EXPLOSION

CROSS MOUNTAIN MINE NO. 1.

BRICEVILLE,

ANDERSON COUNTY,

TENNESSEE.

December 9, 1911.

By

J. J. Rutledge, Mining Engineer.

Pittsburgh, Pa. July 19, 1912.

EXPLOSION AT CROSS MOUNTAIN MINE No. 1, BRICEVILLE, ANDERSON COUNTY, TENNESSEE, DECEMBER 9, 1911.

INTRODUCTION.

This mine explosion occurred at 7:20 a.m. December 9, 1911, at exactly the same moment as the adjacent Fraterville mine exploded on Saturday, May 19, 1902. There were 89 men in the mine at the time of the explosion, of whom 84 lost their lives, and 5 survived the explosion and the resulting afterdamp by barricading themselves. The greater part of this number were suffocated. Three of the men who barricaded themselves walked out to the main entry in safety after ventilation had been re-established and rescue work was well under way, and the other two were brought out by rescue men wearing breathing apparatus. Two of the men were burned about the face and hands when the explosion occurred, and one of these so burned was unable to leave the barricade without assistance from the men wearing breathing apparatus.

GENERAL INFORMATION.

The Cross Mountain Mine No. 1 is about one-half mile west of the village of Briceville, Anderson County, Tennessee. The post office and railroad station is Briceville. A branch line of a standard gauge railroad, about 4 miles long, operated by the Southern Railway, connects the mine with the Southern Railway's Knoxville & Ohio Branch at Coal Creek, Tennessee. The mine is in what is known

as the Coal Creek district, in Eastern Tennessee, and ships coal to all points in the south-east reached by the lines of the Southern Railway

Ownership and Operators: The mine is operated by the Knoxville Iron Company, under a royalty basis, the coal being owned by the Coal Creek Land Company, Knoxville, which company owns all the coal in the vicinity, and leases it to the various operating companies

Cross Mountain Mine No. 1 is said to have been opened in 1868. The adjoining mine on the west is the Thistle mine, owned by the Coal Creek Coal Company. The Fraterville mine, also owned by the Coal Creek Coal Company, adjoins the Thistle mine. The mines of the Tennessee Coal Company are on a branch line of the Southern Railway one mile south of the Cross Mountain mine.

Mr. Thomas I. Stephenson is President of the Knoxville Iron Company. The operations at Cross Mountain Mine No. 1 are in charge of Superintendent P. F. Lynch, and Mine Foreman, George Bulmer. W.A. Parmer, who lost his life in the explosion was inside foreman.

GEOLOGY AND CHARACTER OF COAL.

The mine opening is in a small foothill which extends back into Cross Mountain, a spur of the Cumberland mountains; the advanced workings extend under the mountain, the summit of which is about 2,000 feet above the mouth of the mine. The coal is known as the Coal Creek bed, but no correlation has been made with other beds in the East Tennessee Coal field. The coal is of Pottsville age, and the average thickness is 46 inches, the range being from 3 feet to 4 feet 6 inches. It is a rather hard coal and possesses well defined

faces, and is easily won when undercut by electric machines. The natural conditions are good and coal is consequently produced at a fairly low cost. It is said that mining conditions in the Cross Mountain mine were better than those in the neighboring mines and that the output could be marketed either as steam or domestic coal; the latter quality gave the mine a decided advantage in the market.

Roof: The roof immediately over the coal bed is a rather hard, sandy, gray shale, called slate by the miners. Aside from that portion of the mine workings lying between the drift mouth and the fan, where the roof is poor, this slate is quite strong everywhere, and requires no cross timbering and but few props. It is brushed to a height of about 6 feet on the main entry and air course, and about 5 feet on the cross entries.

Floor: The floor is of fireclay which is usually rather hard but softens and swells when wet or when the adjacent pillars are pulled. It varies in thickness, so far as it could be observed, from one to four feet. In some of the cross entries, notably in the twenty third and twenty fourth left, there seemed to be a heaving of the floor for a considerable distance.

Moisture: Neither the roof nor the coal is naturally moist, and artificial wetting is necessary in order to render the coal dust inert. The open faces in the coal bed apparently tend to drain the coal of its natural moisture as soon as it is opened by entries and rooms. The roof is also dry and little moisture was visible on it.

Gas: It is said that inflammable gas had been found in the

twenty fourth left entry some time previous to the explosion. The first rescue parties found a one-half inch cap at the face of the main entry. The mine was designated as Class B Mine by the State Mine Inspection Service, from which the inference would be drawn t that the authorities did not consider the mine a gaseous one.

DESCRIPTION OF MINE AND METHOD OF OPERATION.

Development and System of working: The coal outcrops about 50 feet above the water level and is opened by a drift which passes under poor roof for the first 3,000 feet, but after that encounters a very strong slate roof. The coal is worked by pillar and room. One main entry extends from the drift mouth to the face of the advanced workings. The main entry is 16 feet wide and is brushed to about an average height of five feet. In places the present roof is 10 to 12 feet above the floor along the main entry between the drift mouth and the fan. A main air course is driven on the right of the main entry going inbye; this air course is from 10 to 12 feet in width and consistently brushed to an average height of 6 feet. Cross ~~sections~~ entries 16 feet in width are driven directly off the main entry at distances of 530 feet center to center. From 1 1/2 to 2 feet of slate is brushed on these cross entries. An air course 16 feet in width is driven parallel to the cross entry. The cross air courses are driven 16 feet wide and are not brushed. The coal has well defined faces and as the entries are driven directly on the butts and the rooms directly on the faces. The ribs of these entries are quite even and present little lodgment space for fine coal, while

the coal in the rooms often falls when the cutter head of the mining machine is being withdrawn. A pillar of 50 feet wide is left between all of the cross entries and corresponding air courses. All entries have from 1 1/2 to 2 feet of slate brushed for height and this slate is gobbed in the entries, so that there is a clear space of about 5 x 9 feet. The cross entries, which are driven 16 feet wide, are not brushed. All break-throughs are driven entry width at intervals of 60 feet, and this distance is consistently maintained. Room necks are 9 feet wide and 35 feet deep, and rooms are driven 40 feet wide to a depth of 200 to 300 feet, with a room pillar of 50 feet. All rooms have two necks, and are widened out at right angles to the axis of the room. Occasionally two rooms are necked only and left standing as barrier pillars in the advance work; these pillars are left at intervals of 600 feet. The pillars are rarely worked advancing, but on the retreat, and in most cases the slate has fallen by the time the mine officials are ready to work the pillars, and it is necessary to resort to "slabbing." By this is meant, taking a skip up along the pillar advancing up the room until the inbye end of the pillar is reached and then cutting across the pillar, bring back what is left of the pillar on the return, as the mining machines in use are self propelling they are used to undercut the pillars in many instances.

Rooms were turned on the gob side or up the dip, so as to facilitate the pushing of the loaded cars out of the rooms. Breakthroughs were driven 9 feet wide with 50 feet of solid coal between each pair of breakthroughs.

The mine was first worked on the double entry plan with entries

500 feet apart, but this was abandoned on account of the grades which prevented the men pushing the cars out of the rooms. The present system is entry and air course pillar and room, with rooms driven 250 feet deep and cross entries 550 feet apart, giving 50 feet of ~~min~~ solid coal below the entries; a 40 foot pillar is always counted on below the airway. As the work in the entries advances two rooms are worked and the adjacent two merely necked and left as a pillar to be recovered on the retreat. No pillars are robbed on the advanced. The first room on each cross entry on the left of the main entry was kept narrow and cut through to the next outbye air way and used as an air course. When a cross entry is turned a solid block of coal 150 feet wide is left before turning the first room. This acts as a barrier pillar. When the cross entries have progressed 1,000 feet from the main entry a solid block of coal 150 to 200 feet thick is left. This is the safety pillar maintained against a possible squeeze. Room pillars are robbed inbye this pillar but none outbye of it.

