REPORT ON MINE EXPLOSION

IN

Nº 7 MINE

WEST KENTUCKY COAL COMPANY

CLAY, KENTUCKY

AUGUST 4, 1917

REPORT BY

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Pittsburgh, Pa.
November 12, 1917.

JWP:AHE 10/10/17

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INTRODUCTION

At or about 7:30 or 7:40 a.m. August 4, 1917 an explosion took place within a part of the No. 7 coal mine of the West Kentucky Coal Company, about 1½ miles from Clay, Webster County, Kentucky, which caused the death of 62 persons and the injury of 3 others. Of those killed 11 were white persons and 51 were colored; of those injured 2 were white and 1 colored. At the time of the explosion there were 153 men in the mine, 91 of whom escaped without serious injury. Eighteen of the 91 were slightly burned or bruised; only 3 required hospital treatment. Out of the 62 deaths, one occurred on the road to hospital, and 7 after reaching hospital. The mine foreman, Chas. Wallace and his brother L. T. Wallace survived the explosion at the bottom of the shaft, but lost their lives when they proceeded without breathing apparatus to attempt rescue work. Thirty-two escaped from the mine without assistance.

Forty-three men, under the direction of Claude Bordis inclosed themselves in an unaffected entry and were rescued 3½ hours after the explosion.

At the moment of the explosion the workmen were mostly

traveling to their working places; only about 6 had reached their working places in the interior of the mine.

Since mules are used for haulage on the room entries it is the practice to allow the drivers until 7:30 a.m. to get their mules beyond the trolley lines before the electric current is turned on to the trolley lines.

On the morning of the explosion the drivers had all about reached their storage side tracks, and the mine foreman, Charles Wallace, at the bottom of the hoisting shaft, closed the switch which turned the electric current on the trolley wires. He had taken only 3 or 4 steps from the switch when the explosion wave reached the bottom of the shaft.

Bureau of Mines Rescue Car: Car No. 3, from Evansville, Ind. with G. T. Powell and cook, arrived on the scene at 12:30 noon on the day of the explosion, and was joined by miners from Sturgis who had been trained with breathing apparatus. These men composed a crew which did effective work in final control of the fire near the top of the air shaft. On August 5, J. R. Fleming and D. J. Parker, and on August 7, J. E. H. Denny [illegible] arrived at the mine and took part in the exploration work.

GENERAL INFORMATION

Location: This No. 7 mine is situate in Webster County, Kentucky, on the Illinois Central and Louisville & Nashville Railroads; it is surrounded by a mining village, which is 1 to 1½ miles distant from

Clay, which is the nearest railroad station and post pffice.

Coal bed: The No. 12 coal of the Kentucky Geological Survey classification is being recovered in this mine, and is reached by two shafts, each 236 feet deep. The top, or collar of the shafts each have an elevation above tidewater of 274 feet, making the elevation of the coal 38 A.T. The coal bed has a gradual dip to the northeast of 1½ to 3 per cent, and has an average thickness of 7 feet. An average of 5 ft. 6 in. to 5 ft. 10 in. is recovered in mining, there being from 6 in.to 18 in. left for the roof, and in some places 6 to 18 in. is left in the bottom. (See appendix for sections and analyses of the coal.)

Ownership: This is one of the several coal mines owned and operated in Western Kentucky by the West Kentucky Coal Company, whose main operating office is at Sturgis, Ky. The officers of the company are:

C. F. Richardson,	President,	New York City;
T. E. Jenkins,	Vice President and Genl.Mgr.	Sturgis, Ky.
H. M. Ernst,	Genl. Supt.	Sturgis, Ky.
James Palmer,	Superintendent,	Clay, Ky.
* Charles Wallace,	Mine Foreman,	Clay, Ky.

*Lost his life following explosion.

The mine was opened in about 1910, and was rapidly developed to a daily output of 1000 tons. Mine No. 5, which is located about 1½ miles to the east has been in operation for a longer period. It was in No. 5 mine in the year 1909 where 7 men were killed by a combined water blast and gas ignition under circumstances which have not been explained. An explosion occurred in No. 9 seam, Webster County, in 1910, and in No. 11 seam at Madisonville in April, 1912, killing 5 men. The bureau has no record of other explosions in this vicinity.

