall they be sent through your office? Of course you understand that they would have no commercial significance.

Very truly yours,

Mining Engineer.

Encl.
Letter to Mr. John D. Jones
Mr. E. H. Weitzel
Copies of analyses 9928 and 9929.

GSR/ACS

Pittsburgh, Pa., March 21, 1910.

Mr. H. M. Wilson — Thru Engineer in Charge

Washington, D.C.

My dear Mr. Wilson.

I enclose herewith three sets of analyses of samples taken in the Primero Mine, Colo. subsequent to the explosion January 31, 1910. Each set contains 8 analyses, and an explanation of where the samples were from is typewritten on the form.

I wish that you would submit one set to Mr. E. H. Weitzel, Manager Fuel Department, C. F. & I. Co., Pueblo, Colo., another set to Mr. John D. Jones, State Inspector of Coal Mines, Denver, Colo., the third set is for your files.

I will be pleased if in forwarding the above, you will mention it was done at my request.

Yours very truly,

Mining Engineer.

Encl.

THE COLORADO FUEL AND IRON COMPANY,
PUEBLO, COLORADO.
FUEL DEPARTMENT.

E. H. WEITZEL,
MANAGER.

March 30. 1910.

Mr. Geo. S. Rice,

Mining Engineer, U.S. Geological Survey,

Pittsburg, Pa.

Dear Sir:-

I wish to thank you for the analyses of samples of coal and coal dust taken from the Primero mine. I received this information from the Washington office as I understand from your request. It will be used in the manner prescribed on the analyses.

Yours truly,

E H Weitzel

EHW-B

GSR/ACS

Pittsburgh, Pa., April 15, 1910.

Mr. H. M. Wilson, Thru Engineer in Charge

Washington, D.C.

My dear Mr. Wilson:

Mines and Minerals have a very good reproduction of the Primero map, evidently photographed directly from the original. It will save a great deal of time to attach copies of this map to the several copies of my formal report. I therefore suggest that you order two or three copies of their Primero article contained in the March issue of Mines and Minerals, or else ask them if they can give us some separate prints of the map.

Very truly yours,

GSR

Mining Engineer.

GSR/ACS

Pittsburgh, Pa., April 15, 1910.

Mr. R. L. Herrick, Assoc. Editor,
Mines and Minerals,
728 Equitable Building,
Denver, Colo.

Dear Sir:-

You may recall that you offered to send me several photographs that you took at Primero if they turned out good. I would very much like to have a copy of Figure 1, 2, 3, 5 and 6, and if you have the photograph which you took of some of my party, I would like a copy of that also.

I would be glad to pay the cost of the pirtures if you will let me know what it is. I wish to congratulate you on your successful and interesting article which has unusual merit.

Very truly yours,

GSR

Mining Engineer.

35—7626

Mines and Minerals

SCRANTON, PENNA.
DENVER. COLO.

ROOM 1, FERGUSON BUILDING
DENVER, COLO.

April 18, 1910.

Mr. George S. Rice, E. M.,
United States Geological Survey,
Pittsburgh, Pa.

Dear Mr. Rice:-

In Mr. Herrick's absence from the city allow me to acknowledge receipt of your favor of April 15th.

I have written Mr. Herrick concerning your request and will write you again as soon as I hear from him.

Mr. Herrick will return here in about six weeks' time.

Trusting that this will be satisfactory to you, believe me,

Sincerely yours,

I. L. Lloyd

Sec'y. to Associate Editor.

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

WASHINGTON

TECHNOLOGIC BRANCH.

April 22, 1910.

My dear Mr. Rice: (Through engineer in charge)

In reply to your letter of April 15:

I have procured four copies of the Primero map which you asked for and am sending them herewith for use in connection with your formal report on the Primero disaster.

The Editor of Mines and Minerals was very kind and prompt in his response contributing these, and I wish you would bear him in mind whenever anything is to be given out to the mining papers.

Very truly yours,

H. Wilson

Assistant Chief Technologist.

GSR/AFS

Pittsburgh, Pa., May 28, 1910.

Mr. E. B. Wilson, Editor,
Mines & Minerals,
Scranton, Penna.

Dear Mr. Wilson:

I enclose herewith letter from Secretary to Mr. Herrick. Mr. Herrick originally offered to send me copies of these photographs. I will, of course, be glad to pay for the cost of same if you still have the negatives on hand.

Yours very truly,

Mining Engineer.

Encl.

GSR/ACS

Pittsburgh, Pa., May 28, 1910.

Mr. John D. Jones,
State Coal Mine Inspector,
Denver, Colo.

My dear Mr. Jones:

Has the cleaning up at Primero been finished and have any additional facts been discovered in the process of cleaning up?

I have been down in Alabama investigating the two explosions there. In both of these cases, I am inclined to think that gas was the originating cause, although dust was a means of carrying throughout the mine. There was much greater amount of coked dust in evidence than in the Primero mines.

Yours very truly,

Mining Engineer.

GSR/ACS

Pittsburgh, Pa., May 28, 1910.

Mr. E. H. Weitzel,

Pueblo, Colo.

My dear Mr. Weitzel:

I heard nothing further from you regarding the Primero investigation. As a matter of fact, I would have been unable to have gone to Primero as the Alabama explosions have more than occupied my time, taken in connection with other matters.

Have you reached the room in which we thought the explosion originated, and has any new information been obtained? I will be very much pleased to learn as I have withheld my formal report until I could learn all of the developments.

Yours very truly,

Mining Engineer.

THE COLORADO FUEL AND IRON COMPANY,
PUEBLO, COLORADO.
FUEL DEPARTMENT.
E.H. WEITZEL,
MANAGER.

May 31, 1910.

File 51,

Mr. Geo. S. Rice,
Mining Engineer, U.S. Geological Survey,
Technologic Branch,
Pittsburgh, Pa.

My Dear Mr. Rice:-

I have your favor of May 28th. We found the last two bodies at Primero May 19th. We have not yet reached the room on 11-A Entry where the explosion seemed to have originated.

While at Trinidad last week I arranged to have a blue print showing the location of all the bodies made up for you.

Would say that our investigations to date have not disclosed any evidence which would lead us to think that the explosion originated at any other than the point determined by yourself and the State Mine Inspectors, but as there were no bodies found within a considerable distance of this point and as all the bodies have been recovered it would seem that the origin of the explosion was without human agency.

I will forward the map to you as soon as it has been completed. Would be very much pleased if you could make a visit to the mine. We are all deeply puzzled as to how the thing could have occurred at a point where there were no men. We hope that in cleaning up this room something will be found to indicate the cause.

Yours very truly,

E H Weitzel

EHW-B

JAMES DALRYMPLE
A. R. TIBBITS, SECRETARY

Office of
State Inspector of Coal Mines
Capitol Building

DENVER, COLO. May 31,1910.

Mr.Geo.S.Rice,

U.S.G.S.

Pittsburg,Pa.

My Dear Mr.Rice:-

Replying to your favor of the 28th inst. I beg to state that the cleaning at the Primero mine is still in progress. All is cleaned excepting the inner parts of A-9 & 10, 11 & 12. The last two bodies were found along the rib between rooms 2 & 3 in 10 blind, off A-9, May 20th. This completes the list of the killed. The 2nd body of A-13 was also found in the undercutting at the face of the cross cut to A-14. If you remember I informed you in my last letter that on Feb.12th, I reached the face of A-13 and found a body in the undercutting. There was about 2 feet of water at the face and the roof falls reached within 3 feet of the face. I went to the edge of the water and noticed the shoulder of the body above the surface of the water. Of course this body was immediately taken out. The other body not being visible at the time, we thought it was under the falls near the powder box, and after all of the falls were removed and the entry cleaned to the face, it was found to be in the undercutting at the faceand was originnally underlying the first body. No doubt the deceased had been in the act of undermining at the time of the accident. Room 5 A-11 will be cleaned out as soon as they can get to it.

Yours very truly,

John D. Jones.

lines and Minerals
SCRANTON, PENNA.
DENVER, COLO.

EBW/THK

SCRANTON, PENNA., U. S. A.

June 1, 1910.

Mr. George S. Rice,

Mining Engineer, Technologic Branch,

U. S. Geological Survey,

Pittsburg, Pa.

Dear Sir:-

Your favor of the 28th ult. received. We do not think that we ever had the negatives of the photographs of which you speak. We have the photographs touched up and will lend them to you. They are going with this mail. After you have made use of them will you kindly return them? We find that we returned a large number of films which Mr. Herrick sent us back to him. We have one, however, here which we did not publish on account of the number which came in. This I find in my drawer and as it includes you we are sending it. Will you kindly return it? We also have another evidently of a fan which we did not make use of. This we are sending to you. There is still another which may not be of use but may come in handy. This is of the main north mine showing where they are cleaning the caved slope. There was another photograph touched up showing the Draeger apparatus on two men. This we are also sending you. When you are through with these will you kindly return and oblige. We may never make use of them and then again we may need them, especially the films.

Mr. Herrick sent in to us about 20 photographs, we believe, and only a very few films.

Yours very truly,

E B Wilson

Editor.

GSR/ACS

Pittsburgh, Pa., June 4, 1910.

Mr. E. B. Wilson, Editor,
Mines and Minerals,
Scranton, Penna.

My dear Mr. Wilson:

I have your letter of June 1st and also the negatives and photographs, for which I am very grateful. I am having copies of these made for our private reports. As soon as the copies have been made I will return the originals.

Again thanking you for your kindness,

Yours very truly,

Mining Engineer.

GSR/ACS

Pittsburgh, Penna., June 4, 1910.

Mr. E. H. Weitzel,
C. F. & I. Co.,
Pueblo, Colo.

My dear Mr. Weitzel:

I have your letter of May 31st regarding Primero. I will be very much pleased to receive the blue-print showing location of all the bodies.

Are you entirely assured that there was no one in Room 5 - 11-A Entry? At the time I was there, it was reported that four men had worked in this room.

While I am aware that you checked the men in by means of their safety lamps, as I understood it, it was entirely possible for a man to enter the mine without being checked in, provided he had a safety lamp of his own. I presume that there would be little danger of a mans sneaking in with an open light.

It is true that there have been at least two authenticated explosions that have occurred in England when no one was in the mine, and which were attributed to a spark made by falling roof.

From your present information, where were the men working who were nearest to Room 5 at the time of the explosion?

Yours very truly,

Mining Engineer.

FUEL DEPARTMENT

E. H. WEITZEL,
MANAGER

June 14, 1910.

Mr. E. H. Weitzel,

Manager, Pueblo, Colo.

Dear Sir:-

In answer to your letter of June 8th regarding the explosion at Sopris mine which occurred while I was there: I give you below details of same.

On Saturday, October 13th, 1906, having received all necessary repairs for the fan engine it was decided to shut the fan down on Sunday morning to give same a thorough over-hauling. As a precaution against any fire which might have been in mine after the night shift of Saturday, and the shot firers, the fire boss, Redpath, was sent through the mine early Sunday morning to make a complete examination of all working places. He arrived at the mouth of the mine Sunday morning, October 14th, and reported everything O.K. Fan was shut down and a good force of men kept busy on fan engine and guard stationed at mouth of mine to see that no one went inside, and in the presence of myself and machinist Gillen, who did not leave the work until repairs were completed, the engine was thoroughly over-hauled and started up about 4 o'clock Sunday afternoon. The fan was started at about half speed, or about 40 R.P.M. andkept on this speed until about 5 o'clock, so that the danger of overheating would be overcome, when speed was increased to 60 revolutions and about 5:30 placed on full speed.