Mining: In the face of the rooms the coal is always undercut by means of electric chain machines and many of the pillars are also cut by machines. Sullivan short wall, and Goodman Chain breast 17 A machines are used, and the cut is made in the lower part of the coal bed. These mining machines pull themselves across the working face while undercutting the coal. The coal is quite hard, and being mined directly on the face, usually falls without much blasting. This occurs even in a room neck where the width is only 9 feet. In some instances the middle of the face in a room falls as soon as undercut

and this coal is then loaded out except the uppermost part, usually about 7 inches thick, which sticks to the roof and which is brought down by rib shots fired to loosen the coal on the ribs. From 5 to 10 inches of FFF black blasting powder on a 1 1/2 inch stick is used to blast the right hand rib, and about one-half of this amount on the left hand rib. But two rib holes are necessary to blast the coal in any working place, be it entry, air course, room or pillar. By reason of the open end on the cars the coal is easily loaded in large lumps. The mining machines yield considerable fine coal and the open ends on the mine cars allow considerable fine coal to fall on the haulage roads. In some places there was a layer of coal on the roadway varying in thickness from 3 to 4 inches, and from 1/2 to 20 mesh. The mining machines yield considerable fine coal dust which settles on the floor, especially in the rooms. Generally speaking there did not appear to be an excessive amount of fine coal dust in the rooms except at points designated later.

The coal is of such a character that the open faces (it is worked directly on the faces in the rooms) fall on the cutter heads of the mining machines while the coal is being undercut and on withdrawal of the cutter head of the mining machine in many cases the coal can be loaded out without the use of powder. This occurs in the room necks as well as in the wide rooms. Usually the miners shoot one rib hole and load out the coal blasted by it before firing the other hole.

The fire-boss at the Fraterville mine, who was a member of the inspection party, reported that a great many of the miners in that mine never blast the coal, but pick it down after it has been undercut. Others fire one rib hole only, the remainder of the face being

then easily worked out by the pick. Drill holes are from 4 to 6 feet in depth and average 1 3/4 inches in diameter. Cartridges are 1 3/4 inches in diameter and from 5 to 10 inches in length. No holes were shot in the solid. The men were about evenly divided between the use of squibs and fuse.

Explosives: The mine did not use excessive quantities of black blasting powder or dynamite. FFF black blasting powder was said to be used exclusively in blasting the coal and 40 per cent National Powder Company's dynamite for brushing the roof. The black blasting powder was generally carried into the mines in 5 and 10 pound "jacks" but at one place a 3 gallon oil can was found partially filled with black blasting powder. The miners usually carried in the dynamite. Black blasting powder was made into cartridges and fired by means of squibs and fuse. Shots were fired by the miners at no stated time. Iron tamping bars and needles were used for charging the shots. There were no shot firers.

Electric power plant and wiring: One of the motor generator sets was 200 kw. and the other 100 kw. There was 250 volts on the trolley wire and also on the mining machine feed wires. The machine feed wires and the return consisting of two No. 0000 round wires were bare. When these wires reached No. 3 side track they branched, one going to the right and the other to the left. The trolley wire was No. 0000, figure 8 form to No. 3 side track, and a round wire from there to the lower end of No. 2 side track. Usually there was 400 amperes on the small generator and sometimes 500 amperes. The larger generator broke at 800 amperes. Four No. 0 bare wire

carried the current in the drift mouth.

Haulage: There were 6 electric haulage motors in the mine, all made by the Goodman Manufacturing Company; of these three were 6-ton motors for use on the main roads, and three were 3-ton motors for use in haulage on the cross entries. Haulage on the main entry was entirely by electric motors and on the cross entries largely so, though some 7 mules were used in the mine to gather coal near the face of the entries. Two of these mules were used by the contractors. The mine cars hold from 1700 to 2000 pounds of coal and were of the type having the bottom of the car resting directly on the car axles, the wheels being outside and rubbing against the body of the car, which had flaring sides. One end of the car was entirely open except for a 1 1/2 inch movable round iron bar so arranged that it could be swung into place horizontally across the end of the car, and was locked in place by a moveable bar fastened to the side of the car. When the car was to be loaded this bar was locked in place and afterward released at the tipple by the dumper. The other end of the car had only a 10 inch plank to hold the coal in place. The purpose in so arranging the cars was to force the men to load lump coal and thus reduce the amount of fine coal made. It will therefore be obvious that they were very well calculated to leave fine coal on the haulage ways while en route from the working face to the mouth of the mine. There was little topping on the cars as the coal was almost wholly machine mined and there were no hand miners, and no especial inducements to top the cars. The low roof and open ends also prevented much topping.

Lighting: The main entries were lighted at important points by incandescent lamps. The miners used open oil and carbide lamps. It was stated that the fire-boss carried a safety lamp, but some times examined the mine by means of an open lamp.

Ventilation: The mine was ventilated by means of a Johnson disc exhaust fan, 7 feet in diameter, and placed in the main airway or manway about 5,000 feet from the drift mouth at the bottom of an air shaft 12 feet in diameter and 104 feet deep. This fan was run by electric power at 300 r.p.m. and, according to Associate Mine Inspector Richards, who had inspected the mine twice since June 30, 1911, the fan gave 40,000 cubic feet of air per minute, with a 1/2 inch water gauge, air measured at the intake at the fan. There were two intakes, the main entry and the manway or main air course. The cross entries, (except the twenty fifth and twenty sixth left entries) were returns, and the airways were the intakes. There was a door across the main entry at the twenty sixth left entry and this splits the air at this point. No gage records were found on the fan, which had been but slightly damaged by the explosion. The intake air was split at the twenty fifth left, one split passing to the left and returning to the fan by an overcast on the main entry, the other one passing to the right and reaching the fan by means of the main air course. There were doors at the mouths of all cross entries and stoppings at the mouths of all cross air courses.

Humidity: The mine was quite dry at the time of the explosion, except for that portion of the main entry between the fan and the drift mouth, where there was over most of the distance from 1 to 2

inches of running water; this water had been carried ~~xxxxxxxxx~~ in ditches at the side of the track previous to the explosion, but the timbers and debris from the explosion had been blown into the ditches and filling them, forced the water to run over the track.

The main and cross entries were watered by means of a water car which was filled either at the tipple or at the face of the main entry, where water usually collected, and then hauled along the main and cross entries by the haulage motors, in the regular trips; the inside foreman being given entire freedom as to what area should be sprinkled. Rooms and air courses were not sprinkled. There is an abundance of running water available for sprinkling, at least during a part of the year, more particularly the late fall and winter. The fire in the seventeenth right entry was fought by means of a 2 1/2 inch water line laid from near the top of the air shaft to the fire and having a head of about 125 feet. The conditions for watering the mine were particularly favorable.

Drainage: A small anticline crosses the main entry just inbye the fan and causes a dip of about 2 degrees in favor of the loads from the fan to the drift mouth; from the anticline inbye to the face of the main entry there is an average dip of 2 1/2 degrees to the face. As a result of the conditions just stated the water drains from the crest of the anticline outbye and inbye. Most of the water comes from the old right entries just outbye the fan. An electric pump is stationed at the point shown on the map on the left of the main entry. This is the only pump in the mine. All other portions of the mine that were visited except the face of the main entry are dry and require no drainage, or pumping arrangements.

Fire protection: So far as could be learned there were no especial arrangements for fighting fire within the mine aside from the use of water barrels, which had to be filled at the tipple and hauled into the mine. There was no rescue or fire fighting corps, or drills, but there was a good supply of water piped to the tipple.

STORY OF THE EXPLOSION.