Civil conditions: For some weeks prior to the date of the explosion there had been much activity on the part of some labor organizers which had brought about much disorganization in the conduct of business in general, and in the mining business in particular, in Webster County. A strike was declared at the No. 7 mine by persons not employed at the mine, and efforts were made to enforce the strike mandate to the extent that physical violence became so acute that for some weeks prior to the explosion martial law had been enforced by regular soldiers and deputized pickets. On the crown of the headframe over the No. 7 shaft were mounted a search light and a machine gun. The mining village was inclosed in part by a wire fence and entrance was denied after 9 p.m. From surrounding woods and corn fields many volleys from rifles and revolvers had been fired into the mining village up to and after the day of the explosion, although on the day of the explosion the strike was declared off. During the recovery of the mine and the dead, and during the investigation made by the engineers of the bureau, volleys were fired from distant points.

The feelings of many of the people were under high tension, and it was impossible to predict what was likely to happen at any moment. Men descending the shaft had no reasonable assurance that the surface plant would be intact when they attempted to return . Under these unassuring conditions the recovery and investigative work was done.

It was reported from trustworthy source that an effort was made to procure the use of the chemical fire engine from the fire engine house at Clay, for extinguishing the fire in the air shaft, which resulted from the explosion, and that the Fire Marshall at Clay, in charge of the engine,

and who had a brother and a brother-in-law entombed within the mine, refused its use and locked the doors of the engine house, whereupon the soldiers forcibly entered the building and secured the engine.

Mining Conditions:

Tonnage and men: The daily capacity of this mine is 2500 tons with a full quota of men, but at present, owing to labor disturbances referred to, the daily output is only 1000 tons. The number of men employed underground ranges from 150 to 200, but on the day of the explosion 153 men were underground. In the section of the mine affected by the explosion there were 83 men, 62 of whom lost their lives.

Moisture: The mine is free from much water intrusion, the shafts and mine making only 24,000 gallons per day, which is handled by one pump running 2 hours per day. In the affected area no water was found in any depressions, but the ribs and roof were moist from moisture deposited from the air current. This moist condition was inappreciable on road dust found after the explosion.

Humidity: No record shows the humidity of any part of the mine prior to the explosion. No methods were adopted for adding moisture to the mine or to the air currents.

Roof: Throughout the mine the roof conditions are good. The head left coal/makes a good roof, and little timbering is required on the entries. In two places in the affected area the roof had been timbered, and falls had resulted from the displacement of the timber. The head coal and the shaley fireclay had fallen at these places, but no appreciable quantity of inert material is deposited on the roadways as the result of falls.

Rib and Road Dust: In the affected area the ribs had been swept clean and there was no accumulation of dust on the ribs, whereas, on the roads some parts had been swept clean and in other parts the dust had been deposited by the slowing down of the explosion wave, or by eddy currents.

In the unaffected sections of the mine, or in those sections of the affected section which had been the least disturbed, there was dust on the ribs and floor. The road dust on the haulage roads on which electric motors are used, is mixed with much sand, especially along the main east dip entry, which has a grade of 1½ to 2 per cent against the loaded trips. Prior to the explosion quantities of the road dust along this entry had been shoveled into breakthroughs along the haulage road. The analyses of road dust samples (see appendix) show a high percentage of ash, and the indications were that the presence of so much incombustible matter in the road dust retarded the explosion, and when the shafts were reached the pressure was so much reduced that the explosion died away.

Haulage: The cars are made of wood, with swinging endgates, weigh 2400 pounds empty, and hold 5000 pounds of coal when slightly topped. On mule haulage roads there is spillage and tramping of coal, whereas on the motor roads fine coal is spilled through loose endgates. The track is 40 inch gage, entry 40 and rooms 16 pound rails. Four electric locomotives of about ten tons weight are in service. Owing to the grade against the loads the speed of motor trips on the main East dip entry is very moderate. The cars are hoisted on self-dump-

ing cages to the surface plant. Little spillage of coal is made in the process of dumping the car.

Ventilation: The ventilation is produced by a Clifford-Capell steel fan, 6 ft by 16 ft, steam driven. The fan gives a pressure on the ventilating current of 1.5 inch, and operates as a blower; the air shaft has a downcast compartment, and a man-hoist cage; the hoisting shaft is the upcast. Following the explosion the current was reversed to facilitate recovery operations thru the main hoisting shaft.

The air current within the mine has three primary and two secondary splits. The fan has ample capacity for the requirements of the mine. The fan is operated continuously, and at the time of the explosion was working normally. No record was available as to the distribution of the air at the working faces prior to the explosion, but judging from the nature of the stoppings and overcasts the air was plentiful on the entries, but canvas was in use at some places where doors should have been placed. In one place the indications were that a car left under a canvas had caused interruption to the air current in the section of the mine in which the explosion originated. Along the main haulage roads the stoppings were made of concrete, and on room entries made of wood. Canvas was used to deflect the air at several places in the main entries, but no line brattices were observed.