Night Boss John Jenkins, who is at present Superintendent at Morley, appeared about 6:30 P.M. and met men at mouth of the mine

and started in at the head of his night shift about 6:40 P.M. No indications of anything unusual were detected by the night shift until they arrived at 10 West Entry where Mr. Jenkins found the trap door blown out of rock stopping and the water barrel blown out on track. He immediately realized that something was wrong in the mine and sent his men out and came to my house and reported same. In the presence of Mine Boss, Night Boss and two Fire Bosses, I started into the mine with safety lamps and traveled as far as the trap door which was blown out just inside the 10th west, went through the trap door, hung a brattice on same throwing the air with us and traveled the air course which showed no indications of much damage until we arrived at the over-cast 14th West. At this point we found the over-cast which had been built of forth pound steel rails and concrete badly dmolished. We crossed into the slope at this point and on rope parting found a number of empty cars badly damaged, having been blown towards the mouth of the mine. We then traveled the slope to the 15th and 16th east, and found the new overcast at 16 East, which was built the same as the one on 14th West, badly dmolished. We then retreated, traveling the air course to the 15th West and from there to the face of the slope and air course, retreated and examined 17th and 18th East and back out the slope to the 16th East. We attempted to travel the 16th East and got within about 600 feet of the slope when we encountered gas, the only gas we found during our exploration of the working places both on the east and west sides. We then retreated and traveled on the 15th East

to about room 7 when we encountered a timber jam which had been blown out and again retreated and bratticed clear to the 16th East and eventually the 15th East. It took several days to clear these entries of gas and when done it was very evident that the source of the explosion was room 22, 16th East.

There was absolutely no one in the mine at the time the explosion occurred. At what hour during the day it happened no one knows. The peculiar part of the situation is that at no time of the day was there any indication at the fan or at the mouth of the mine that any explosion had occurred on the inside. I was at the fan from the time of shut down until the time of starting and the watchman at the mouth of mine did not leave until the night shift went in. There was no concussion felt and no dust or smoke appeared either at the fan or at the mouth of the mine. Before leaving the mine Sunday morning the fire boss took particular care to see that all doors were O.K. The 16th East entry was badly caved from the overcast up to about room 17. 15th East was badly caved from the intersection with main slope up to room 15. The condition of the entries inside of these falls was good, comparatively no timbers blown out and no falls. The timber at the neck of room 22, 16th East was charred and splattered with coke. There must have been several different explosions from the way we found the deposit of coke, same being found, in one particular case, on timber which stood well out

E COLORADO FUEL & IRON COMPANY
PUEBLO, COLORADO
FUEL DEPARTMENT
I. WEITZEL,
MANAGER

from the rib near the intersection of the hauling cross cut from 16th to 15th East just inside of room 22, a very stong deposit of coke was found on four sides of the timbers. After all of the rooms had been examined no one who had traveled all of the working places could make up his mind at just what point on the 15th and 16th the explosion occurred, and no indications were found of fire at the face of any of the rooms. The more I examined into the conditions in connection with this explosion the more it baffled me as well as all others who examined the mine.

The damage to the mine was comparatively light in comparison to the force of the explosion as shown on the Main South in the vicinity of rope parting, but the extent of the damage did not travel out of the mine beyond the 14th East.

Yours truly,

(SIGNED) J.S.Thompson,

THE COLORADO FUEL AND IRON COMPANY,
PUEBLO, COLORADO.
FUEL DEPARTMENT.
E. H. WEITZEL,
MANAGER.

June 15, 1910.

File 51,

Mr. Geo. S. Rice,
Mining Engineer, U.S. Geological Survey,
Technologic Branch,
Pittsburgh, Pa.

My Dear Mr. Rice:-

Referring to your letter of June 4th.

We are entirely sure that there was no one in Room 5, 11-A Entry. Of the four men working in this room two were not at work on the day of the explosion and the bodies of the other two were found near the mine opening. Our original count of 75 dead based on the safety lamps has proven correct and every one has been accounted for.

I am sending you under separate cover a print of the Primero mine showing the location of all of the bodies.

Your statement that there has been two authenticated explosions in England recalled to my mind the explosion we had a few years ago at Sopris. Our Mr. J. S. Thompson, who is now Division Superintendent in Trinidad, and whom you met at Primero, was at that time Superintendent at Sopris and I have asked him to give me a full account of the occurrence at Sopris and I am enclosing herewith a copy of his letter. There has never been any explanation of this Sopris explosion.

Yours very truly,

E H Weitzel

EHW-B

GSR/ACS

Pittsburgh, Pa., June 21, 1910.

Mr. E. H. Weitzel, Manager,
The Colorado Fuel and Iron Company,
Pueblo, Colo.

My dear Mr. Weitzel:

I have your letter of June 15th in reference to there being no one in Room 5, 11-A Entry, Primero. Also copy of the print showing location of all the bodies.

I was exceedingly interested in Mr. Thompson's statement of the explosion that occurred at Sopris. In the case of the English explosions, they are supposed to have occurred by reason of friction that took place at the time of the fall. It would not require this explanation in Primero inasmuch as it was the custom there to keep explosive caps in the working places. Mr. Jones, State Inspector, and myself found a small tin box containing exploders in a room near room 5. This box was close to the rib, but entirely exposed to a fall. Granted a similar situation in Room 5, it is not difficult to see that if a fall had occurred, the edge of which struck such a box, you would have all the conditions necessary for starting an explosion. That is, there would be the concussion, the dust would be thrown up in clouds, and if the fall brought down gas, this with the dust might readily iggite from the flame of the exploders.

Whether or not this conjecture is correct, it suggests that it will be desirable to protect from possibility of such accidents by not allowing the miners to handle the exploders, or if they do, to require that the exploders be placed in a strong wooden box and the box to be left in a

crossout or in a niche where there is no danger of there being a roof fall.

Yours very truly,

Mining Engineer.

c. c. to Dr. J. A. Holmes

E COLORADO FUEL AND IRON COMPANY,
PUEBLO, COLORADO.
FUEL DEPARTMENT.
E.H.WEITZEL,
MANAGER

June 28th, 1910.

Mr. Geo. S. Rice,

Mining Engineer, United States Geological Survey,
Technologic Branch,

Pittsburgh, Pa.

My Dear Mr. Rice:-

I have your favor of June 21st.

Since the Primero explosion we have taken the detonators entirely out of the hands of the miners. The Company is now furnishing them and they are handled only by shot firers. This is being done at all our mines where detonators are used. We have also introduced batteries for firing shots at several of the mines and expect to continue their introduction until the use of fuse has been entirely discontinued.

Yours very truly,

E H Weitzel

EHW

DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES

WASHINGTON

July 23, 1910.

Mr. George S. Rice,
Bureau of Mines,
Pittsburg, Pa.

Dear Sir:

I am returning herewith the letter from Mr. E. H. Weitzel of the Colorado Fuel and Iron Company, as per your request.

I note that the formal report on the explosion at the Primero mine will be submitted in the course of a few days.

Yours very truly,

Van. H. Manning

Chief Clerk.

Incl.

ACS/MB

Pittsburgh, Pa., July 29, 1910.

Acting Director,
Bureau of Mines,
Washington, D.C.

Thru Engineer in Charge

Dear Sir:-

Enclosed please find copy of my report on the explosion which occurred at the Primero Mine of the Colorado Fuel and Iron Co. on January 31st, 1910.

Yours very truly,

Mining Engineer.

Encl.

S

DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES

WASHINGTON

PLEASE REFER TO
OUR FILE NO.

August 4, 1910.

Mr. Geo. S. Rice,
Bureau of Mines,
Pittsburg, Pa.

Dear Mr. Rice:

Your report on the Primero disaster was referred to me for comment. I found on inquiry that the Acting Director had already discussed with you the matter of its revision for publication in bulletin form.

The report has been noted as in course of preparation.

Very truly yours,

S. Sanford

Asst. Engineer.

GSR/ACS

Pittsburgh, Pa., August 8, 1910.

Director,
Bureau of Mines,
Washington, D. C.

Your file 52-33

Sir:-

Referring to a letter received from Mr. Sanford about report on the Primero Disaster and the matter of the revision of this report and others of a similar nature for publication, will it be advisable for the mining engineers who have written the various reports to prepare the respective reports for publication before submitting, or is it intended that Mr. Sanford do this?

While it may save the time of the mining engineers materially, it does seem that it might be best that we should make the first revision.

Respectfully,

Mining Engineer.

GSR/ACS

Pittsburgh, Pa., August 9, 1910.

Director,
Bureau of Mines,
Washington, D. C.

Sir:-

I submit herewith another copy of my report on the Primero explosion which occurred January 31, 1910. Hitherto it has been the custom to submit copies of such reports in confidence to the management of the operating company with the expressed understanding that it shall not be published or used in litigation.

I suggest that this copy be sent to Mr. J. F. Welburn, President, Colorado Fuel and Iron Company, Denver, Colo.

Very truly yours,

Mining Engineer.

Encl.

ACS/NB

Pittsburgh, Pa., October 3, 1910.

Mr. E. B. Wilson, Editor,
Mines and Minerals,
Scranton, Penna.

Dear Mr. Wilson:

I am returning under separate cover the photographs and films pertaining to the Primero, Colorado, explosion which you so kindly sent me some time since.

We have kept these photographs much longer than we expected and desire to beg your pardon for having been so remiss.

Please accept our warmest thanks for your courtesy in this matter.

Yours very truly,

Mining Engineer.

Coal and Minerals
SCRANTON, PENNA.
DENVER, COLO.

EBW/EHK

SCRANTON, PENNA., U. S. A.

October 6, 1910.

Mr. George S. Rice,

Mining Engr. U. S. Bureau of Mines,

Pittsburg, Pa.

Dear Mr. Rice:-

Your favor of October 3rd received, and today the photographs which you mentioned in your letter appeared. We were in no hurry for them. We also wish to thank you for your kind remembrance in sending us the "Explosibility of Coal Dust." We expect to take a look at that later on. As it is we were only able to review it casually.

Yours very truly,

E B Wilson

Editor.

OSR:AHE

May 25, 1912.

PRIMERO SAMPLING.

Director: -

I have just received from you copy of Mr. J. C. Roberts report on the mine sampling at Primero; I have also received from Mr. Roberts copies of the Primero mine section reports.

Are we to make the formal reports on this matter from here? If so please send to me as early as completed three sets of analyses; one for transmittal to the Navy Department, one for your files and one for my file.

In this connection I wish to bring to your attention that it is desirable to have our mine files here as complete as possible as they are to furnish information for not only the mining engineers but the chemists and chemical engineers who may have occasion to look up particular districts or mines. It appears that we did not receive some 30 reports which Mr. Pope had made up until Mr. Fay was called upon to prepare the analytical reports for the past year for publication.

Very respectfully,

Chief Mining Engineer.