Local conditions: The weather was clear and rather cool, but exceptionally warm weather had prevailed for the week immediately preceding the explosion. There had been a sudden drop in temperature just previous to the explosion. Barometric readings will be found in the appendix. The mine had not been working full time during the two weeks immediately preceding the explosion, but had only worked a portion of each day. On the morning of the explosion at the time work began there was not a sufficient number of railroad cars in which to load the day's output, and some of the men remained outside awaiting the arrival of more cars before entering the mine; as a result of this only 69 men were in the mine, and the remainder of the entire force of 125 were outside, hence escaped the explosion. The fan was in operation and all the conditions about the mine were normal so far as could be learned. Two motormen and one sprogger had come out of the mine with a loaded trip previous to the explosion; presumably they double headed out as they found the trip at No. 2 side track, [illegible] The other motorman had taken the miners to No. 5 side track and there picked up a loaded trip and brought it as far as No. 2 side track, where the explosion overtook him. A trip

A trip containing 11 men was just preparing to go into the mine when the explosion took place.

The fire boss J. H. Hatmaker, had examined the mine workings on the morning of the explosion and had reported everything o.k. in the mine report book. He left the mine at 4:30 a.m. on the day of the explosion; Mr. Prior, the day engineer at the power plant, reported that at the time of the explosion he had the larger generator on the trolley and feed wires for the fan and mining machines; since there would be no machines in operation until after the miners reached their working places the generator would not be overloaded by this load. The circuit breaker on the larger generator blew out at exactly 7:20 a.m. as he noted by looking at his watch. From ten years experience at this power plant he estimated that the disturbing influence must have been located near the face of the main entry. On account of the starting resistance on the fan it was customary to wait one minute after the circuit breaker had blown out before throwing it in again. He reported that he had just looked at his watch and noted that 45 seconds had elapsed since the breaker had been thrown out when he chanced to look out of the power house door, as he looked toward the switch board preparatory to throwing the breaker in again, when he saw a shower of leaves and gravel come out of the opening adjacent to the power house, where the temporary fan was later installed. He threw in a switch lower down on the switchboard but following this all the breakers were thrown out. He furthermore stated that it was customary for the machine men and others in the mine to set their watches with his, since the man trip was run in

accordance with the whistle in the power plant.

The night engineer at the power plant was starting to go hunting Saturday morning , and chanced to be a short distance from the mouth of the air shaft when the explosion occurred. He reported that he heard a sound resembling the explosion of a skyrocket, and saw dust and smoke rising from the mouth of the air shaft to a height of 100 feet.

Superintendent Lynch and mine foreman Dalmar came to the power house and ordered Mr. Prior to stop the machinery as there had been an explosion in the mine.

Alleged causes: Dust: The manway which was parallel with the main entry with a pillar about 50 feet thick between, was quite dusty in many places, as the men and mules entered the mine workings through this entry; this dust, which was 5 or 6 inches deep in places was almost wholly shale dust. It was commonly/rumor that a dust explosion caused the disaster, and the manway was generally cited as a place where there was considerable dust. This main airway was free from obstructions and was the best brushed passageway in the mine.

Windy shot: It was reported that several men, probably four, entered the mine at 5:30 a.m. on the day of the explosion in order to blast coal for the days loading, as their places had been cleaned of coal on the day preceding the explosion. The shot fired by these men was said to have resulted in a windy shot which started the explosion. These men worked in the twenty sixth left entry.

Gas ignition: Some of the miners asserted that the twenty fourth left entry had been idle for some time previous to the explosion on account of taking up the bottom. Work was to be resumed in this entry

on the morning of the explosion and the fire boss had requested the mine foreman to notify him in advance of the resumption of work in order that he might examine it carefully before allowing the miners to enter it. Gas was reputed to be present in this entry.

Rescue and recovery work: Mr. P. F. Lynch, Superintendent and Mr. George Dulmer, mine foreman, and a rescue force entered the mine immediately after the explosion and by reconstructing the stoppings reached the overcast about noon. They used mostly open lights Mr. E. B. Sutton, foreman of the Knoxville station of the Bureau of Mines, accompanied by volunteer assistants, E.E.Owen and Harry Thompson, reached the mine at about 1:30 p.m. on the day of the explosion, and immediately began to explore the main entry. Car No. 7, in charge of foreman William Burke and first aid miner, John Farrell, reached the mine about 8:00 p.m. on the day of the explosion. The Director arrived at the mine on the evening of December 9. A.R.Brown, foreman in charge of the Birmingham station, arrived at Bridgeville Sunday morning December 10, but did not enter the mine until that evening.

A disc fan obtained from the Black Diamond mine near by, was set up at the old drift mouth near the power house. Steam pipes were laid to the fan and it was ready for operation at midnight Saturday, but was not started until 2:00 a.m. Sunday. This fan was operated as a force fan so as to conform to the directions of the ventilating current operating at the time the explosion occurred. Previous to this the mine officials had built a huge bonfire on the surface at the mouth of the air shaft in order to induce ventilation in the mine. Balls of burning cotton waste were also thrown down the shaft to start an upward current of air.

Rescue men: The following men, acting under the engineers of the Bureau took part in the rescue work, those designated * wearing artificial breathing apparatus:

* E. B. Sutton, Foreman, Knoxville Rescue Station;
* E. H. Owen. Temporary assistant to Mr. Sutton;
* William Burke, Foreman, Mine Safety Car No. 7;
* John Ferrell, First Aid Miner, Mine Safety Car No. 7;
* Dr. J. A. Holmes, Director, Bureau of Mines.
* A. R. Brown, Foreman, Birmingham Station;
* W. T. Richards, volunteer rescue man, Rockwood, Tenn.
J. J. Rutledge, Mining Engineer, Bureau of Mines;
* J. W. Neeby, Salesman, Jefferson Powder Company, Birmingham, Ala. vol
J. W. Paul, Engineer in Charge of Rescue Work;
* J. T. Ryan, Assistant Mining Engineer, Rescue work;
* William A. Vandenbush, foreman Mine Safety Car No. 6;
* O. O. Roberts, First Aid Miner, Mine Safety Car No. 6;
* John Richards, Volunteer rescue man, Rockwood, Tenn.
* J. W. Groves, Mining Engineer, T.C.& I.R.R.Co. Birmingham, Ala. vol.
* James Brown, Rescue man. do do
* Ulric Brondy, do do do
* Francis Moseley, do do do
* Roy Verchot, do do do
* Arthur Wayne, do do do
* Thomas Wayne, do do do
* John Wayne, do do do
* Mike Dugan, do do do
* George Blankenhorn, do do do

x John McCrory, Rescue man, K. C. & I. R.R.Co. volunteer;

x H. H. Hamilton, Salesman, DuPont Powder Co. Birmingham, Ala. volunteer

x P. C. Long, Interstate Coal Company, Warren, Ky. volunteer;

x Frank Pippen, do

x Ray B. Moss, volunteer, Straight Creek, Ky.

x Charlie Marlow do

x E. W. Pittman, do

x W. M. Tomlbee, do

The above named persons arrived at the scene of the accident in the order in which their names are given.

Rescue and Recovery work: The men wearing breathing apparatus and operating under the direction of the Director and the engineers of the Bureau, advanced ahead of the miners, who were erecting brattices, reestablishing ventilation, and removing the bodies. The employees of the Bureau, with volunteer assistants (all wearing breathing apparatus in the beginning) advanced along the main entry until the face was reached, and then explored the cross entries, locating all bodies, and advising the stretcher crews of their location. These rescue men worked in corps composed of 4 or 5 men; a reserve corps being held in readiness for instant service at all times. As the cross entries varied in length from 2,000 to 3,000 feet, and the time allotted for the trip from the mouth of the entry to the face and back, averaged about one hour, the men had to work very rapidly, consequently the work was very arduous. Moreover, the roof was very low in places. All the cross entries, and as far as possible, the air courses also, were explored before the ventilation was established. This was done to locate any men still alive and to discover and extinguish any fires before the ventilation should

be reestablished and any inflammable gas in the mine be drawn over the fires. That this method of procedure was wise was demonstrated by the rescue of the men found alive, and the discovery of inflammable gas, and the extinguishment of several fires.