Gas: Under the classification as prescribed by the Kentucky state mine law, the mine was considered non-gaseous when in normal

working condition, that is: - the fan in operation and the air current reaching all working places. However, with interrupted ventilation gas would accumulate in several sections of the mine. In the affected section gas feeders were in evidence in the advance workings, and samples of air taken during the investigation gave percentages of methane, although not showing more than a trace in the safety lamp.

Trouble with gas has not been a serious problem at this mine in the past, due, no doubt, to efficient ventilation.

A fire-boss has been employed at this mine and he makes a daily record of his observations in a book. The record, however, is of no practical benefit since neither the fireboss nor any other person is able to read the record.

Several samples of the mine air were taken in the affected area of the mine. The current of air was traveling the reverse direction to that under normal conditions prior to the explosion, and much of the air current was controlled by temporary stoppings, which permitted leakage. (See appendix for gas analyses). The total gas given off by the affected area may be indicated by sample No. 9245 taken on the 3rd left in an airway conducting the return air from the affected area. This amounts to 13,896 cu. ft. CH_4 per 24 hours. The total gas for the entire mine was not determined owing to inaccessibility to certain entries as a result of temporary stoppings having been erected.

Conditions at point of origin of explosion: At the place where the indications pointed as being the origin of the explosion there was a liberation of methane at the working faces of the entries and rooms.

The faces had been undercut, and in one room a post auger was in position; the auger was in a hole which had been started but not completed to the required depth.

On the day previous to the explosion there were two men working in the room in which the auger was located; one of the men, a negro, recently imported from the cotton fields of Mississippi, had worked one day in the mine.

On account of the labor disturbance at this mine many of the old miners had gone to Illinois mines and their places were filled by negroes brought from the South, who had had no previous experience in mines.

Mine development: The boundary under development at this mine comprizes about 1600 acres unmined. The coal is reached by a 3 compartment hoisting shaft, and a 2 compartment air shaft, each 236 feet deep. The head frame is of the "A" type, and the tipple is of steel construction. Self dumping cages are used, and the coal is sized on shaking screens, and the lump coal delivered on a picking conveyor, which delivers to the railroad car.

The mine is developed on the double entry, room and pillar, panel plan; entries are 10 feet wide, with 15 foot pillars between; barrier pillars, 100 feet. Rooms are 21 feet wide by 300 feet long, with 20 foot pillars between. It is claimed that 41 per cent of the coal is recovered in the advance work, exclusive of roof coal. This recovery is about 3929 tons per acre, out of a total of 9583 tons available, exclusive of roof coal. As the rooms in a panel are driven up the panel is abandoned, and it is doubtful if the room pillars are ever to be

recovered. While it is probable the barrier and chain pillars may be recovered, this recovery will entail additional expense in the relaying of tracks, clearing falls and timbering.

The maximum day's output is 2050 tons; the output for 1916 was 360,000 tons. However, the present daily output averages 1200 tons. The future daily output will depend upon the quality of labor employed. With skilled labor the mine might average 1500 tons daily.

The coal is undercut by electrically driven machines of the Sullivan C.E . type, operating at 220 volts D. C. there being 12 machines in service. The machine cuttings are loaded into mine cars sometimes before and at other times after the coal is shot.

The entries and rooms are driven without reference to butts and faces, as may be seen from the map. Timbering is scarce in the entries since the roof coal requires no support and the roof conditions are good. In the rooms timber is used at such places as the conditions necessitate it, as determined by the miner or mine foreman.

Explosives: All shots in the coal are fired by shot-firers at night after the miners have left the mine, by use of electric battery.

Collier X with No. 6 strength detonators are used in the shots. The shot firers handle all explosives, load and fire the shots. Clay tamping is reported as being used, and a steel rod tipped with copper as a tamping bar. The explosive is kept in boxes in different parts of the mine. Detonators were found intermingled with the explosive, so it is presumed they are often stored with the explosive. The

maximum diameter of the shot holes is 1¾ inches; the explosive is put up in cartridges; 1½ pounds constitutes the limit charge.

No record of blownout shots of previous explosions in this mine were found.