Newspaper Accounts

02/01/1910 - 02/28/1910

70 OTHER MEN ARE ENTOMBED

Scores That Are Unaccounted for Are Either Dead in Fatal Colcrado Colliery or Else They Are Now Buried Alive

53 GET OUT WITH SLIGHT INJURIES

Hope That Any of the Entombed Victims in the Wrecked Mine Are Living Grows Dimmer

EAGER RESCUERS AT WORK

Primrose, Col., February 1.—Five more bodies were today recovered from the Primero mine of the Colorado Fuel and Iron Co., making 39 the total number of known dead by explosions in the colliery yesterday afternoon. Seventy miners are still unaccounted for and are either dead or entombed alive.

One hundred and fifty men were in the mine when the explosions occurred. Fifty-three of them escaped with slight injuries.

In the bucket which was suspended almost at the bottom of the main shaft, eight miners lost their lives, as they were being drawn up to the surface and to safety. As an evidence of the force of the explosions it is stated that three helpers, standing at the top of the shaft in the shafthouse, were killed by the concussion.

IDENTIFIED DEAD:

DAVID WILLIAMS, pit boss, American.
ALBERT COLE, miner, Austrian.
ERNEST STRANGFELDT, miner, German.
"JACK" KLIAS, driver boss, American.
"JACK" ISKRA, miner, son-in-law of Strangfeldt.
JAMES RUMING, driver, American.

Among the seriously injured who have been taken from the mine is William Alexander, miner. Alexander was entering the mine tunnel just as the disaster occurred and was hurled nearly a hundred feet. His face and hands were severely burned. He may die.

Dianado Virgen, the first living man taken from the mine, is sinking rapidly and will probably die. He has lapsed into unconsciousness and has not spoken since he gave out his first statement.

A searching investigation is in progress to locate the cause of the disaster, but it will probably be impossible definitely to fix the blame. The mine was of an extremely gaseous character and all of the employes had been warned to take all precautions and never to use a naked lamp in the depths.

The mine consists of four tunnels bored into the sides of the mountain.

The main tunnel was thoroughly explored and from it all the bodies thus far found were taken. Three tunnels remain unexplored, and it is within them that the missing men are imprisoned; whether alive or dead is unknown.

Several caveins obstructed the rescue workers after a dozen dead miners had been removed. The rescuers feared that no man who was in the workings at the time of the disaster had lived. A faint cry behind a wall of earth caused them to redouble their efforts. Breaking through the walls, the men found Dianado Virgen, half suffocated, lying with his face close to the floor of the tunnel. He was delirious with fear. He is still delirious.

"I don't remember much about it," he said. "All I know is that there was a roar and everything got black.

"Then I heard men rushing by me and fighting like mad. I saw a light ahead and tried to crawl to it. I was so weak that I could not get off my hands and knees, but I managed to crawl a long distance. I saw dead men ahead and others who were groaning and screaming for help.

"Soon the cries about me stopped and I knew I was the only live man there. It seemed years before I heard the picks of the rescuers."

Hope of rescuing any of the entombed miners alive grew dimmer as the morning wore away. The feeling of hope lessened and settled down on the groups of women shivering around the mine shaft as one by one the members of the rescuing parties came to the surface bringing with them nothing but reports of blazing galleries and caveins.

As fast as these men came to the surface they were replaced by other eager rescuers and the work of exploring the mine was pushed with vigor.

Most of the missing men are believed to be in entries 9, 10, 11 and 12. It may be days before they are reached.

The machine shops have been converted into a morgue, but the bodies will be sent to Trinidad today. Supplies are being rushed from all the surrounding camps.

Sheriff J. S. Grisham, of Las Animas county, and Sheriff Farr, of Huerfane, are sending armed deputies to assist.

The mine is completely wrecked below the shafthouse and the work of rescue is extremely hazardous because of the presence of blackdamp, which gathers faster than it can be gotten out.

A cordon of guards about the mouth of the shaft is keeping the frenzied relatives of the victims at a distance in order that the rescue work may not be hampered.

When the members of the rescue party managed to make its way down the shaft today they found bodies massed at the foot of the shaft. It was plain that when the initial explosion was heard these men had all rushed toward safety, but before they could signal for the elevator to be dropped a second explosion, caused by the ignition of the dreaded blackdamp stirred up by the first explosion, came, killing them in their tracks. At the bottom of the pile were a number who had been suffocated while battling to reach the entrance.

The work of rescue is in charge of General Supt. Thompson, assisted by A. C. French, head of the Wooten mines, and one of the most experienced miners in Colorado; J. E. Hinds, state mine inspector, and the foremen of the other mines of the Colorado Fuel and Iron Co. in this vicinity, who were rushed to the scene in automobiles so soon as the report of the disaster was heard.

Only the mothers and wives, watching

(Continued on Page Two.)

70 OTHER MEN ENTOMBED

(Continued from Page One.)

through the night around the shaft and urging on the rescuers with prayers and tears, still believe the missing live.

Volunteers were rushed to Primero from all the adjoining camps and all night hundreds of miners stood about the shaft begging for a chance to join the rescue work.

Most of the miners employed are Slavs, Hungarians and Italians, but a few Americans, among them William Helm, electrician, and David Williams, the latter killed, were in the colliery.

The fire which followed the explosion soon burned itself out.

With the Cherry (Ill.) disaster fresh in their minds, frantic women and children surged against the ropes drawn to keep them away from the shaft and begged the rescuers to bring back their husbands and fathers. Some of the women attempted to join the workers below and had to be restrained by force. As each body was brought to the surface, the women gathered about it with shrieks and prayers, but the bodies were so charred and disfigured that they could not be identified.

Coroner J. H Guilfoil has taken charge of the bodies and has ordered 80 coffins from Denver.

FEB. 28, 1910
DENVER (Colo.) TIMES

ANOTHER BODY FOUND IN THE PRIMERO MINE

TRINIDAD, Colo., Feb. 28.—Workmen engaged in cleaning up the "main" Primero mine, in which seventy-six miners lost their lives in the explosion of January 31, early today recovered the body of Fidel Arguello. This makes sixty-nine bodies that have been removed from the mine. Arguello was identified by a leather belt.

IMPROPER SPRINKLING CAUSED EXPLOSION AT PRIMERO MINE

Special to the Chieftain.

Denver, Feb. 28.—"Dust accumulated in room 5 entry A-11, caused the explosion."

"The accumulation of dust resulted from improper sprinkling."

These are the principal statements in the report of State Mine Inspector John D. Jones upon the causes of the Primero coal mine disaster January 31 in which seventy-five men lost their lives. Inspector Jones holds the Colorado Fuel and Iron company responsible for the accident in that its method of sprinkling the mine appeared to have been lax. So far as equipment is concerned, he commends the Primero mine as one of the most modern in the state.

In his report Inspector Jones recommends that a law be enacted by the next legislature makes it the duty of shot firers to handle A 1 powder used in blasting to take said powder into mines and to fire all shots. This recommendation is said to have the endorsement of Governor Shafroth.

The report opens with a statement of the details of the accident and gives minute descriptions of the locations of the various passages and workings of the mine. Jones, who personally investigated the accident, after being notified fifteen minutes after its occurrence, gives all the details of affairs as he found them there.

In conclusion, he reaches findings as follows: That the ventilating fan was in working order and reported in good condition the morning of the disaster; that dust was the predominating factor of force in the explosion; that, although the explosion could have started from the explosion of powder or shot, it was not probable; that the presence of dust in the mine was the means by which the explosion ceased to be local and became of the magnitude which caused the wholesale slaughter; that the coal found in the southern fields contains a low percentage of moisture and a high percentage of volatile gases and that these gases when inflamed were highly explosive.

He states that for about 1,500 feet up the shaft the ground shows sufficient moisture to compel the mine owners to look after the overflow of water, and and that from the point of moisture to the part of the mine where the explosion occurred the mine is in an excessive state of dryness. This was the cause of the violence of the explosion.

The mine, he states, was sprinkled that morning, but there was a lack of sufficient sprinkling. The main north entry, where the accident occurred, ranks, he states, with any first class mine in the state, and only the presence of dust could have occasioned the accident.

42 BODIES OF VICTIMS ARE RECOVERED

Little Hope That the Men Unaccounted For in Primero Pit Catastrophe Will Now Be Found Alive

Pgh Press 2/1/10

RESCUERS ARE AT WORK

By United Press.

Primero, Col., February 1.—The bodies of 42 of the victims of the explosion in the Colorado Fuel & Iron Co.'s mine were recovered today, and it is now expected that at least 78 men lost their lives. One man is known to have escaped from the tunnel, but there is practically no hope that any others will be found alive.

Because of the mutilated condition of many of the bodies, it is believed the exact number of victims will never be known.

The mine consists of four tunnels bored into the sides of the mountain. The main tunnel was thoroughly explored early today and from it all the bodies thus far found were taken. Three tunnels remain unexplored and it is within them that the missing men are imprisoned whether alive or dead, is unknown.

IDENTIFIED DEAD

MS. pit boss; American.
ALBERT COLE, miner; Austrian.
ERNEST STRANGFELDT, miner; German.
JACK ELIAS, driver boss; American.
JACK ISKRA, miner; son-in-law of Strangfeldt.
JAMES RUMING, driver; American.

Several cave-ins obstructed the rescue workers after a dozen dead miners had been removed early today, the rescuers feared that no man who was in the workings at the time of the disaster had lived. A faint cry behind a wall of earth caused them to redouble their efforts. Breaking through the wall, the men found Dianado Virgen, half suffocated, lying with his face close to the floor of the tunnel. He was delirious with fear.

He is still delirious today. "I don't remember much about it," he said. "All I know is that there was a roar and everything got black.

"Then I heard men rushing by me and fighting like mad. I saw a light ahead and tried to crawl to it. I was so weak that I could not get off my hands and knees, but I managed to crawl a long distance. I saw dead men ahead and others who were groaning and screaming for help.

"Soon the cries about me stopped and

I knew I was the only live man there. It seemed years before I heard the picks of the rescuers."

Many of the victims of the disaster are Mexican and Italian miners. The work of rescue is in charge of General Superintendent Thompson assisted by A. C. French, head of the Wootan mines, and one of the most experienced miners in Colorado: J. E. Hinds, State mine inspector, and the moremen of the other mines of the Colorado Fuel & Iron Co. in this vicinity, who were rushed to the scene in automobiles so soon as the report of the disaster were heard.

LOST LIVES IN BUCKET.

In the bucket which was suspended almost at the bottom of the main shaft, eight miners lost their lives, as they were being drawn up to the surface and to safety. As an evidence of the force of the explosion it is stated that three helpers, standing at he top of the shaft in the shaft house were killed by the concussion.

A searching investigation is in progress to locate the cause of the disaster, but it will probably be impossible definitely to fix the blame. The mine was of an extremely gaseous character and all of the employees had been warned to take all precautions and never to use a naked lamp in the depths.

The explosion occurred at 4:30 oclock.

With a terrific roar and a belch of flame the main shaft crumpled in blocking the entrance to the mine.

Both fans with which the property is equipped were shattered and it was not until 7:40 oclock that the fans were repaired and a rescue party headed by Gen. Supt. J. F. Thompson was able to descend the air shaft.

Find Bodies in Heaps

They discovered three bodies before they were forced to return to the surface. Five men, one of them 100 yards away, were killed at the entrance to the main shaft by the concussion.