The ventilation was reestablished as far as possible in accordance with the course which it took previous to the explosion, since this seemed the wisest course to the Chief Inspector, the mine officials and those rescue men first on the scene of the explosion. To this end the board brattices were erected at the mouths of all cross entries and air courses and the overcast on the main entry at the mouth of the thirteenth left entry, was rebuilt. Some of the rescue men were of the opinion that each cross entry and air course should have been explored and ventilated in its turn, advancing inbye along the main entry, and pushing the entire air current of the mine through each cross entry; but it would seem that this plan would have required more time than the one used, since many of the rooms were holed through from one cross entry to another, and it would have been necessary to erect additional brattices at the mouths of these rooms in order to conduct the air up to the face of the cross entry and out the corresponding air course. By the plan adopted what little air the temporary fan gave was conducted to the face of the main entry and there allowed to split, one part going to the left and slowly drifting back through the left entries, and then returning to the upcast by way of the overcast. While the other split went to the right and circulated through the right entries and then returned to the upcast by way of the main air course or manway. Considering the conditions in the mine and the small volume of air given by the fan, the course adopted

seemed to be the best.

Ordinarily the fan at the adjoining Thistle mine was run as a force fan, but soon after the explosion, the officials of the Thistle mine reverse the fan to draw out any afterdamp in order to save the lives of any men who might still be alive in the long right cross entries. There was no direct opening from the Cross Mountain mine to the Thistle mine existing at the time of the explosion, although some years ago such an opening was made inadvertantly, but it had been closed later. The fifteenth, sixteenth, seventeenth and eighteenth right entries had been pillared back 200 to 500 feet from the boundary, but the Thistle fan undoubtedly pulled the afterdamp through this caved ground, as the Thistle men were driven out of their places 10 minutes after the fan was reversed, and later the men were unable to progress beyond the overcast in the Thistle mine on account of the afterdamp. Moreover, all the rats in the Thistle mine were suffocated by the afterdamp.

Samples of the mine air in the face of the sixteenth right were collected after the explosion and the results are appended.

It was the concensus of opinion among the men who were wearing the breathing apparatus that the mouth breathing form was much preferable to the helmet, especially under the conditions of low roof and narrow entries that existed in the Cross Mountain mine. One of the men wearing a breathing apparatus fitted with a helmet was overcome by afterdamp by reason of his helmet being displaced by striking against the roof. He was, however, quickly revived by means of the pulmotor. This was the only ~~incident~~ instance of an accident to rescue men.

enclosed by three stoppings, two in the air course and one in the breakthrough. Part of the ~~fire~~ fire in the breakthrough was loaded out before the stopping at that point could be built. The stoppings were made of one inch plank, puddled with red clay dug from the mountain side near the drift mouth. A 2 1/2 inch water line was laid from a small brook on the mountain near the mouth of the air shaft and along the main entry to the fire. This gave a head of about 125 feet and allowed the water to be thrown inside the stoppings on to the fire. This fire was not completely extinguished at the time the examination was made, but it was under control and apparently almost extinguished. Previous to the laying of the water line the fire was fought by means of a hose and nozzle. Water was brought into the mine in barrels in mine cars, which were filled at the mine tipple and then hauled to the mouth of the seventeenth right, where they were emptied by means of a hand pump which discharged into the hose line. This method was not as effective as the water line which superseded it.

Coroner's Verdict: There was no coroner's inquest.

NOTES OF EVIDENCE OBTAINED BY BUREAU OF MINES ENGINEERS.

Mr. George E. Sylvester, Chief Mine Inspector for the State of Tennessee and his two associates, Joseph Richards and John Rose, examined the mine workings very carefully. The mine was in Mr. Richards' district and he had made two inspections of it since his appointment in June, 1911. In addition to the above men, Mr. E. T. Buffett, Superintendent of the Tennessee Coal Company, Cupp, Tennessee, Mr. T. P. Wangle, Mine Inspector for the Travellers Insurance Company, of Hartford, Conn. which company carried the liability insurance on the mine

Fires: The work of rescue and examination was seriously retarded by numerous fires, the presence of which was manifested as the work of re-establishment of ventilation progressed. A small fire was found in the sixteenth right by the rescue men, but it was easily extinguished; another gob fire was then discovered in the eighteenth left at the point designated on the map, and the fire extinguishers from the cars were used in subduing it. It was several days before the fire was completely extinguished. Later a fire developed in a breakthrough in the seventeenth left. This when found had spread to the chain pillar, and had to be dug off finally by the pick and wet down with water as it was shoveled back. A large fire was found in a breakthrough in the seventeenth right at the point designated on the map, and this caused a delay of about ten days, until it could be successfully stopped off; a line brattice was carried up to the fire in order to bring the fresh air to the fire so that the men could work at the stoppings. This fire spread to the air course and was finally enclosed by

employees. Mr. P. F. Lynch, Superintendent of the mine, two or three representatives of the miners, and Messrs. Rutledge, Sutton and Burke of the Bureau of Mines, made up the investigating party.

The inspection of the mine workings was begun on January 3, and completed on January 12. During this time all of the mine workings from the sixteenth right inbye to the twenty sixth left were examined in detail. All possible assistance was given the examining party by the mine officials.

Extent of the explosion: The entire mine workings from the seventeenth right and the seventeenth left entries inclusive, and inbye to the face of the main entry were affected more or less by the explosion, though the greatest violence was found in the twenty third, twenty fourth, twenty fifth and twenty sixth left entries and the corresponding air courses.

Working places: At the time of the explosion the first working entries were the eighteenth left and the nineteenth right, in both of which entries pillars were being worked by pick work. All the right entries inbye the nineteenth right were worked by machines, as were all those left entries inbye the twenty second left inclusive.

The barricaded men: Arthur Smith and Doric Irish appeared to have been the leaders in arranging the barricade. William Henderson worked in room No. 45 in the nineteenth left entry, and his son Milton Henderson worked in room No. 47 in the same entry; Arthur Smith, Irwin Smith, his brother, Doric Irish and Arthur Scott worked in the last room in the eighteenth left entry, pillaring the room. Arthur Smith wrote the inscription on the door in the eighteenth left, and left the door open, and then probably with cooperation of Doric Irish (who drove

the contractor's mule) selected the haulway between the sixteenth and seventeenth left entries, the highest point on that side of the mine, as the most likely place to build the barricade. Horace Irish, father of Doric, who also worked in the eighteenth left, was injured by the explosion, and had been left on the seventeenth left entry, as he was unable to move himself. While the men were constructing the barricade the Hendersons appeared and were asked to assist in the construction. They first built a wall or barricade of gob rocks near the sixteenth left entry. A lighted lamp was left on the top of this wall to serve as a warning of the approach of the afterdamp. When the gas was found to be coming into the barricade from the sixteenth left another barricade was built 41 feet inbye the first one, and 80 feet from the seventeenth left entry. This one was built quite solidly of gob; the spaces between the pieces of slate being filled with hay from the mule stable on eighteenth left, the outer part of the wall being supported by an old door. The space inside the barricade was 45 feet long, 6 feet high and 9 feet wide As the brattices were put up at the mouths of the cross entries, the air behind changed in the barricade and the lower wall was necessary. The men inside the barricade reported that they knew when the mouths of the entries were being closed by the change in their air within the barricade. William Henderson had an oil lamp, and the other four had carbide lamps. They reported that they had to fan their lamps with their coats in order to keep them burning. Irwin Smith and Doric Irish had been burned about the face and hands by the flame from the explosion, the latter rather severely and as his burns gave him considerable pain he required attention. Scott went through the lower barricade from time to time, and brought water from

the tube on the eighteenth left entry, where the mules formerly drank. A mule fell down and was suffocated by the afterdamp directly outbye the door on which Arthur Smith had written his instructions to the rescue party. John Duff was also in the barricade but left it on Saturday or Sunday evening, in company with Arthur Smith. Smith had an axe and Duff a pick. They had determined to make their way out to the main entry. The body of John Duff was found in the sixteenth left entry about 425 feet from the main entry, on the evening of the thirteenth, between two heavy falls. He was sitting against the rib, his cap and unlighted lamp still on his head, and the pick about 25 feet outbye the body, lying against the rib; the body was not burned and had the appearance of being dead but a short time. The body of Arthur Smith was found in the sixteenth left air course, about 20 feet from the breakthrough and 40 feet from where Duff's body was discovered. The body was in a sitting position, and the axe which he carried when he left the barricade, was on top of the fall.