Mechanical Equipment: The hoisting engine is a Litchfield 24 by 36 inch direct connected. There are 6 boilers having a total of 900 HP. Two Westinghouse electric generators 225 K.W. at 250 volts. One Clifford-Capell steam driven fan, 6 ft by 16 ft. One pump 12 by 6 in. by 12 in. 12 Sullivan C.E. electric mining machines; 4 electric locomotives constitute the mechanical equipment underground.

Lighting: All underground men except the fireboss, use open flame lamps, principally carbide. The fireboss uses a Wolf lamp.

Fire Protection: No special equipment is provided for fire fighting, altho a tank is used for storage of water for the supply of the steam boilers. As previously stated, the fire in the air shaft, which resulted from the explosion, was extinguished by the use of a chemical fire engine brought from Clay. No first-aid or mine rescue organization exists at this mine. If rescue apparatus had been a part of the equipment of the mine, and the mine foreman had been trained in its use, it is probable he would have gone to the surface before attempting rescue work, and in doing this he would have saved his life, and the life of his brother. The cages in the hoisting shaft were not disturbed by the explosion, so it was only two hours after the explosion until the men at the bottom of the shaft were brought to the surface. The fire in the air shaft no doubt was a fortunate occurrence, since

at the time of the explosion the main shaft was the upcast, but the air conduit at the top of the air shaft having been blown away, and the partition in the shaft being set on fire, caused the air shaft to become the upcast, thus protecting the men near the main shaft bottom from the full effect of the afterdamp.

As a precaution against mine explosions, the ventilation of the mine is ample to take care of the gas liberated, provided it is properly distributed; the use of permissible explosives in limit charges in coal that has been undercut; the employment of shotfirers who load and fire the shots; the employment of a fireboss and loading out machine cuttings constitute the precautions. No watering or rock dusting is practiced in this mine.

STORY OF THE EXPLOSION

This explosion occurred between 7:30 and 7:40 on Saturday morning, August 4, 1917, while the miners and other underground workmen were traveling to their working places. Conditions as to weather were normal; the fan was running at its regular speed, and the mine had worked the previous day. The condition of the mine as to gas accumulations on the morning of the explosion is unknown to the authors of this report, but from conditions in the mine it is reasonably certain that gas had accumulated in the 2 south off the 7 right entry off the East dip entry; and that the ignition of this gas by the flame of a miner's lamp was the cause of the explosion. The only fire resulting from the explosion was found at and near the top of the air

shaft where the wooden partitions and buntings were set on fire.

RESCUE AND RECOVERY WORK

Evidence obtained by Bureau of Mines Engineers: The evidence on which this report is written was secured by J. W. Paul, E. B. Sutton and G. T. Powell on their investigations made during visit to the mine August 18-19-20, 1917. Mr. Powell had been continuously at the mine with Car 3, since noon on August 4, the day of the explosion, and had accumulated much information as to conditions, which are embodied in this report. During the investigation Mr. T. E. Jenkins, Vice Prest. and General Manager of the Coal Company, offered every facility at his disposal for securing information, and he accompanied the investigators underground.

Prior to the Bureau's investigation, the Chief Inspector of Mines for Kentucky, C. J. Norwood, and deputy inspector Davis, had concluded their investigation, Mr. Powell having accompanied them in the mine.

Need of rescue apparatus: Within a radius of 100 feet from the bottom of the hoisting shaft there were about 20 men at the time of the explosion. On account of the smoke and gases coming up the hoisting shaft men on the surface did not attempt to descend until the fire had been extinguished in the air shaft and the fan placed in service exhausting. This occupied 2 hours time, and when the surface men descended the hoisting shaft with the intake air they found 18 men alive but unconscious. Ten of these revived when brought to fresh air, but 8 died after being brought to the surface. None of the men

had severe burns, but had inhaled the hot gases and afterdamp.

The prompt use of oxygen rescue apparatus probably would have saved the 8 men, since 10 men in the same vicinity survived. This would indicate that the full effect of the afterdamp was not present at the bottom of the hoisting shaft, and that the men who succumbed were victims of the heated gases and the cumulative effect of the gases in the afterdamp. The fire in the air shaft probably established a current which prevented the main body of afterdamp from reaching the hoisting shaft.