The first rescue party found the bodies piled in heaps about the foot of the air shaft, where the frantic men had fought and trampled on each other in their struggle for liberty until overcome by gas and flames. Three bodies were taken up before the rescuers were forced back to the open air.

After it had been proved that the main shaft was completely wrecked, another party equipped with oxygen helmets descended the airshaft and began removing bodies.

Two Americans, William Helm, electrician, and David Williams, were among the missing.

The fire which followed the explosion was confined to the workings near the main shaft and soon burned itself out.

Rush Work of Rescue

The cause of the accident is unknown. As soon as the accident occurred, however, volunteers began to attempt rescues.

Rescue parties were hurried to Primero from Trinidad, Segundo, Starkville, Sopris and Cokeville, and worked desperately to open the main shaft.

It soon became evident, however, that the shaft was hopelessly caved, and another rescue party descended the air shaft.

Shortly before 2 o'clock this morning Supt. Thompson, who was directing the rescue work, was overcome by gas and taken to the surface. He soon recovered and again went below.

Entire Mine Wrecked

The rescuers say that the whole mine is wrecked, and it is almost impossible that any of the entombed miners are still alive.

The fire which followed the explosion was confined closely to the workings near the main shaft, and soon burned itself out.

Superintendent Thompson was reinforced by every superintendent and expert within reaching distance of the mine and hundreds of miners stood about the shaft last night, begging for a chance to join one of the rescue parties.

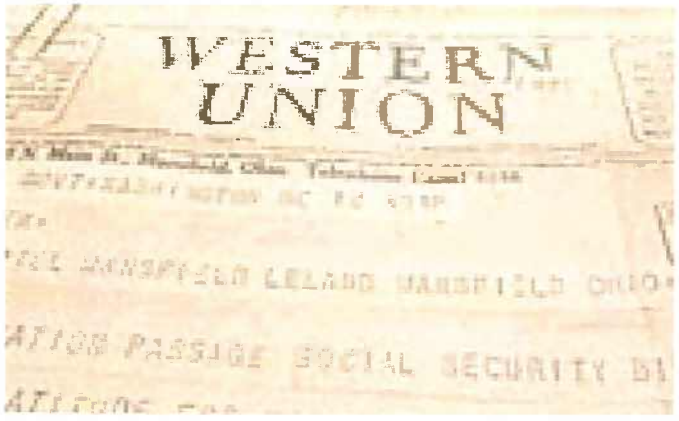
With the Cherry disaster fresh in their minds, frantic women and children surged against the ropes drawn to keep them away from the shaft and wildly begged the rescuers to bring back their dear ones. Some of the women attempted to join the workers below and had to be restrained by force.

Shriek and Pray

As each body was brought to the surface, the women gathered about it with shrieks and prayers, but the bodies were so charred and disfigured that the wives and mothers could not identify them.

Until the workings can be opened, the cause of the explosion will remain unknown. Officials of the company declare safety lamps were used in every portion of the mine and that every precaution was taken to prevent accident.

Coroner J. H. Guilfoil has taken charge of the bodies and has ordered eighty coffins from Denver.



Telegraph

02/01/1910 - 02/04/1910

Form 168

THE WESTERN UNION TELEGRAPH COMPANY.

INCORPORATED

24,000 OFFICES IN AMERICA. CABLE SERVICE TO ALL THE WORLD.

8 15

RECEIVED at

1 Wh Jo 24 Pd 1SR V Feb 1/10

Washn DC 31

Rice, W S Pgh Pa

If possible, Jones R Williams should proceed Trinidad colo desaster with appartus & well immediately

Wilson

To Manager of Telegraph Co.:
This message should be sent "Paid Gov't" Rate and forwarded with your monthly report as voucher for your credit.

9—132.

OFFICIAL TELEGRAM.

Charge: M. A.

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

The POSTAL TELEGRAPH Company

WILL SEND THE FOLLOWING MESSAGE SUBJECT TO THE RATES FIXED BY THE POSTMASTER-GENERAL.

J. W. Paul [Sender's name in full.] | Mining Engineer [Title.] | 1-2

Time filed.	Receiver's No.	words, PAID. Government Rates, at [Day or night.] rate.

Pittsburgh, Pa., Feb. 1, 1910 190..

To L. M. Jones, Care P. F. Jarvis, Missouri Trust Building

St. Louis, Mo.

Immediately upon arrival at McAlester proceed to Trinidad Colorado to join me

P A U L

C O N F I R M A T I O N

To McAlester, Okla.

To Manager of Telegraph Co.:
This message should be sent "Paid Gov't" Rate and forwarded with your monthly report as voucher for your credit.

9—132.

OFFICIAL TELEGRAM.

Charge: M. A.

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UNITED STATES GEOLOGICAL SURVEY

The POSTAL TELEGRAPH Company

WILL SEND THE FOLLOWING MESSAGE SUBJECT TO THE RATES FIXED BY THE POSTMASTER-GENERAL.

Geo. S. Rice [Sender's name in full.] | Mining Engineer [Title.] | I-2

Time filed.	Receiver's No.	
		words, **PAID.** Government Rates, at [Day or night.] rate.

Pittsburgh, Pa., Feb. 1, 1910 190

To Rice, Fourteen Seventeen First National Bank, Chicago

Paul proceeds Trinidad Colorado explosion
Has wired Jones meet him there.

S C H A B A C K E R

To Manager of Telegraph Co.:
This message should be sent "Paid Gov't" Rate and forwarded with your monthly report as voucher for your credit.

9—132.

OFFICIAL TELEGRAM.

Charge: M. A.

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UNITED STATES GEOLOGICAL SURVEY

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Has wired Jones meet him there.

S C H A B A C K E R

C O N F I R M A T I O N

Official Business U.S. Geological Survey

POSTAL TELEGRAPH COMMERCIAL CABLES

CLARENCE H. MACKAY, PRESIDENT.

NIGHT TELEGRAM

G. S. Rice
Mining Engineer
1101

REGISTERED TRADE-MARK. DESIGN PATENT No. 36369.

The Postal Telegraph-Cable Company (Incorporated) transmits and delivers Night Messages subject to the terms and conditions printed on the back of this blank.

NUMBER	SENT BY	REC'D BY	CHECK

Received at 11

(WHERE ANY REPLY SHOULD BE SENT)

Dated Feb 9 1910 Trinidad Col.

To Wilson

U.S. Geological Survey.

Determined originating point explosion Primero but not cause account heavy fall. Leaving tonight for Denver Brown Palace Hotel reach Chicago Saturday Pittsburgh Monday

Rice

Send paid

POSTAL TELEGRAPH — COMMERCIAL CABLES

CLARENCE H. MACKAY, PRESIDENT

TELEGRAM

Butler St.
Phones { Bell 558
(P & A 252 Lawrence

Received at

(WHERE ANY REPLY SHOULD BE SENT.)

16/92

20G Kt Js 29 Govt

Chicago Ill Feby 1 1910

Schabacker Care Roberts U S Geological Survey.

Pgh Pa

Am leaveing this evening on Santafe Calfornia Limited mail me immediately six gas bottles and ten cans to primero

Rice .

4 Pm

Government Business. To U.S. Geological Survey

POSTAL TELEGRAPH COMMERCIAL CABLES

CLARENCE H. MACKAY, PRESIDENT.

G. S. Rice

(1101) 7117

TELEGRAM

COUNTER NUMBER.	TIME FILED.	CHECK.
	M.	

Send the following message, without repeating, subject to the terms and conditions printed on the back hereof, which are hereby agreed to.

To Schlachter or Roberts   Feb 1 1910

U. S. Geological Survey

Pittsburgh Pa

Am leaving ~~for Primero~~ this evening on Santa Fe California limited. Mail me immediately six gas bottles and stew cans to Primero

Rice

Send Paid Rush

Form No. 2.

THE WESTERN UNION TELEGRAPH COMPANY.

INCORPORATED

23,000 OFFICES IN AMERICA. CABLE SERVICE TO ALL THE WORLD.

ROBERT C. CLOWRY, President and General Manager

Receiver's No.	Time Filed	Check
		4312 R

SEND the following message subject to the terms on back hereof, which are hereby agreed to.

Chicago Feb 1 1900

To Mr. Paul or Roberts
U.S. Geological Survey
Pittsburgh Pa

Wire from Crumine says have helmets at mine Satisfied no fire unnecessary to bring apparatus

Rice

READ THE NOTICE AND AGREEMENT ON BACK.

Form 2114

THE WESTERN UNION TELEGRAPH COMPANY.

INCORPORATED

24,000 OFFICES IN AMERICA. CABLE SERVICE TO ALL THE WORLD.

Express Building
185 Dearborn Street
Phone Central 5141. Chicago

RECEIVED at

7117

1 02ch gp oy 45 paid G rate

Washington, DC. February 1st, 1, 1 0

George S. Rice, Care Hollis First Nat. Bank Blg
Chgo

Subsequent to telephone conversation paul leaves this afternoon to join you in Colorado with two helmet outfits prefer that Jones proceed to Oklahoma remaining there you or Paul should return Pittsburg soon as possible

Holmes.

1221pm

THE WESTERN U[NION TELEG]RAPH COMPANY. G. S. Rice

INCORPORATED

24,000 OFFICES IN AMERICA. CABLE SERVICE TO ALL THE WORLD. 4372 R

ROBERT C. CLOWRY, President and General Manager.

Receiver's No.	Time Filed	Check

SEND the following message subject to the terms on back hereof, which are hereby agreed to.

Chicago Feb 1 1910

To Colorado Fuel & Iron Co
Primero Colorado

Do you need rescue apparatus from Government station Pittsburgh Am leaving here tonight with another engineer for Primero

G. S. Rice

Fourteen Seventeen First National Bank

Paid

☞ READ THE NOTICE AND AGREEMENT ON BACK. ☜

Form 2114

THE WESTERN UNION TELEGRAPH COMPANY.

INCORPORATED

24,000 OFFICES IN AMERICA. CABLE SERVICE TO ALL THE WORLD.

710

RECEIVED at

Adams Express Building,
[illegible] street,
Phone Central 6240. Chicago.

184 ch es 7c 24 Paid

Primero Colo Feb 1st 10

G SRice,

Fourteen Seventeen First Natl Bank , Chicago .

We have draeger helmets and rescue appliances at mine. Am satisfied there is no fire. Think it unnecessary for you to bring any apparatus.

E H Weitzel.

31 O.m

Official Business a/c U.S. Geological Survey

POSTAL TELEGRAPH COMMERCIAL CABLES

CLARENCE H. MACKAY, PRESIDENT.

NIGHT TELEGRAM

G.S. Rice
1101

REGISTERED TRADE-MARK. DESIGN PATENT NO. 36369.

The Postal Telegraph-Cable Company (Incorporated) transmits and delivers Night Messages subject to the terms and conditions printed on the back of this blank.

NUMBER	SENT BY	REC'D BY	CHECK

Received at 1

(WHERE ANY REPLY SHOULD BE SENT)

190

Dated Feb 5 Trinidad

To Wilson
U.S. Geological Survey
Washington D.C.

Paul left tonight with apparatus via Chicago reaches Pittsburgh Monday evening Expect finish investigation ~~Monday~~ by Tuesday Unless Message to contrary Will see operators Raton and Denver about joint station

Rice

Official Business of U.S. Geological Survey

POSTAL TELEGRAPH COMMERCIAL CABLES

CLARENCE H. MACKAY, PRESIDENT.