About 5:00 p.m. Monday, December 11, A. R. Brown, John Ferrell and John Richards were in a car in which one of the drivers was taking rescue apparatus into the mine along the main entry; when the car had reached a point opposite the mouth of the eighteenth left entry, which was stopped by a brattice, Brown heard someone pounding on the inside of the brattice, and asking to be let out. Assuming that the voice came from some of the miners who were engaged in putting up the brattices, Brown and Richards took a pick and tore a plank off the brattice and were astonished to find three men, the two Hendersons and Irwin Smith behind the brattice. William Henderson was smoking his pipe; Irwin Smith's hands and face were burned, but the two Hendersons were in fair condition.

The driver took the three men out to the mouth of the mine, after they had informed the rescue men that there were two men still in the barricade but unable to come out unassisted. One of the men, they said, was badly burned and in need of attention. Ferrell ran along the main entry to the twenty fifth left entry, where Messrs. Paul and Rutledge and the remainder of the rescue men were assembled, and informed them that there were living men in the eighteenth left. A rescue corps was at once formed, composed of Brown, Vandenbush, Ferrell and John Richards, with Ryan, C. Roberts, Burke and Will Richards acting as a reserve corps. The rescue party found the inscription on the eighteenth left door, and sign boards pointing to the barricade. They opened the barricade and brought Dorie Irish and Irwin Scott out. Brown and C. Roberts placed emergency dressing on Irish's burns and then the two were sent to the surface.

Irwin Smith's ears, face and both hands were burned, the right one severely. He asserted that the force of the explosion carried him some distance and dropped him so that he lighted on his back. This statement seems corroborated by the fact that his back appeared to be sprained. When the explosion occurred he stated that he thought he felt the ground tremble and heard a distant sound and a flash of fire followed, which set his clothing on fire. He extinguished the fire in one of the tubs used for watering the mules. He said that John Duff and Arthur Smith left the remainder of the barricaded party at about 2:00 p.m. Saturday, and that they were going toward the sixteenth left.

DETAILS OF EVIDENCE: The examination of the mine began at the drift mouth or main opening and progressed inbye. A piece of slate was found on the inbye side of a post at about 200 feet from the mouth; about 20 feet further inbye three pieces of slate were found sticking on the inbye side of a post, and at the same point the insulators on the inbye side of posts were covered with dry dust.

About 400 feet from the drift mouth a post on the left side of the entry had a train of dust on the inbye side, but there was the same quantity of dry dust on both inbye and outbye sides of the insulators. At about 450 feet a small piece of rock was found imbedded in the inbye side of a post on the right side of the entry. A post 500 feet in had a small piece of rock sticking in the inbye side. At 510 feet a post had a train of dust, triangular in cross section, on the inbye side and at about the center of the post. At about 550 feet a post was seen on the inbye side of which a small piece of stone was imbedded about one inch/ and the roof of the entry was about 15 feet high. At 650 feet, a post on the left side of the entry had on the inbye side, a train of dust 1 1/2 inches wide, and extending from the top to bottom. At this point the track was not muddy, as had heretofore been the case. Water was running alongside of the track. Shale, mixed with coal, was on the track. At 675 feet a post that stood on the left side of the entry had a train of dust 1 1/2 inches wide, and extending from top to bottom on the inbye side of the post. At 700 feet, a prop on the right side of the entry had a train of dust the same as just noted, and also small coke-like globules on the inbye side. (Sample taken by Mr. Paul.) Small globules were also seen on the inbye side of a prop on the left side of the entry at 710 feet. These globules were in

a train of dust about 1 1/2 inches wide; they were from 1/16 to 1/8 inch in diameter, and were the first indications of coking. On the inbye side of a trolley cross arm on the left side of the entry, at 750 feet there were very small splotches of coke, slightly globular, and the fused edges had a silvery appearance. The top of a prop on the right side had been pushed outward. At 775 feet coke was found more pronounced on the outer side of a prop than on the inner, as was evidenced by the appearance of the top of the prop. At 790 feet there were props right and left on the outbye side of which was strong coking. The right hand props were about 6 feet in advance of the left hand ones. At this point there was running water on the roadway.

At 800 feet a timber set was found dislodged; there was coke on the outbye side of the cap and legs and running water in the center of the roadway. A post on the right side was bent outward, and a cap, lying on the floor had a band of dry dust on the inbye exposure at center, top and bottom. At 850 feet, a prop 12 feet long had a train of dry dust on the inbye exposure, extending from the top to about 4 feet from the bottom. At this point all timbers were dislodged. There was no ditch here, as it had probably been filled by the debris of the explosion.

At 900 feet there was a second opening to the right. Opposite this opening there was a post with a train of dust on the inbye side, extending from top to bottom. At 920 there was a prop 10 feet in length which had the top pushed 12 feet outbye. At 950feet there was an opening to the left with feed wires into it; a line of track extended into this opening, but at about 40 feet a fall covered the track. At 980 feet dislodged timbers were found with thick trains of dust on the inbye exposures.

At 1,000 feet there was an opening right and left and all timbers were dislodged except one collar; there was running water on the track at this point.

At 1,100 feet there was an opening to the right; all timbers were dislodged, and there was water on the roadway, and the roof was about 12 feet above the track.

There was an opening to the right at 1,200 feet, and the track was wet, but there was no running water on it. The timbers were all dislodged. There was no water on the track, but the floor was muddy nearby. At 1275 feet a collar was marked with "t:45 a.m. 12/9/11" This collar was pushed outbye about 12 inches, and on the inbye side of it was a train of dry dust. In the niches of a broken collar there was fine dust about 1/8 inch deep. The roadway was damp at this point.

The collar of a set of timbers at 1300 feet had a train of dust, triangular in cross section, extending across the inbye side. The set was pushed about 9 inches outbye. At 1320 feet there was a small opening on the right, and the timber sets at this point were pushed out - one leg 3 feet from the vertical; the roadway was damp at this point. At 1350 feet there was a collar still standing with a crescent shaped train of dust on the inbye side. There was also a piece of coal sticking on the inner side of the collar. At 1360 feet there was an opening to the right and some water standing on the roadway.

From 1300 to 1400 feet the roof was 18 to 20 feet above the roadway, but at 1400 feet the roof was only about 5 1/2 feet from the roadway, and this low roof continued for 20 feet, when it again rose to 20 feet from the roadway. There was an opening to the right at this point, and also

standing water on the track. The inbye edges of the roof slate were whitened and spalled. At 1450 feet there was a large opening to the right with water running on the track. At 1480 feet the roof was only 5 feet from the roadway.

At 1500 feet there was a gobbed opening to the right, with the roof but 5 feet from the floor; there was also standing water on the track at this point. At 1575 there were openings right and left, with a new plank brattice over the left opening; the roadway was muddy at this point.