RESCUE AND RECOVERY OPERATIONS

Bureau of Mines Car No. 3, with Foreman G. T. Powell in charge, arrived at the mine at 12:30 p.m. August 4. After a conference with T. E. Jenkins, General Manager, H. M. Ernst, Genl. Supt. and C. W. Strickland, Mining Engineer, it was decided to make an exploration to ascertain the extent of the fresh air zone established by the fan and to observe general conditions. A crew without oxygen rescue apparatus, but equipped with a canary, electric flash lamps and a flame safety lamp, composed of Alexander Blair, of Basket, Ky. Sterling Lanier, H. D. Delaney of Nortonville, Ky. Ben Floyd of Providence and G. T. Powell, descended the main shaft and advanced along the main east entry and down the east dip entry to the first breakthru outby the 4 right, where the bird indicated signs of distress. The point reached was one breakthru inby the first concrete stopping that had been blown out. Fourteen dead bodies were located on this trip. Returning to the outside at 2:30 p.m. the same crew wearing Fleuss

oxygen apparatus, entered the mine at 3:30 p.m. and explored the 4 right off the east dip entry, and returned to the surface at 4:45 p.m. A conference was held with the officials of the company previously named, and it was decided to restore the ventilation in the main east dip section, and explore 1000 feet in advance of the ventilation by the use of oxygen rescue apparatus for detection of any fires or explosive gas. The direction of this work was placed in charge of G. T. Powell, pending the arrival of the state inspectors. While this plan of procedure was in progress and a number of bodies had been removed, T. E. Davis, the local deputy state inspector, and C. M. Wells, Deputy state inspector, arrived and took charge of the work without any change in the plan of procedure, and the work was continued until all bodies were recovered. All the oxygen rescue apparatus in service was supplied by Car 3, no others being on hand. The recovery work was expedited by the mine officials securing electric cap lamps from the Oliphant-Johnson Coal Company, Bruceville, Ind.

List of persons wearing apparatus:

Alexander Blair, Pittsburgh Coal Co. Basket, Ky.
Sterling Lanier, Nortonville Coal Co. Nortonville, Ky.
H. D. Delaney, do do
Ben Floyd, Providence, Ky.
John J. Harland, do
J. T. Aldridge, do
David McWhirter, Associated Insurance Co. Pineville, Ky.
Bicknell, Indiana, rescue crew, Messrs. Scott, Robertson, Eadie, Little, Logan and Pollock, who made explorations on August 10-11.
U. S. Bureau of Mines: Messrs. G. T. Powell, D. J. Parker, E. H. Denny and J. R. Fleming.

Fire in the shaft:

The fire in the air shaft which had been gotten under control on the morning of the 4th, rekindled during the night, and the temporary covering on the air shaft showed signs of collapse. On the morning of the 5th the fan was stopped, the cover removed from the shaft, and by means of a painter's swinging scaffold suspended in the air shaft a man wearing oxygen rescue apparatus was lowered 35 feet and the fire discovered in the lining of the shaft. Holes were chopped in the lining and water was supplied from ~~x~~ two ~~inch~~ hose, and the fire extinguished. A new cover was placed over the shaft and a fan drift was constructed to the fan housing, all of which was completed by 10:30 a.m. on the 5th.

No fires were found in any part of the mine.

Recovery of bodies:

Men wearing apparatus located the bodies of men that were beyond the fresh air current or off the ventilating current, and a number of bodies were thus brought to places where they could be gotten by men not wearing apparatus.

Coöperation with the State Inspectors:

The rescue crews worked in coöperation with the two deputy state inspectors, and after the arrival of the Chief Inspector of Mines, C. J. Norwood, and at his request, the crews continued to make explorations in advance of the recovery crews for detection of fire and the location of bodies in rooms and other unventilated parts of the mine where men were thought to have been working at time of the explosion.

Supplies and tools:

The progress of recovery of the mine was somewhat retarded at the start owing to the supply of brattice material on hand being quickly used up in repair to the fan drift and overcasts, but this shortage was soon overcome by the receipt of a supply of canvas from Evansville, Ind.

Efficiency of apparatus and crews:

None of the men wearing the apparatus were affected by the mine gases and the apparatus responded to all the demands made upon it.

Extent of explosion:

The explosive wave was limited to the East dip entry and the 5th, 6th and 7th rights and 2nd and 3rd lefts off the east dip. The flame, however, reached the top of the air shaft, and the hot air reached the bottom of the main hoisting shaft; the pressures which were set up disarranged the ventilation by damaging 3 overcasts south east of the air shaft on the main east entries. The damage to these overcasts was sufficient to admit of short-circuiting the air between the air shaft and the main hoisting shaft. The pressures which disrupted the overcasts appeared to have been exerted above the overcast since the top side walls were blown toward the main entry, and the

tops broken thru from above. The main side walls suffered little damage due to the material being stored in a sloping form inside of the walls. The overcast on the main east at the intersection of the main rise entry had been damaged slightly from a force acting from below, the tops of the overcast having been slightly raised and several openings having been made in the top side walls.