Geo S Rice

1101

NIGHT TELEGRAM

REGISTERED TRADE-MARK. DESIGN PATENT No. 36369

The Postal Telegraph-Cable Company (Incorporated) transmits and delivers Night Messages subject to the terms and conditions printed on the back of this blank.

NUMBER	SENT BY	REC'D BY	CHECK

Received at 7 11 P.M.

(WHERE ANY REPLY SHOULD BE SENT.)

190

Dated Feb 3 Trinidad Colo.

To Roberts U.S. Geological Survey
Pittsburgh Pa

Matters Pitmers proceeding satisfactorily - Paul arrived tonight Will be ~~here till Saturday~~ at Cardenas Hotel till Saturday

Rice

Send paid

Official Business c/o U S Geological Survey
Geo S. Rice
1101

POSTAL TELEGRAPH — COMMERCIAL CABLES

CLARENCE H. MACKAY, PRESIDENT.

NIGHT TELEGRAM

Number	Sent By	Rec'd By	Check
			23

Received at 717

(WHERE ANY REPLY SHOULD BE SENT)

190

Dated Feb 3, 1910 Trinidad

To Holmes U.S. Geological Survey
Washington D.C.

Matters at Primero systematically handled, helmets not needed Heavy falls roof retard investigation progress. Jones leaves tomorrow for McAlester - Paul arrived ~~here~~ tonight with helmets - Stopping Cardenas Hotel Trinidad

Rice

Send Paul

16
133

POSTAL TELEGRAPH COMMERCIAL CABLES

CLARENCE H. MACKAY, PRESIDENT.

TELEGRAM

REGISTERED TRADE-MARK. DESIGN PATENT No. 36369.

The Postal Telegraph-Cable Company (Incorporated) transmits and delivers this message subject to the terms and conditions printed on the back of this blank.

(15)

Received at

Trinidad Colo.

(WHERE ANY REPLY SHOULD BE SENT)

7117

S.D. W. 22 Govt

Washington Dc Feb 4th

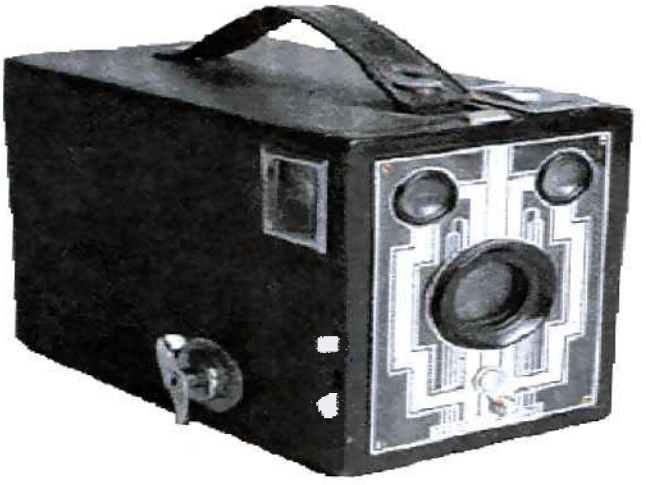
Geo. S. Rice ,

% Cardenas Hotel Trinidad, Colo.

In view condition at primero Paul or you should return Pittsburg immediately with Helmett

Wilson

10. 10 a,m



Photographs

1910

Clearing caved slope, Main North Mine.

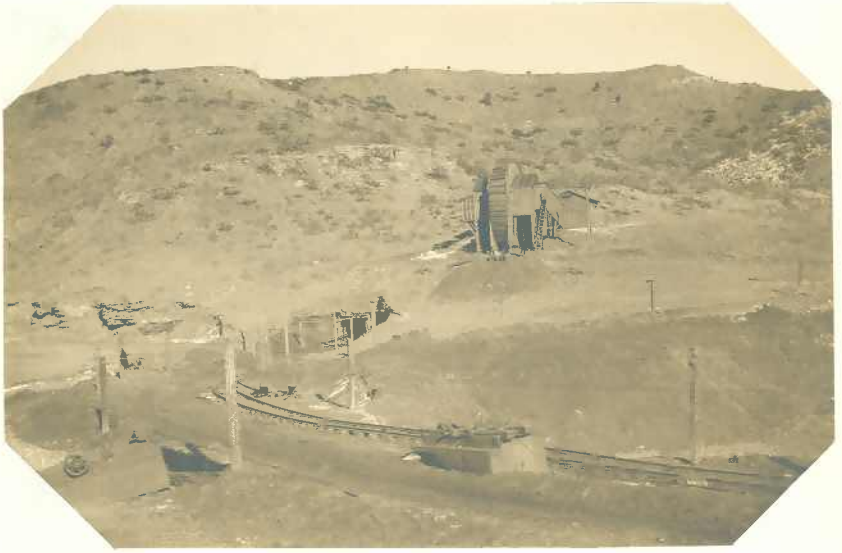
C. F. & I. officials in foreground.

C. F. & I. officials in conference with Government experts.

Main North fan in background.

Reading left to right:

1. Herrington, legal dept., C. F. & I. Co.
2. Mgr. E. H. Weitzel, C. F. & I. Co.
3. L. M. Jones, Government, McAlester, Okla.
4. Supt. Jas. Thompson
5. Geo. S. Rice, Government, Pittsburgh, Pa.



Fan beside opening of No. 1 East Mine, east of Primero, Colo.

Magazine Article

March 1910

THE PRIMERO DISASTER

Written for Mines and Minerals, by R. L. Herrick

Primero, the recent scene of Colorado's worst coal-mine disaster, is 21 miles to the northeast of Trinidad, on the Colorado & Wyoming Railroad. Just below Primero, the Purgatory River forks, one branch extending to the northeast, the other to the northwest. The branches have cut through the flat-lying coal measures causing the main coal bed to outcrop along a contour roughly **M**-shaped, the legs of the letter running downward, almost due south.

Description of the Mines. Action of the Explosive Force. Conditions in the Mines.

Seven mines have been opened on this **M**-shaped coal outcrop. Along the left leg are Nos. 1, 2, and 3 west mines, numbered from the north on the leg going south. In like manner Nos. 1, 2, and 3 east mines, have been opened on the outcrop of the right leg of the letter **M**.

The seventh and largest mine of the group, known as the "Main North" has been driven in on the outcrop from a point about half way down the left diagonal of the **V** forming the **M**.

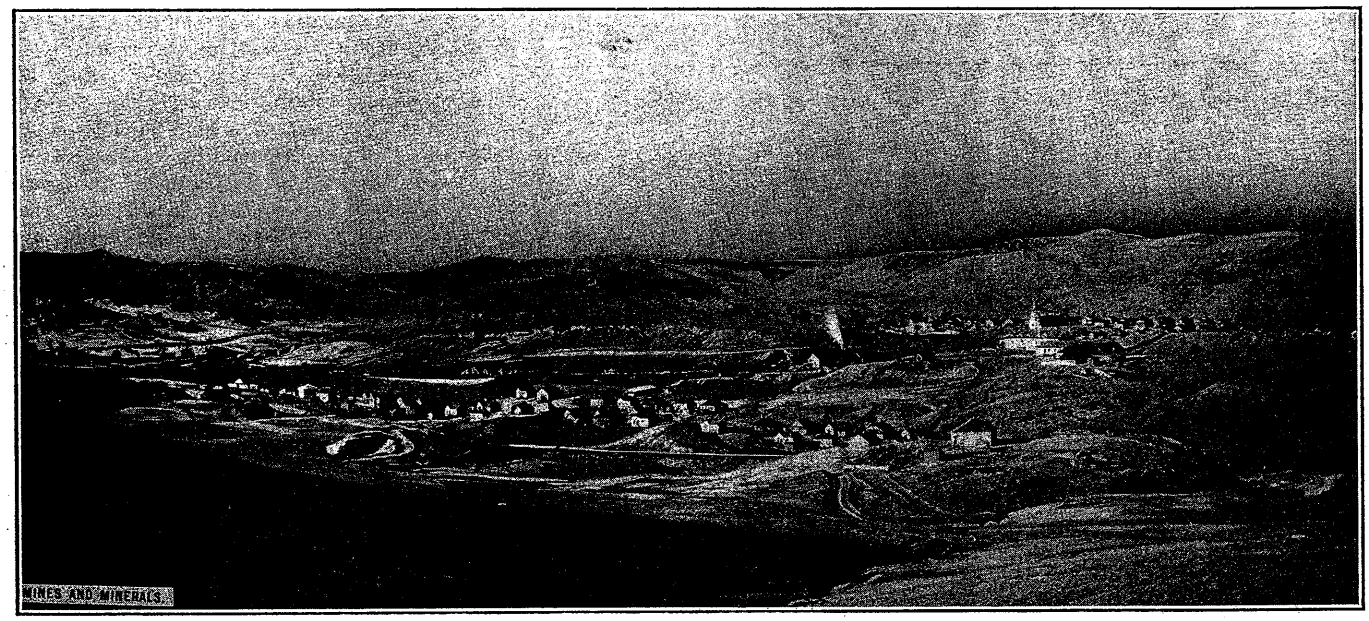


FIG. 1. PRIMERO, COLORADO

The town of Primero occupies the high ground between the two forks of the Purgatory, and from there back on the hill slope some distance. The mine tracks roughly parallel the right leg of the **M**, serving in turn mines 3, 2, and 1 east, but from this last opening a rock tunnel about 1,000 feet in length has been driven southwesterly under the town to connect with the Main North Mine. From the largest mine the tracks roughly parallel the outcrop around to the west group of mines.

Extending across the gulch, at the left-hand top of the **M**, is the tipple which serves all seven mines.

Fig. 1 shows a panorama of Primero and its mines, taken from the southwest of the town. The tipple shows at the extreme left with the track approaches of mines No. 1 and No. 2 showing in the left foreground. In the middle background is seen the power plant, with the six stacks, situated just to the right of the great shadow on the hillside showing the work of the explosion in blowing out the mouth of the main haulage slope of the Main North Mine.

The gulch in the background of the town is the one in which the three east mines are located, the fan of East No. 1 showing faintly in the background at the extreme right.

This group of mines has the largest producing capacity of any in Colorado, although its production at the time of the disaster was only about 1,600 tons, of which the Main North produced about 500 tons, the east side mines about 600 tons, and the west side openings, 500 tons per day.

The Explosion and Subsequent Fan Repairs.—Monday, January 31, was a clear, warm day, as was also Tuesday, while Wednesday with its snow and bitter cold was the sort of a day whose atmospheric conditions were more favorable for an explosion. About 110 men had gone into the mine on the day shift and about 4 P. M. the first of the off-coming miners began emerging from the mine. At this time the fans were running regularly and the only incident of note was the fact that several cars of the empty trip were off the track at the mouth of the main haulage slope into the mine, and were being replaced on the track under the direction of Outside Foreman D. D. Dodge. About this time Pit Boss David Williams telephoned the hoistman from what was probably the mine station at the mouth of A-12 entry on the main slope. The last loaded trip had been hoisted from A-12 entry about 3:30 P. M., and Williams, noting the delay, inquired of the hoistman what the trouble was. When informed that the cars were off the track, he ordered the next trip of empties into entry A-8, and the loaded trip pulled out from this point. As there were 26 loaded cars waiting on the A-8 parting, it was arranged to hoist 14 on the first trip and the balance on the second. The hoistman, Lopez, was instructed to hoist the second loaded trip slowly as it passed into the main road from A-8, in order that Williams might get aboard. When the cars on the surface were replaced, about 4:20, the tail- and hoist ropes had already been attached to those at the head of A-8 entry, so that as the empty trip went down, it was all ready to start into A-8 as soon as the signal was received by the hoistman. In 5 minutes more the empty trip, as shown by the engine indicator, had reached A-8, and on receiving the signal to go ahead, the hoistman ran it ahead about 300 feet before shutting off the power when the explosion came.