An opening to the right was found at 1600 feet, and the track was muddy. At 1620 feet there was an opening to the left, not bratticed, but closed by a fall about 20 feet from the main entry. The roadway was damp at 1650 feet, and there was an opening to the right that was nearly closed with gob.

At 1700 feet there was an opening to the right, closed by gob; the roadway was dry; at 1750 feet there was an opening to the right, mostly gobbed; the sandy shale roof was broken and timbers were dislodged.

At 1800 feet there was a gobbed opening to the right, and the main entry widened to 18 feet; this was the beginning of No. 1 sidetrack. There was a gobbed opening to the right at 1850, and also an opening to the left at 1900 feet, which was almost full of gob. At 1900 feet there was also an opening to the ~~[illegible]~~ manway on the right of the main entry. There was a gobbed opening to the right at 2,000 feet.

Station 2,100 was the stopping at the air shaft. The cross section of the main entry opposite the air shaft was 500 feet with 25,000 cubic feet of air passing per minute, on December 18.

Continuing along the main entry inbye of the thirteenth left the conditions were as shown on the sketch map. The stoppings are numbered inbye from the fan to the twenty sixth left. At stopping No. 7 the rescue party found a body lying with the head outbye; the head was badly crushed and the right leg blown off. Another body was found at No. 10 stopping. The overcast, which was entirely destroyed had been at this point. Between stoppings No. 14 and 16 a motor trip of loaded cars was found; the cars were all blown outward. Two bodies, both badly mangled, 25 feet apart, lying face downward, were found near the trip; these were the motorman and his spragger. The stoppings on the main entry were all of brick; they were 9 inches thick and nearly all were blown out toward the main air course. At several points small splinters of slate were found on the inbye side of the props; the trolley hangers had been bent outbye and the inbye sides of the insulators covered with fine dry dust.

The mouth of the fifteenth left entry was at the inbye end of No. 2 sidetrack. On the roadway in the main entry between the seventeenth right and No. 3 sidetrack there was considerable shale mixed with the fine coal. The bodies from the seventeenth right haulway were brought out through No. 40 stopping, as it was not possible to bring them past the fire on the seventeenth right.

From the eighteenth left inbye to No. 3 sidetrack there was considerable shale dust on the roadway which rendered the coal dust inert, and there was some spalling of the coal ribs. The insulators and trolley hangers were bent outbye. The beginning of No. 3 sidetrack was at stopping No. 47. The main entry was about 25 feet wide at No. 3

sidetrack, and the roof was about 6 feet from the floor, while a "run-around" 9 feet wide and 6 feet high branched off this sidetrack. This "runaround" was to allow the small haulage motors to pass by the sidetrack on route to the cross entries when the sidetrack was full of loaded cars.

A sample of the road dust was taken near the right rib of the entry at stopping No. 55 where the dust was 1/2 to 3/4 inch thick, on the floor. The first coked dust in quantity was found on the inbye rib of the crosscut to the stable between stoppings No. 54 and No. 55; This mass of coke was about 1 inch thick and covered an area about 3 inches in diameter. Some splinters of wood were also driven into the outbye exposures of the roof slate at the crosscut. A body and two dinner pails were found near this point. Another body, badly mangled, and lying across the tracks was found at the tool house at stopping No. 56. There was also a body on the sidetrack opposite the twenty second right entry, and one on the sidetrack between the mouth of this entry and stopping No. 58. The main entry was only 9 feet wide at stopping 59.

The switch at the mouth of the twenty second left entry was thrown out, and the door was blocked open outward. At stopping No. 64 the right rib was swept clean by the explosion. Between stopping No. 65 and the mouth of the twenty fourth right entry a motor trip of empty cars was found and the bodies of eight men in and around the trip. The bodies were neither burned nor mangled. The switch was thrown for the twenty fourth right, and the bodies were the men who were to work in that entry.

The trolley switch at the mouth of the twenty third left had been blown away and the trolley wire dislodged from the hangers. Considerable fine coal, not mixed with shale, was found on the main entry roadway between the twenty third and twenty fourth left entries.

At the mouth of the twenty fourth left a piece of slate was found imbedded in the inbye side of a prop on the right rib. The door at the mouth of the twenty fourth left entry was blown outward into the main entry. The track on the main entry opposite the mouth of the twenty fourth left air course was broken by a force which came out of the air course.

The door posts formerly at the mouth of the twenty sixth right were found on the main entry 20 feet outbye the mouth of the cross entry. The bottom on the right rib was swept outbye. The door frame which had formerly stood just inbye the mouth of the twenty fifth left entry was found on the main entry 40 feet outbye the mouth of the twenty fifth left entry. The cross timbers were pushed outbye and there were small pieces of slate on the inbye sides of the props. The trolley on the main entry inbye the twenty fifth left was still in place, as was also the trolley at the mouth of the twenty seventh right entry. It was not possible to proceed in the main entry beyond the mouth of the twenty sixth left air course on account of water from the fire line in the seventeenth right entry.

Twenty second left entry: The trolley switch at the mouth of this entry was open. The door at the mouth was blocked open when found by the rescue party, a tie having been placed between the door, which opened outward, and the outbye rail of the track. All other doors at the mouths of the left entries outbye this entry had been blown inward from the main entry. The stoppings, which were mostly of gob, were in the condition as shown on the accompanying sketch map, and the force appeared to have come from inbye this entry. The body of Jim Robbins was found in the twenty second left air course at the point designated on the sketch map. It was naked and was burned red from the neck to the knees, and the face was crushed flat so that it was unrecognisable except for part of the mustache. Both feet had been broken off, and one foot was missing, while the other one partially covered by a sock, hung by the skin. The entire body had been badly burned and mangled, and evidently had been blown some distance and struck violently against various obstacles.

There were two other bodies found in this entry as shown on the map. The one found farthest inbye had the hair singed, but the clothing was not burned, although the face and hands were. The other man was burned to about the same extent.

No. 2 main haulway was examined from the twenty second left to twenty first left, and the air boxes for carrying the air were found still in position on the rib. The doorway was blown toward the left. The haulway only extended from the twenty second to the twenty first left; from the twenty first left to the twentieth left the bottom had not been taken up, and the passageway was merely an airway. On the

twenty second left entry outbye the haulway coked rosddust was found on the outbye side of the props; this was the first coke observed in quantity, and, except that on the No. 3 sidetrack, was the first seen. The twenty second left entry exhibited the first traces of violence and may be said to be the outer limits of the explosive force, so far as the left entries are concerned.

Twenty third right entry: On Monday, December 11 at 12:30 p.m. John Richards, Ferrell and Sutton explored the twenty third right entry. Very little violence was manifested on this entry. One body of a man and a dead mule were found, and at the mouth of room No. 58 a plank was found on which was written these words "Gone to 22d right." The rescue men reported this to those in charge, but the mine foreman said that the drivers often left such notices after going from one entry to another, and that this notice was probably one left by the driver and not by men who might have been alive after the explosion. Later in the day when living men were found in the eighteenth left, the finding of this sign was recalled, and the twenty second rightentry was searched by a rescue party, but no living men were found.