In the main rise entry, 150 feet beyond the second lefts is where 44 men under the leadership of **Claude Bordis,** constructed canvas brattices across both rise entries and opened a door on the second right, thus saving themselves from the afterdamp. Two men refused to join the 44 and made an effort to reach the shaft. Their dead bodies were later found on the main rise entry just inby the 1st right. About 3 hours after the explosion the 44 men were able to reach the hoisting shaft in good condition.

Proceeding down the East dip entry from the main east: The concrete stoppings between the entry and air course were intact to a point 3 breakthrus beyond the 3 right air course. Beyond this breakthru all concrete stoppings were blown down toward the haulage entry.

Before the explosion most of the connections on the right side of the haulage entry were open, having no stoppings in them. In the recovery work these had been temporarily closed with canvas or board stoppings.

From the main east to and inclusive of the 9th crosscut the road was dusty, the dust appearing to have been blown from inby.

On the inby side of trolley hanger at the first cross cut inby 3 right aircourse a train of mud was adhering. From the 3 right aircourse to the 4th crosscut inby the roadway was wet to the point of being muddy. Inby 3 right aircourse between 4th and 5th crosscut was an entanglement of trolley and feed wires, among which were pieces of men's clothing; in and around this entanglement were found the bodies of 13 men, some or all of whom had been riding in a mine car, which was found just outby the bodies badly smashed and distorted. The mule which had been pulling the car was found between 2 left and 5 right entries, or about 580 feet from the car. The car in being blown out had detached the trolley and feed wires from their hangers and the car men and wire were hurled along the entry with much violence. In its flight past the 4th right some part of the car struck the rail which turns inth the 4 right, and bent the rail outby 8 inches out of alignment.

Between the wire entanglement and the 4 right debris and dust was deposited on the inby sides of obstructions, and there was a heavy deposit of coal dust on top of the sand along the track.

This zone is of especial importance since here is found the first concrete stopping blown out, and there is abundance of road dust, having a large percentage of sand. The velocity of the explosive wave appears to have slowed up here, and deposited much road dust previously carried in suspension from points farther in the mine.

Between the 4 right aircourse and the 5 right, a trolley hanger had been turned thru 90 degrees and bent outby. Midway between

4 right and 5 right the roadway for 100 feet had been swept clean, the material being carried outby.

At a small space 60 feet outby the 2nd left the roadway was normal, as stated by Mr. Jenkins, and consisted of compact coal dust and sand. From this point to 5 right there was a deposit of dust on the sandy road. At the first breakthru / Inby the 5 right aircourse there is a fall of roof ~~xxxxxxxxx~~. At this point the trolley had been broken and carried out beyond the 4 right to the entanglement previously mentioned. From here inby the trolley was but little disturbed, although it showed signs of having been pulled thru one hanger in outby direction /about/3 inches. Two single pole electric /switches were found on the entry, detached.

At the 6 right entry there were standing two sets of timber undisturbed.

The first evidence of coke was found on the East dip just inby the 6 right entry, it being on the inby ledges on the roof.

In the entrance of the 6 right air course was found a broken door which, previous to the explosion had been hung in the entrance of the 3rd left entry, the door having been carried outby.

At the entrance to 6 right aircourse a timber had been blown down, outby. Between the 6 right aircourse and the 7 right entry, the road was dry and dusty, having an abundance of sand. In the first breakthru outby the 7 right entry was an electric hoist or winch, not damaged. In front of this breakthru there was soot on the roof. Between 7 right and its empty track was the end of the trolley wire, the cutout switch on power line intact and found in closed position after the explosion. In the first breakthru inby the 7 right empty track was located an

electric pump, its rheostat lying alongside, apparently not damaged.

In the entrance of 7 right entry were 3 empty derailed mine cars, and 8 loaded cars on the track, and in front of the 7 right were found the bodies of 5 men. The outer empty car had been blown against the rib, breaking the side of the car against the rib.

Seventh right off east dip: The haulage on this entry is done by mules, there being no trolley or motor haulage, consequently no sand is found along the track.

In the center entry near the first breakthru to left was found the body of a dead mule; in the first breakthru on right one dead mule. In front of room 1, a loaded car had on its right, or room side, fine compact dust adhering to the car irons; on the left side there were coke crusts adhering to the outby exposure of car irons.