In the meantime, about 35 miners of the day shift had left the mine, and one had gone home, changed his clothes, come back and stood directly in front of the haulage slope, at 4:30, talking to three miners who had just emerged from the slope. Outside Foreman Dodge, having finished directing the gang which replaced the cars on the track, had just stepped 50 yards to the west of the slope and J. C. Risher, assistant master mechanic, stood at the door of the machine shop 200 feet from the slope when the explosion took place. Both Dodge and Risher, therefore, were close eye witnesses of what happened

and both narrowly escaped death. Just at the instant of the explosion a loaded trip of cars from one of the east mines, drawn by an electric locomotive, passed the mouth of the slope. The locomotive had barely passed the danger line when the shock came, catching the cars of the trip and hurling them from the track a short distance. According to Dodge and Risher, a vast volume of black dust and smoke shot out of the slope mouth, and catching the four unfortunates in its path, hurled three of them against and under the trip of cars to their death. The fourth man, a negro, was hurled entirely over the cars and landed 100 feet south of the slope opening. Although terribly burned, at this writing, it is likely he will survive. In the midst of the smoke and dust rolling from the slope mouth came a great flame, which quickly subsided. The concussion of the explosion is said to have been very great, but only comparatively few windows were broken in the town, although in a number of houses the plaster was hurled from the walls.

In a few moments Dodge and Risher recovered from the shock and rushed for the fan, where they were soon joined by Superintendent William Kilpatrick and Dan Sullivan, boss carpenter. An inspection showed that although dirt and timbers had badly damaged the blades and blown out a portion of the casing, it could be repaired in a short time. The fan at mine

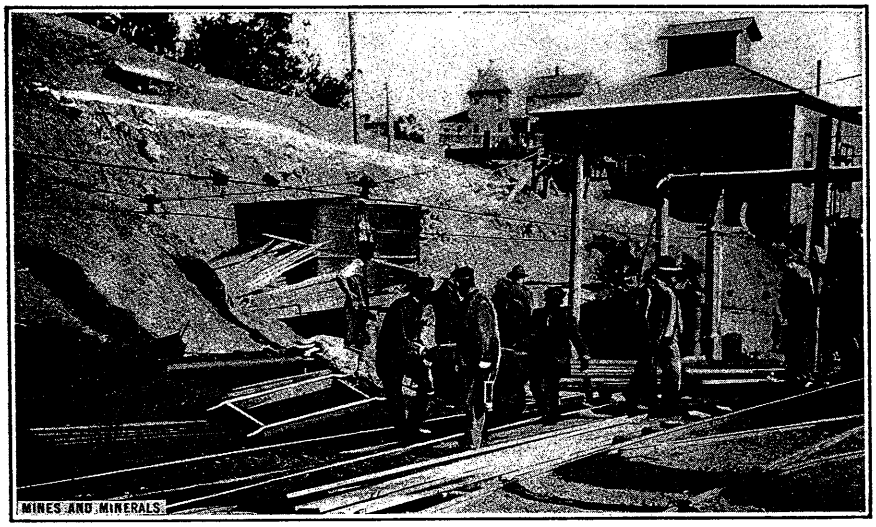


FIG. 2. BRINGING THE DEAD THROUGH THE FAN HOUSE

No. 1 east, was not affected by the explosion, and acting under the instruction of Superintendent Kilpatrick, Wm. Easton and Al Thompson ran to No. 1 east, accompanied by helpers, and down the haulage road to a masonry air stop. Here Thompson and helpers started to tear down the masonry stopping, while Easton and helpers erected a temporary air stopping a short distance away. The latter stopping was just erected when those engaged at the masonry stop blasted it down. Instantly the No. 1 fan began drawing the gases from the wrecked mine down the passage in which Easton and his helpers were traveling. Thompson and his party at once escaped into the neighboring intake, but Easton and his helpers had a 1,700-foot race with the deadly gases to the safety of the outside. Thus, the No. 1 fan began relieving the ventilation of the wrecked mine in about 45 minutes, and about 3 hours later, the main fan, having been hurriedly repaired, was reversed to blow fresh air down the air-course upon which the rescuing party could advance. This air-course was not badly blocked by roof falls, but the haulage slope was caved nearly tight for a distance of about 120 feet.

Rescue Work.—In the meantime, the call for help had gone out to the neighboring mines, to which a prompt response was made. Division Superintendent James S. Thompson quickly organized a relief party at Trinidad and started for Primero on a special train, which picked up a number of expert mining men on the way. By the time the two fans had partially restored the ventilation, Superintendent Thompson had organized the first rescue party, consisting of Joseph Ball, superintendent of the second division; Superintendent Chas. Chambers, of Sopris; Superintendent Wm. Morgan, of Piedmont, mine inspector for the C. F. & I.; J. B. Manley; Superintendent Thomas Lee, of Frederick; Superintendent Jas. Wilson, of Starkville; Bob McAlister; A. C. Larson and others. Shortly after the arrival of the first relief party from Trinidad, a party from the neighboring Cokedale mines of the American Smelting and Refining Co. arrived, led by Manager Baylis and Superintendent Burt Lloyd, bringing with them three Draeger helmets. The Trinidad party had brought four helmets with them and in the morning two more arrived from the Stag Cañon Fuel Co., of Dawson, N. Mex., in charge of Jas. B. Morrow, the company expert in rescue work with these helmets.

Shortly after 9 P. M. the fans had restored the ventilation sufficiently to allow the first rescue party under Superintendent Thompson to start into the mine. The party advanced about 2,400 feet, to entries B-3 and B-4, and the opposite A entries, Nos. 7 and 8, by 2 A. M. About 14 bodies were recovered up to this time, all found on the main slopes and all badly burned, indicating that the men were on their way out when killed by the explosion. Several of the rescue party were overcome by gas and carried out unconscious, among them being Superintendent Thompson. Division Superintendent Joseph Ball then assumed leadership and continued the work of exploration up entries A-7 and A-8. As A-7 was found fairly clear of afterdamp, rapid progress was made until the diagonal haulage road leading into A-8 was reached. At this point the immense heap of tangled timbers was encountered and passed over. At the point where the two doors in the diagonal haulage road had formerly stood, a small fire was found and extinguished after a short delay. Knowing that some of the men would be found with or near the last trip of cars that had entered A-8, the rescue party here turned east toward the parting distant hardly 100 feet. Here was found the largest group of bodies recovered and here occurred the dramatic incident that will long live in the memory of those who witnessed it. With Superintendent Ball in the lead, the rescuers had passed over the bodies of a number of mules and six men, an electric flash light being turned on the face of each as it was passed. As the light was flashed on the face of the seventh prostrate form, the eyes suddenly opened, and the form sat up, an uncanny performance for one in the midst of a heap of dead. "Please, Mr. Boss, can I go home now?" said the voice of the sole survivor of the interior disaster. It was Leonardo Virgen, a Mexican, in front of whom lay eight dead bodies, and beside him lay his dead Mexican buddy, with whom Virgen had conversed but a short time before, so he says. The body of the buddy was still warm at this time, though death had taken place some time before. Virgen walked part of the way out, but overcome with fear and weakness, was carried the greater part of the way up the main slope.

In the meantime Superintendent Thompson had recovered and returned into the mine to again assume leadership in the rescue work. By the dawn of Tuesday morning the workings off from A-7 and A-8 had been thoroughly explored and about 28 bodies recovered. With the morning came Manager E. H. Weitzel, from Pueblo, together with State Mine Inspector John D. Jones and Deputy Inspector Griffiths. Among the experienced mining men from the other mines of the C. F. & I. Co. were Superintendent David Griffith of the Fremont County mines, and Thomas Jolley, pit boss of the Victor Fuel Co.'s mine

at Delagua, who also earned special recognition by tireless efforts in rescue work.

The drainage of the explosion gases from the lower portion of the wrecked mine progressed slowly, and not till Wednesday morning, February 2, had the brattices been advanced to the mouth of entries B-4, B-5, and of the opposite A entries, Nos. 9 and 10. By this time about 40 bodies had been recovered and all hope of rescuing any living had been abandoned, although exploratory work was continued with unabated energy. Before this time the work had been thoroughly organized into three 8-hour shifts, and a thorough record of all persons entering the mine was kept, together with the number of the safety lamp carried in by each individual. These lamps were tested at the mine entrance, and all persons entering the mine were deprived of matches. Up to Thursday morning the work had been confined to restoring the ventilation and rescuing the bodies of the victims, of which some 50 odd had been recovered at this time. A house-to-house canvass by the company had established the total number of lost at 75, not including Virgen and the negro survivor at the slope entrance. In concluding these notes on the rescue work the writer is satisfied that not a man in the mine lost his life through any failure of the rescuers to exercise every possible effort at finding them before death took place. It was also made evident that only 11 men in the mine at the time of the explosion had the slightest chance to survive, the rest of the victims having died almost instantly.

The Survivor's Story.—These 11 men above referred to included the Mexican survivor, Virgen, and his partner, and nine Koreans, all of whom were at work in the rooms driven off the second south blind entry off main entry A-7. All being green miners, they had been purposely given that portion of the mine with the safest roof.

From Virgen's story told at the inquest held February 4, it appears that this party was on its way out of the mine and had probably progressed north up the second south blind entry into A-7 entry and some little distance east along it, when met by the explosion. Picking themselves up in a dazed condition, Virgen said the entire party beat a retreat to a room he cannot locate, where the air was good—probably close to his own working place, if the dinner buckets dropped at intervals along blind entry No. 2 south, are any indication. Virgen said that after a wait of a number of hours, the Koreans became impatient to get out and at intervals made several sallies forth in the effort to find good air, but failing in this, invariably returned. Finally a little after midnight, so he estimated, five of the Koreans made a final sally from which they did not return. After waiting about an hour, the two Mexicans and four Koreans assumed that the five Koreans had succeeded in their effort to escape and decided to follow after them. Taking the same route as before, they probably reached A-8 through one of the cross-cuts above the diagonal haulage road, which must have been impassable owing to the small fire there. Below this road they came upon the bodies of the Koreans who had preceded them, and suddenly overcome by afterdamp, fell across them. The Mexicans probably fell here close upon 2 A. M., Virgen falling upon his back, his buddy upon his face. Virgen was picked up about 2:30 A. M., so he probably had not been in the noxious atmosphere of this place for more than 30 minutes, and as before stated, his buddy had probably expired only a few moments before his own rescue.