Twenty third left entry: At the point shown on the sketch map an electric haulage motor and a mining machine were found. There were 8 bodies on or about the motor and machine. One body lay face downward in the mouth of a room immediately at the front of the motor; the second was on the right hand rail, facing inbye, with the head against the motor wheel; the third body was on top of the motor, facing inbye and lying on the left side; the fourth body was on the left side, headed inbye and on the left side of the motor; the fifth body was headed outbye

and lay alongside of the motor; the sixth, seventh and eighth bodies were along the left side of the machine. There was dry dust over the machine and motor and entry, but no coke was visible. Both trolley poles were clamped down off the trolley wire. The switch on the inbye end of the motor was locked, demonstrating that the motor was proceeding outbye the cross entry when stopped. The motor was not grounded. There were no means of coupling the mining machines to the motors, hence it was impossible to push the machine with the motor. Moreover, the machine was off the track, which confirms the opinion that the motor was headed outbye. The additional bodies over and above those of the four men required to operate the motor and machine, were those of men who were probably assisting in placing the machine on the track. At the point where room No. 30 on the 24th left was cut through into the 23rd left air course the bottom was swept clean over the entire width of the opening (about 12 feet) by a force which had come from the 24th left entry. There was considerable disturbance of the gob in this entry it requiring several hours labor to clear the short distance of roadway between the motor and the mouth of the entry. The remainder of the entry required very much more labor before the roadway could be cleared sufficiently to permit the passage of mine cars. On the night of December 16, twelve bodies were removed from the twenty third left.

Twenty fourth left entry: This entry was reached by way of the twenty third left air course and room No. 30 in the 24th left entry, as the room had been driven through to the air course of the twenty third left. The mouths of the twenty fourth left entry and air course were bratticed tightly in accordance with the plan of bringing the intake air

down to the face of the main entry before splitting it. Since all the bodies in the twenty fourth left entry had been taken out through the twenty third left entry, the work of investigation naturally followed this same route. The results of considerable violence were observed in this entry, the gob being thrown down and timbers scattered at various points. Several of the mine employes stated that gas had been found in this entry some time previous to the explosion, and further that the entry had not been producing coal for a week or two preceding the explosion on account of the bottom being taken up to increase the height. The twenty third left entry showed signs of the bottom heaving and the twenty fourth left appeared to have recently had the bottom lifted. The miners also ~~xxx~~ said that the fireboss had requested the mine foreman to give him notice when the entry was ready for coal production and he would examine it before allowing the miners to resume work there. One of the machine runners who had been off duty for some time on account of a broken leg, and who worked in the twenty fourth left, stated that it had been idle for some time preceding December 9, on which day it had resumed operations. He also declared that in his opinion, the men had walked into standing gas at the face of this entry, as gas had been found in it previously. The statement that gas had been found in this entry was corroborated by other miners who had previously worked in the twenty fourth left entry. No gas was found here after the explosion.

On the afternoon of December 17, two bodies were removed from the twenty fourth left entry. These bodies were found at the places designated on the map, and the outbye one was standing upright, being held tightly by gob packed about him up to his shoulders. This man had been standing immediately in front of the stopping when it was blown

violently into the entry from the air course.

The stoppings were in the condition shown on the sketch, nearly all of them being out, the force evidently having come from the air course into the entry. The face of the air course was squared up and there was some loose coal in the face of the entry, but no signs of a shot. Considerable soot was observed on the floor at the face of the entry and some coke in situ on the roof. In the last breakthrough the track had been blown into the entry from the air course, and there was a heavy fall on the entry at the mouth of room No.38. On the entry between rooms No. 34 and No. 33 a mine car was turned completely over and the ends reversed, as was shown by the couplings. A deposit of coked road dust 3 to 4 inches deep was found on the chain pillar opposite the mouth of room No. 2. One of the 30 pound steel rails in the track on the main entry opposite the mouth of twenty fourth left air course was broken and the entire track pushed over to the right rib of the main entry inbye, by some force which had come directly out of the air course.

Twenty fifth left entry: The conditions in this entry were as shown on the sketch map. There were many carbon filaments in this entry at room No. 13, and at room No. 27 the trolley wire was literally covered with these filaments, varying in length from 1 to 3 inches. Five bodies were found at the points designated on the map. In room No. 21 there was a pillar fall which had come down in two sections,- the first, or lower part being covered with a layer of dry dust, evidently the result of the explosion, and the upper, or smaller portion, being free from any covering of dust. The Wolf safety lamp, when held over

the fall showed a gas cap, variously estimated by different observers as from 1/2 to 3/4 inch high. Samples of this gas were taken and the results of analysis are appended. The fall extended from the road head diagonally across the room to the pillar stump. A miner's shovel was found lying against the fall on the road head and an empty mine car was found about 30 feet outbye the shovel, blocked on the roadway, as if it had been left by the miner at the close of the shift. The body of the miner was found face downward and headed outward near the pillar stump at the point shown on the sketch map. Probably the miner had found the fall on entering his working place at the beginning of the shift, and had gone up on the fall to inspect it while carrying a naked light, with t the result that the gas had been ignited.

The twenty fifth left entry was the last entry ventilated on the left of the main entry and whose return went to the air shaft by way of the overcast. The rooms off the twenty sixth left entry were not holed through to the twenty fifth left, and a door across the main entry just inbye the twenty fifth left split the air. One split went to the left and the other to the right.

Twenty sixth left entry: The face of this entry was undercut and fired. Several tons of coal had been loaded out of the right side of the face. In the center of the face was the bottom of an old hole 18 inches deep, one inch of which extended up into the roof slate. The mouth of this hole was about 7 inches from the roof. The roof was brushed to within 25 feet of the face, while the gob was back about 30 feet from the face. All the props were blown outbye from the face, and the roof

was in an extremely dangerous condition. There was considerable coke on the left rib of the entry in the inbye exposures. All the props were covered with fine dry dust.

The last crosscut between the twenty sixth and the aircourse had evidently just been holed, as there was coal lying in the aircourse opposite it. There was some question in the minds of some of those in the examining party as to whether or not this crosscut had been fired on the morning of the explosion. However, the examination seemed to indicate that it had been fired a day or two previous; but there was no conclusive evidence as all the men concerned were dead.

The last shot in this last breakthrough was thought by some to have been fired on the morning of the explosion by the men whose bodies were found in 26th left entry room No. 5. The bodies were grouped together as if they were firing shots, and they would probably have retreated to Room 5 if they had fired the breakthrough. There was no turn into the air course but there was a switch from the entry into it. There was coke 2 to 3 inches thick on the outbye exposures of the coal on the outbye rib of this last breakthrough. There was track in the aircourse, but it was broken, opposite the breakthrough. There was some loose coal on the floor of the breakthrough where it had been holed into the air course. This was carefully shovelled away so that the precise nature of the connection could be observed. The marks of the chain machine cutting picks could be clearly seen on the bottom. The machine had cut completely through the coal on the outbye side of the face of the breakthrough, and there only remained about 10 inches of coal on the inbye rib of the face in the breakthrough. If the miners had been unaware of the machine having cut entirely through the coal and had blasted the coal as though it had not been holed, (probably with an excessive charge, since it was the last cut in the breakthrough, and they desired to insure it holing) there would doubtless have been a blown out shot. The air course track was broken at a point opposite where the breakthrough holed and there was about 1 1/2 tons of coal lying against the inbye rib of the aircourse as though thrown there. There was also dry dust covering the pile, and a great deal of coked road dust in the breakthrough where it joined the entry.

Room No. 2, Twenty sixth left entry: This is the room in which it was said that the men fired their shots at 5:50 o'clock on the morning of the explosion. It was really the first room on this cross entry though it was numbered the second one; it had been started as a double room, but later narrowed up, as it was destined to serve as an air course. As shown by the sketch attached, room No. 2 had been driven to a total depth of 72 feet, and was 16 feet wide at the face. The face had been undercut 6 feet. About 4 inches of the coal face projected, making the total undercut 6 feet 4 inches. The neck of the room was 9 by 56 feet The center of the coal face had evidently dropped away from the upper 7 inch layer, either while the coal was being undercut or when the cutter head was withdrawn. The lower 8 inches had also dropped down, leaving an opening 2 inches wide between the middle and the lower part of the bed, which opening extended entirely across the face. The center part of the room face was loaded out and a hole 46 inches deep was drilled in the top layer of coal on the right rib, but in the judgment of the writer there had been no shot fired in this hole. There was a roll of safety fuse on the gob side of the entry, just inbye the mouth of room No. 2, which fuse had been burned, evidently from a flame coming from outside the fuse.