Thirty feet inby the loaded car was found the bodies of two men and a harness. These men, no doubt, were in the act of securing the harness to put on one of the mules.

The outby rib of the second breakthru had coke crust adhering.

All stoppings up to room 8 were blown out on to the haulage or room entry. In front of room 9 a stopping remained standing with a small hole broken thru it.

At room 9 the room entry is discontinued and from this point only two entries are continued.

Between rooms 4 and 5 broken pieces of wooden brattice are against the right rib, having been carried outby 20 feet. In room 5 coke is present on the left rib on outby projections, and at mouth of room on

left rib coke crusts were on outby projections.

In room 8 an empty derailed car standing 20 feet from entry has coke on inby end. The roadway on the entry is dry and dusty.

From room 9 the middle entry becomes the haulage. From a point opposite room 9 for a distance of 100 feet on the haulage entry there is a continuous heavy fall of the roof which prior to the explosion was held up by timbers, which were blown out by the explosion.

It is to be noted after passing room 9 all stoppings are blown away from the haulage entry into the aircourse.

Approaching the first south off the 7 right timbers were blown down and carried outby. Immediately in front of the first south was a mine car derailed and half full of coal which had fallen from the roof, immediately above. The right side of the car was broken by a force coming from the first south. On the inby end and extending under the car was a piece of canvas which had been detached from a brattice placed across the 7 right between 1 and 2 south entries. The frame which had held the canvas was still in place, and pieces of canvas remained attached to the frame. It appears that this car, prior to the explosion had been standing under the canvas and admitted of the air being short-circuited. thus permitting gas to accumulate near and at the faces of 1 and 2 South entries.

1 and 2 South off 7 Right: The conditions in these entries are of special interest since the explosion appears to have had its origin in the second south.

The general direction of forces traveled out each of these entries

and in advancing into them the evidence of heat gradually increases; coked dust is found on the roof and ribs and granular coke is found on the floor and ledges. Two stoppings were blown into the 1 South and the remainder into 2 South.

On 2 South between rooms 1 and 2 were found explosives and electric detonators. In a niche in the left rib opposite the 3rd break thru were found 2 dozen detonators and lead wires in a mass of entanglement. In the 3rd breakthru was found a spike keg overturned, containing a gallon of spikes and 19 sticks of explosive, Collier X. Just outby this breakthru was a miner's broken powder box and trailing outby were 34 sticks of explosive, Collier X. All the explosive had absorbed moisture and the sticks were quite soft.

In front of room 3 on 2 South were two timber sets, and on the inby side of the sollars was found coke crusts adhering.

Room 4, coke on roof and inby rib;

Room 5, coke on roof, gas feeders at face;

Room 6, coke on roof.

Room 7, mine machine on track at entrance of room, coke on roof inby machine. Coal dust dummy found on entry by room 7.

Room 8, Coke on roof, coke granules on floor; gas cap at face. Post auger set up at face and hole partly drilled. Auger in hole. About 5 to 10 feet outby room 8 was found the body of a man badly burned. He had a carbide open flame lamp.

An empty car on the track by the last open breakthru had granular coke on bumpers on inby end. On the right side of car coke crusts

adhered to the wooden boards. From this breakthru to the face coke scales were on the roof and gramular coke on the floor. At the face gas feeders could be heard and a gas cap was observed.

On the first South two falls of roof had occurred between 7 right and No. 2 room.

At room 5 and 6 the power wire had loops made by a force acting to the outby.

At room 5 coke was located on the roof on outby exposures.

Room 5, The roof at 20 feet from the entry had coke on all exposures.

Room 6: Coke on roof, loose props on floor covered with granular coke and soot one-quarter inch thick (Sample taken).

Room 7: Coke on roof and on standing props near roof, all exposures.

Between rooms 7 and 8, coke on roof both inby and outby exposures.

Room 8: Coke blisters on roof and coke crusts on left rib on inby exposures, Coke on both sides of crosscut between rooms 8 and 9.

Room 9: Dry and dusty, coke granules on floor.

Room 10: Gas cap $\frac{1}{4}$ inch at face; sample XIII. On entry from last open breakthru to new breakthru, partly made, coke on roof and ribs. From newly turned breakthru to face of entry no coke on roof and ribs.

Face of entry: Short end of drilled hole in face, upper right corner, having 1 inch explosive (Collier X?) unburned. Gas cap at face. Contrasted with 2 South, there is a striking difference in the distribution of coke. In 2 South the coke on the roof extends from the last breakthru to the face.