Use of Rescue Apparatus.—Nine sets of Draeger helmets were on the scene of the disaster by Tuesday morning, the day after the explosion. At this time the exploration work was being pressed forward along the main haulage slope toward A-9 and A-10, and owing to the slowness with which the afterdamp was cleared, progress was halting. Had there been men at the mine experienced in the use of the Draeger apparatus they might have safely penetrated the dangerous atmosphere ahead of the air, but from subsequent events, it appears that the most possible to accomplish with this apparatus would have been the recovery of a few bodies a little earlier. The C. F. & I. Co. and the Cokedale Co. had only recently received their apparatus and it had never been unpacked until it arrived at Primero, where there was no one conversant with its proper assembly or use. In spite of this lack of knowledge, however, Superintendent Bert Lloyd and Fire Boss Mark Brown, of Cokedale, early in the morning donned their apparatus and intrepidly advanced to the limit of the good air and would have gone further if not stopped by Superintendent Thompson and ordered back. An investigation of their discarded apparatus a little later by Mr. Morrow, who arrived at 8:30 A. M., showed that several important valves, washers, etc. of the sets were found loose, so that if the wearers had penetrated the danger zone with them in that condition, they probably would have traveled out on stretchers. The lesson of this incident is obvious: Such apparatus cannot be donned by those inexperienced in its assembly and use without subjecting the wearer to undue risk.

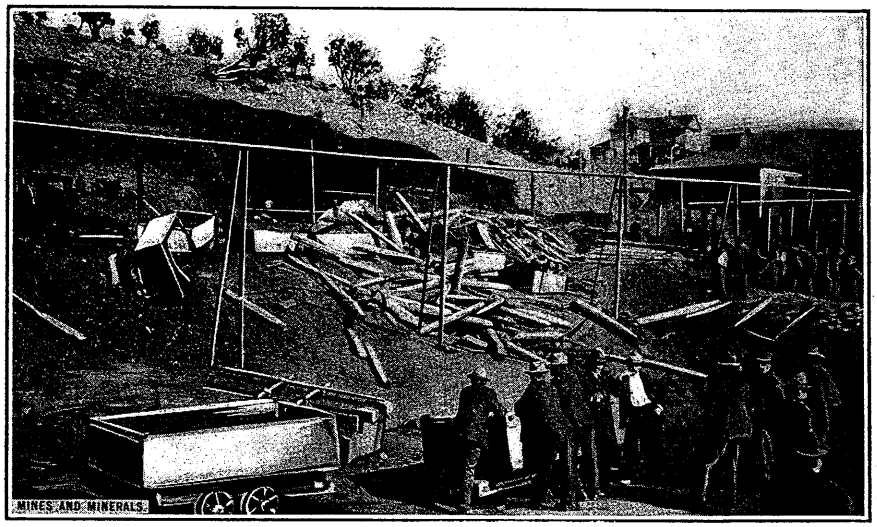


FIG. 3. WRECKAGE OUTSIDE MAIN DRIFT

Scientific Investigation of the Disaster.—Up to Thursday morning, the third day after the explosion, conditions were so far improved as to allow investigation into the origin of the explosion by government experts, and State Inspector John D. Jones and Deputy Griffith turned their attention to this work coincident with their exploration of the workings for more victims. An independent examination was also conducted during Friday and Saturday by Mr. Morgan Griffith, of the Union Pacific Coal Co., accompanied by Inspector Manley and a party of the company men, which the writer was kindly permitted by the management to accompany.

The following notes on the mine workings and the methods of operation were gathered during these visits of inspection:

The Main North Mine Workings.—As the explosion was confined wholly to the workings of the Main North Mine, the following data relate almost wholly to it. The coal bed worked was the uppermost of three in the Laramie Cretaceous. It was bituminous coking coal varying from 6 to 7 feet in thickness, and was shipped to the Segundo coke ovens some 3 miles southeast of Primero. The bed had a fairly regular dip of about 4 to 5 per cent. In the most southern and western portions of the mine the roof was a strong sandstone, but in other portions of the mine it was a weak draw slate in which was intercalated a thin bed of coal. The draw slate varied from a few inches to

10 feet in thickness and had to be supported by props. The coal invariably carries feeders of marsh gas CH_4 which discharge into the mine atmosphere whenever there is a roof fall of draw slate. Previous to 1907 the mine was worked on the double-entry system, with side entries and rooms turned at right angles, but owing to the difficulty of supporting the roof at the junction of cross-entries with main-entries, and of cross-entries with room necks, it was abandoned and the blind-entry system adopted. The blind system not proving as successful as anticipated, it was discarded in favor of the "panel system"; working the rooms from the extreme end of the entry and retreating with a solid block of coal as a barrier against squeezes and other troubles.

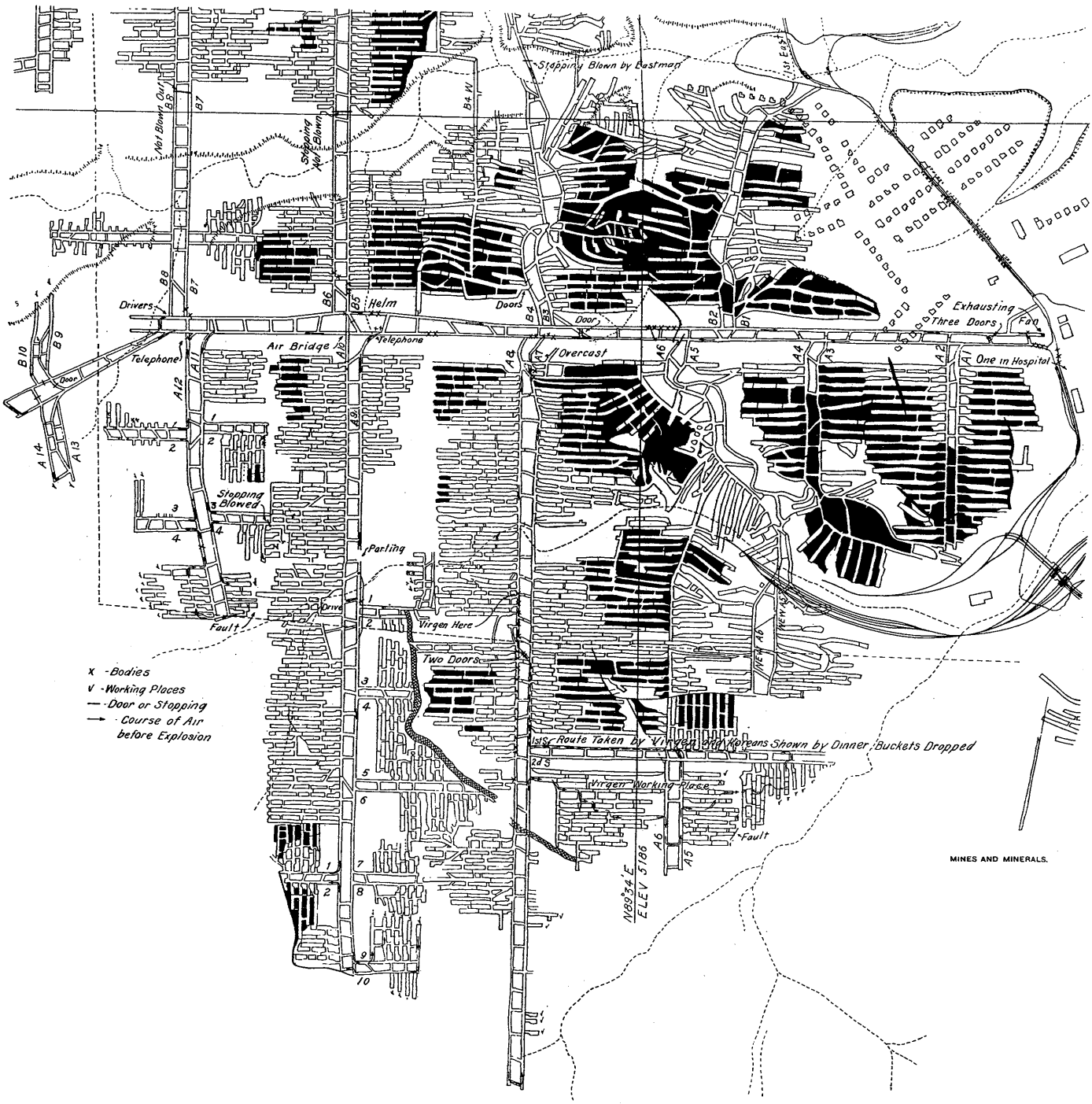


FIG. 4. PLAN OF PRIMERO MINE

Although there is no state law to compel it, all the mines have shot firers employed by the companies, and this was strictly enforced at the Primero mines. After placing the holes, therefore, each miner simply prepared his charge for each hole, placing the primed fuse in the cartridge and laying this and the adobe tamping on the floor in front of the hole. A piece of paper was usually stuck on a nail over the entrance to a working place upon which paper was marked the number of holes ready for firing within. When the shot firer came along, he was supposed to carefully measure the holes and estimate the quantity of explosive needed. If he did not approve of the quantity, he modified it to suit his judgment, and if not satisfied with the hole, could refuse to fire it. He invariably placed the charge himself and tamped it. Only one shot was fired at a time and each fuse was lighted from a smouldering piece of cotton wicking carried for the purpose. The wicking was lighted outside the rooms and smouldered like punk. Ætna B. powder

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one adjacent to the caved pillar, the other half way to the entrance. The fourth miner whose presence would be expected from the fourth dinner bucket could not be located. All the timbers of the entire room were badly charred and those near the entrance caked with coke as before noted.

Between blind entries No. 2 and No. 3 only a few timbers remained standing, those noted giving no evidence. It is noteworthy that one set remained standing some 20 feet east of the entrance into No. 3 blind, from whose collar hung an unburned sight string. Arrived at No. 4 blind, the force had apparently gone south along it, bursting the stopping between the entry and room No. 20, driven north from the main entry A-10, and throwing the stopping some distance into the room. Between blind entry No. 4 and the six rooms driven south from A-11, few timbers stood and on these no evidence was noted. The first room passed going west was the last driven and it had no break through the pillar into the second room. The timbers of this first room showed a pronounced coking only on the inside. In the second room nearly all the timbers were standing, but for the most part charred and caked on their south sides. The worst of this caking was noted on timbers standing between the room face and the first breakthrough into room No. 3, passed in retreating from the face toward A-11. The force of the dust explosion in room No. 2 was evidently not excessive, since several loaded cars remained standing unmoved on their track a short distance from the face. Room 3, however, was badly caved, access into it being possible only a short distance from A-11 and not at all via the break through the pillar from room No. 2. In rooms 4 and 5 most of the props stood near the entrance but were down and the roof badly caved next the faces. Coking on the props showed mainly on the south sides. In the last room, No. 6, the evidence was particularly clear. This room had been driven hardly 100 feet before encountering a fault, after which it was abandoned. Near the face of this room was the breakthrough into room No. 5. Opposite the mouth of this breakthrough in room No. 6 a slab of flat rock stood vertically extending parallel with the rib. The face of this rock slab toward the breakthrough had evidently received impinging particles of coked dust, as it was caked ½-inch thick—plain evidence that the dust explosion was following the ventilation current at this point. In addition, the posts at the entrance to the room carried on their south sides, cakes of glistening coke from 1 to 1½ inches thick, showing intense heat in this room. Without detailing any more of the evidence it may be briefly stated that as far as noted at this writing, a series of dust explosions apparently swept up the main slope from the intersections of main entries A-11 and A-12 with it. Below these intersections the explosions apparently failed to travel far northwest, as previously noted. Sweeping up the main haulage way the masonry overcasts bridging it opposite A-10 and A-7 were demolished and the fragments blown some distance up. In the main slope the roof falls averaged a height of 6 feet, reaching a maximum of 8 to 10 feet at points. The heavy falls extended from just below A-12 to a point about 200 feet north of A-10, a distance of about 600 feet. This was about as far as the slope had advanced at the time of the first explosion in 1907. This disaster took down the shaley roof up to the hard overlying slate, and the latter rock stood the second explosion. Only comparatively minor roof falls, therefore, occurred at isolated spots along the slope, the only cave worthy of note occurring at the mouth of the haulage slope and extending about 120 feet in.