Room No. 3, twenty sixth left entry: This was merely a room neck 30 feet deep and 10 feet wide. The face was undercut 6 feet and the coal had dropped down on to th e undercutting, separating from the 7-inch layer of roof coal at the parting. A 1 3/4 inch drill hole 29 inches deep had been drilled on the right rib but all observers agreed that this shot had not been fired. It was unnecessary, and moreover showed no signs of having been fired. Samples of the drillings

were taken from this drill hole to be compared with the scrapings from the hole in room No. 2. The hole pointed slightly toward the right rib and made an angle of about 10 degrees from the horizontal. There was about one ton of machine cuttings thrown against the left rib. In this room neck, about 10 feet from the entry, the bodies of 4 men were found with their clothing badly burned. There was coke in situ on the roof over where the bodies lay. All the bodies were huddled together and appeared as though they had been awaiting the explosion of a shot, or had been conversing with each other when the explosion occurred. Superintendent Lynch said that Messrs. Wayne and Haynes worked the rooms in the twenty sixth left entry, and the Ridemour brothers worked the twenty sixth left entry and air course; the bodies of these four men were found in room No. 3.

SUMMARY OF EVIDENCE.

The work of examination proceeded from the drift mouth inbye, and the first coked roadDust in any quantity was observed on the outbye exposures of the coal at the outbye end of the runaround at No. 5 side track. An electric haulage motor with an electric mining machine attached to it, but off the track, was found about 500 feet inbye the twenty third left entry at the point designated on the map. Both trolley poles were clamped down off the wire and there were no signs of the motor being grounded. 8 bodies were found on or near the motor and machine.

Some pieces of sheet metal were found about 25 feet outbye the motor, which later proved to be parts of the metal boxes in which Okonite friction tape is packed. This box may have contained detonators, and probably was in the pockets of one of the miners near the trip. The presence of four of the bodies is easily accounted for, since the machine runner and his helper were doubtless there, in addition to the motorman and his brakeman, but the presence of the remaining four men is not easily explained. Perhaps these men were assisting the motor and machine crew in replacing the machine on the track. This machine had in all probability been derailed before the explosion. The presence of so many bodies at this point seems significant.

Gas was found in room No. 21 off the twenty fifth left entry over a large pillar fall. The fall extended across the room roadway and there was a miner's shovel at the base of the fall on the road, while the miner's car was blocked on the track 50 feet from the fall. A man was found face downward next to the room pillar, about 40 feet outbye the pillar fall. The lower part of the fall was covered with a considerable thickness of

dry dust, while the upper portion of the pillar fall was not so covered, indicating that this part of the pillar fall was had dropped some time subsequent to the lower part. The gas was found in a pocket directly over the upper and new portion of the pillar fall.

In room No. 2, twenty sixth left entry, a drill hole was found which some of the inspection party asserted had been fired, though others dissented from this view; there was no smoke on the roof, as is usually the case with windy or blown out shots, nor did the props which were all in place, show any evidence of a blown out shot, but pieces of what was apparently cartridge paper were found on the room road about 30 feet from the shot. In the adjoining room, No. 5, there was a similarly placed drill hole, which all agreed had not been fired. In this room the bodies of four men were found huddled together near the room switch. These four men worked the rooms and entry, and doubtless were the ones who came in at 5:30 a.m. on the day of the explosion. There was also some evidence of violence at the face of the twenty fifth left entry, the props being dislodged and thrown against the gob side; a large amount of coal was thrown against the inbye rib of the aircourse opposite the last breakthrough, which had evidently just been holed.

The door at the mouth of the twenty second left entry when found by the rescue forces, was blown open. The heavy 30 pound rail on the main entry opposite the mouth of the twenty fourth left entry was broken by the explosion.

CONCLUSIONS AND LESSONS.

(1) The Cross Mountain Mine No. 1 had by far too much territory opened up for the output of 500 to 600 tons per day. Had it been worked by panels, or the pillars pulled advancing, there would not have been the necessity for opening up one-half the work which was developed. Moreover, there would be more economical supervision, haulage and inspection if the mine were intensively worked. However, these long cross entries gave a place of refuge for the men after the explosion.

(2) All mine workings should be carefully examined by use of an approved safety lamp immediately before the miners enter the mine. No one man could, possibly have examined the mine workings in the Cross Mountain mine No. 1 in the time stated, with a safety lamp.

(3) In such mines as the one under discussion, where the coal requires such small charges of powder, a permissible explosive should be used in order to avoid all possible danger from windy and blown-out shots, and the use of any other than electrical means of firing should be prohibited.

(4) The use of such mine cars as those which were in this mine previous to the explosion, should be prohibited on account of the large quantity of fine coal which they drop on the roadways. None but tight mine cars should be used in a mine in which coal of this character is produced.

(5) The Cross Mountain Mine No. 1 should be well watered, either by the use of exhaust steam or by water sprays. It is seldom that a mine is found which can be watered as cheaply during the danger period, as

this mine.

(6) The mine needs a larger volume of air, and an accordingly larger fan should be installed at the mouth of the mine, or near the mouth of the air shaft. Each cross entry and air course should be separately ventilated.

C O N C L U S I O N.

The primary cause of the explosion is believed to have been an ignition of inflammable gas either in the twenty fifth or in the twenty fourth left entry, as is indicated by the following:

The fire-boss left the night shift men at 2.30 a.m. on the day of the explosion for the purpose of making the examination of the working places; it is said that he rode on a motor while on his rounds, and carried an open light; this is supported by the fact that the door at the mouth of the twenty second left entry was found blocked open, outward, after the explosion. The fireboss doubtless, examined only a few of the working places and probably returned hurriedly to the remainder of the party at 4:30 a.m. and left the door at the mouth of the twenty second left blocked open in order to avoid stopping to open it on coming out to the main entry. He and the miners left the mine at 4:50 a.m. He neglected to close this door and the failure to do so resulted in a short-circuiting of all the air in that part of the mine workings between the twenty second left and the face of the main entry and on the left of the latter. No fireboss marks were found at the faces of the left entries; Ray P Peters, whose body was found in room No. 21, twenty fifth left entry (in which room gas was found over a large pillar fall) probably walked up to the fall to examine it and ignited the gas. The explosive area above mentioned had become filled with an explosive gas-air mixture between 2:30 a.m. and 7:20 a.m. when the explosion occurred. This was ignited either by Ray Peters or by Sam Robbins. It is probable

that this gas was ignited by the former, as Robbins' body exhibited evidence of having been subjected to considerable violence. This would have been the case if the explosion had gained force by the time it had reached the twenty third left, at which place his body was found.

The broken track at the main entry at the mouth of the twenty fourth left entry indicated that the force had come outbye from that point. Moreover, the rescue party found gas on the main entry between the mouth of the twenty fifth left entry and the face of the main entry.

The man found in the twenty fourth left entry, entirely b buried in the gob thrown from the cross cut, had evidently been killed by a force which came into that entry from the corresponding aircourse. In the writer's experience, gas explosions have usually occurred at the beginning of the shift, as in the present instance.

Coked road dust was not found outside of the area which the major portion of the explosion covered, although there was considerable fine coal in other parts of the mine. The body of Robbins was badly burned, as noted previously, and it had been carried about 125 feet, indicating that he had been in the direct path of the explosion. There was no direct evidence of the shot in number two room in the twenty fifth left entry having been fired. The chemist's examination of the scrapings from the drill hole (see appendix) also indicate that it had not been fired. The analysis of the mine air samples taken from near the face of the sixteenth right entry during the progress of the examination, showed an oxygen deficiency, as if it were the product of an explosion of inflammable gas. The amount of methane was too great

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