As the dust explosion came up the main slope it doubtless gathered momentum until it burst forth at the mouth with the phenomena previously noted. While the explosion traveled both the haulage way and the air-course, the fact that the stoppings in the cross-cuts between were largely blown into the air-course would seem to indicate that the explosion in the haulage road traveled ahead of that in the air-course. From the fact that the fan, which stood directly in line with the air-course, was but slightly damaged, it may be assumed that the explosion in the latter was lacking in intensity as compared with the one in the haulage way. In all about 25 men were killed on these main slopes, of which five were found blown into the fall at the head of the haulage road within 100 feet of safety. The four men outside who stood in line with the blast from the mouth of the haulage way have been previously mentioned. All of these bodies were badly burned and the majority terribly mangled as well. As the explosion swept up the main slopes, it apparently was carried down the main entries from them with varying intensity and effect. In general the intensity of the explosion traversing the B entries was apparently considerably less than that of the explosions in the A entries possibly because as previously noted the air circulation was less active. In B-7, for instance, although there were small roof falls at and near the intersection with the air-course, in which two drivers were

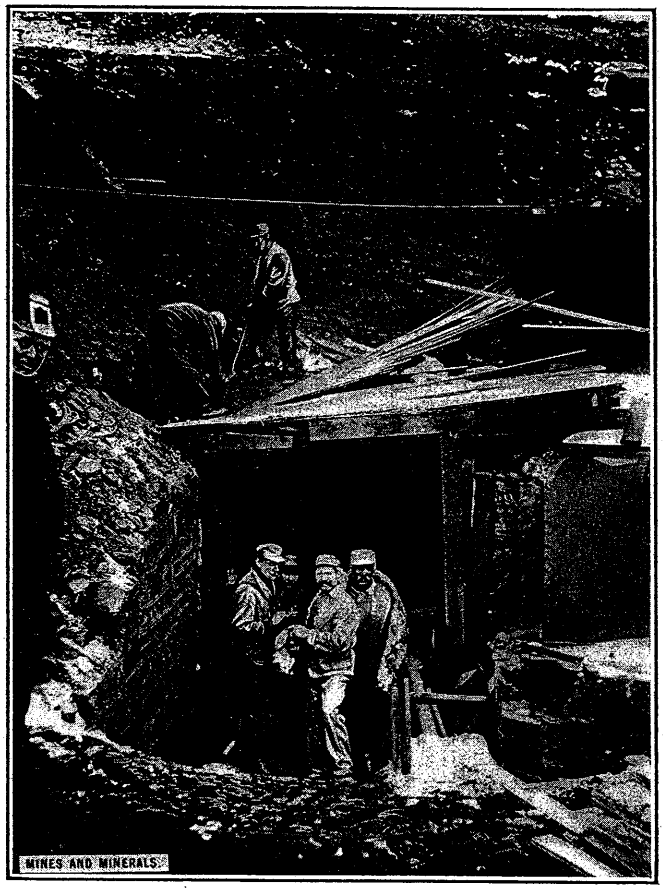

FIG. 6. ENTERING MINE THROUGH FAN HOUSE

killed, the force of the explosion evidently did not penetrate more than 100 feet up the entry. At about this distance up, a single room had been driven south from the entry, and from this room two other rooms had been turned east from it. The air-deflecting curtains at this point were apparently untouched by the explosion. Inside the rooms conditions were found exactly as left by the miners. At the faces of the rooms the holes had been bored, and the charge for each hole lay on the floor in front of it awaiting the placing by the shot firer. At B-5 and B-6 the force was evidently greater. Amid twisted rails and debris near the mouth of B-5 was noted a car with its west end stove inward and its door blown about 8 feet east from it. Of two timbermen who had been at work in the air-course at the mouth of the cross-cut into the main haulage stope and directly opposite B-5, one was found blown about 200 feet up the B-5 entry, or east, and with him the terribly torn trunk of a man supposed to be David Williams, the missing pit boss.

The other timberman was found at the intersection of the cross-cut with air-course, close to the point where he had been at work. B-3 and B-4 were not examined, as a stopping above south B-3 had been placed in order to utilize them for the return air-courses to the fan at No. 1 east mine, as previously explained. Wreckage in them was said to be slight. B-1 and B-2 had long been disused, as were also the A entries from A-1 to A-6, inclusive.

In entries A-9 and A-10 the heavy roof falls commenced at about the points at which the entries had ended at the time of the previous explosion. Beyond these points the roof falls averaged from 4 to 6 feet high. Near the mouth of A-9 a heavy post bearing a tail-rope sheave had been broken off a little above the floor and the upper part hurled down the entry, west, for a distance of about 20 feet. This and other evidences, needless to detail, established the fact that the dust explosion had traveled west up the entry from its intersection with the main-haulage slope.

In entry A-8 the evidence seemed to indicate a westerly travel of the explosion as far as room No. 35, just beyond the diagonal cross-cut driven into A-7 for a haulage road. Beyond room No. 35 the explosion very evidently had not traveled, as all the timbers were in place, but had swept up the diagonal haulage road into A-7. At the point of intersection with A-7 was found an immense mass of tangled timbers, the shape of this mass reminding one of a great beehive. Inspection of this curious place has led several observers to express the belief that a whirlpool-like action of the explosion took place here into which whirlpool were drawn the timbers of the vicinity. Apparently the force of the explosion spent itself in this whirlpool, for while A-7 was a wreck up to this point, not 30 feet beyond it going west all the timbers were in place and everything just as before the disaster. It should here be explained that entry A-7 had been wrecked this far by the first explosion in 1907 and as it was used merely for a return air-course from the intersection of this diagonal haulage road leading into A-8, it had never been cleared of roof falls.

As has been previously explained, the sole survivor of the interior mine disaster, Leonardo Virgen, was picked up on A-8 at a distance of about 225 feet east from the intersection of the diagonal haulage road. In front of him lay eight bodies and behind him six more and several mules. Four of these bodies, including those of two drivers, were burned. The remaining bodies of the group were unmarked and death had evidently taken place by asphyxiation. It is here noteworthy that rooms 30 and 31, driven north from A-8 (between which the bodies were recovered), connected with blind entry No. 1, driven south from A-9. The stopping between this entry and the rooms is said to have been blown south into the first room. The possibility therefore suggests itself that perhaps the afterdamp from A-9 circulated across these rooms and down A-7 and A-8, and up B-3 and B-4 to the No. 1 east fan. If this is so, it explains why the party of nine Koreans and two Mexicans, who escaped the force of the explosion and who delayed some hours after it, before attempting to leave the mine, were overcome at this point on their way east down A-8. The portion of the mine in which these 11 men were at work (rooms driven off blind entry No. 2 off A-7—at least 1,600 feet from the nearest explosion) was absolutely unaffected by the explosion and in it the air remained good, due to the short-circuiting of the afterdamp currents around it. Had they been able to communicate with the outside and obtained instructions to stay in safety till reached by the rescuers, all would have been saved. As it was, these were the only men in the mine at the time of the disaster who had the slightest chance to survive. All others apparently died almost instantly.

Conclusions.—To definitely place the origin of the disaster at this writing would be, of course, impossible. We may go so far, however, as to express some ideas relative to this matter, which data later uncovered may or may not bear out.

So far, it appears that the dust explosions traveled all the main entries intersecting the main slopes *inward toward their faces*, with two exceptions. These exceptions are apparently A-11 and A-12. The dust explosions have apparently traveled out of the mouths of these entries and into the main slopes, short-circuiting around the extension of the slope from the point where their direction was changed to northwest. The main dust explosions in the entries have apparently almost invariably followed the course of the ventilating air-currents. The evidence thus far recorded from A-11 is unsatisfactory, inasmuch as it fails to show the direction of travel of the dust explosions at crucial points. Between the mouth of A-11 and blind entry No. 1 the explosion apparently traveled east into the main slope. Between the mouth of blind No. 2 and the face of the entry, however, the evidence fails to conclusively show whether the explosion traveled west with the air-current or came east from one of the rooms. Although the stopping in blind entry No. 4 was blown south, this would have been the case whether the explosion originated off from blind No. 2 or in the rooms off the west end of A-11. Plainly, the explosion did not originate in the rooms off blind No. 4.

Since the direction of travel was plainly *out of room No. 6* at the face of A-11, through the cross-cut and east from A-12, following the direction of the ventilating current, it seems that the origin may be located either in the rooms off of blind entry No. 2, or in the rooms driven south off the west end of A-11. At both of these points the evidence of coking is plain. At both of these points the rooms were finished and pillar drawing was in progress at the time of the disaster. Roof falls, as previously stated, always broke up through and above the overlying narrow seam of coal, and this seam appears to carry quantities of CH_4 gas. The pillar drawing operations at both points would, therefore, doubtless liberate quantities of gas whose ignition in some unknown manner might have started the series of dust explosions that spread throughout the mine.

The writer learned from several sources that rooms Nos. 5 and 6 off blind entry No. 2 showed quantities of gas when last examined only a few days before the disaster. It should be stated, however, that periodical examinations sometimes showed gas here and sometimes none at all, the finding evidently depending on whether or not there had been roof falls incident to pillar drawing shortly preceding the time of examination. The rooms driven directly off A-11 showed no gas at this time of last examination.

In the rooms off blind No. 2 four men were working, as shown by dinner buckets, two of whom had just started work the day of the disaster. Of the three bodies located by the party of which the writer was a member, two of them were identified by their new clothing as the new men. One of these was found on the entry, the other close to the entrance of room No. 6. The third body lay close to and partially under the caved pillar. The fourth was not located. Up to this writing no bodies have been located in the rooms off A-11, and until they are cleared of heavy roof falls, particularly room No. 3, it is apt to be most difficult to definitely locate the origin of the explosion.

If one cares to lay special stress on conditions in room 6, off blind No. 2, assume that the dust explosions uniformly followed the ventilating current, disregard the unburned sight string hanging 20 feet east of the opening into blind entry No. 3, and explain to suit his theory the lack of evidence on the few timbers standing in A-11, between blind No. 2 and the face, the idea may be expressed that the origin may be eventually located in room 6, off blind No. 2.

On account of the magnitude of the roof falls, it is likely to be at least 10 weeks before the mine can be completely cleared of debris and the last bit of evidence noted. At this writing all but 12 bodies of the 75 killed have been removed during the first week after the disaster and the recovery of the rest is apt to be very slow. In a later article it is hoped to present the final evidence.

Maps Not Scanned