3 Left off Main Dip: The door on 3 left was blown outby to the 6 right aircourse.

A trip of empty cars was derailed on the empty track. The indications were that the trip had been blown inby and then outby. The outside rail of the track at the curve had been bent outby by an object (presumably a car wheel or bumper)which left a scar on the rail.

At the inby end of the loaded track there was an empty car, under which were the bodies of two men, and on top a mule which had been pulling the car. The sides of the car had been bent inward and downward, which completely closed the car, and the mule was lying on top of these sides. Apparently the inby end of the car had been forced against the roof and the mule badly crushed.

Six men and two mules were located on the loaded track outby the wrecked empty car.

From the wrecked car inby, the roof was covered with soot and the ribs with fine dust. All stoppings were blown on to the entry.

At room 11 a mining machine was standing on the track in the mouth of the room. On the inby end pieces of paper had been blown into the recesses of the machine. Ten feet inby room 11 on the entry was found a bunch of electric exploders. Ten feet inby the exploders were found 20 sticks of explosive (Collier X) scattered along the left rib.

At mouth of room 12 a bunch of 20 electric detonator wires were found, all detonator caps except one had been exploded. Loose explosive was lying along rib near the detonator wires. A miner's powder box

had been blown against the rib at this point from a breakthru in the entry pillar between rooms 11 and 12.

Second left off Main Dip entry: No evidence of heat on the coal or other objects was manifested in this entry, other than slight burns received by two men whose bodies were found near the face of room 21. All stoppings along this entry were blown into the haulage or room entry.

Sixth Rights off Main Dip entry:East: This entry was worked out, rooms abandoned, but pillars left standing. No evidence of heat or mechanical disturbance within the three openings to these entries.

Fifth Rights off main Dip East: All stoppings were blown on to the haulage, or room entry. Part of a trip of loaded cars on the entry between rooms 1 and 3 was blown off the track against the right rib. Outby the loaded trip the bodies of two men were found, one showing signs of burns. From room 17 were turned four rooms, all of which had heavy falls after the explosion. The men who worked in these rooms were found, one near the face of a slant near the face of the entry, and another on the aircourse near the second breakthru from the face.

The fire-boss's report: Previous reference has been made to this. The records of the fireboss are so illegible as to be of no practical benefit.

State Mine Inspector's Report: At the time of writing this report the State Inspector's report was not available, and no intimation has been given as to the nature of any report which may be forthcoming.

Coroner's Inquest and Verdict: No Coroner's inquest was conducted.

S U M M A R Y

Origin of explosion: When the explosion occurred it was at first considered the work of persons in sympathy with the leaders of the strike or enemies of the Government. The Grand Jury of Webster County was convened shortly after the explosion and many persons were interrogated concerning lawlessness in the vicinity of the mine with the purpose of ascertaining if the mine was purposely exploded. While many indictments were found for lawlessness, no convictions have been obtained which have direct bearing on the explosion.

The inside conditions strongly indicate that the explosion originated by the ignition of standing gas near the head of 2 South off 7 Right by a miner's helper carrying an open flame lamp. The body of this colored man was found on the entry about 8 feet outby room 8. This gas igniter had worked in the same entry on the previous day, his first day in a coal mine, as a helper in drilling shot holes. On the morning of the explosion he went to the 2nd South alone. The man with whom he worked had stopped along the haulage road for some purpose, his body being found on the Main Dip East near the entrance to 7 Right.

There were no line brattices at the face of 1 and 2 South where gas was being liberated, and the indications are that the canvas on 7 Right between 1 and 2 South had been disarranged or held up by an empty mine car, thus allowing the air current to short circuit and deprive 1 and 2 South of their normal ventilation.

Action of Physical Forces: The direction of forces are detailed on the map of the mine, and in two instances are of special im-

portance. The velocity of the explosive wave appears to have been relatively slow along the haulage on the Main Dip East, since a mine car and 13 men were carried along the entry for a distance of at least 600 feet, and the car was not injured beyond being repaired and put into service.

On 3 Left off Main Dip East there is indication of a force having moved inwardly and again outwardly. The trip of empty cars on the sidetrack or lyeway had first been forced inby beyond the curve of the track, but in line with the direction of the entry, and then forced outby. In the outby movement the outside rail of the track at the curve was bent outby.

Gas occurrence: The volume of methane returning from 7 Right and the face of the Main Dip East, as measured at 3 Left, was 579 cubic feet per hour, or 13,896 cu. ft. per day of 24 hours. Since the main dip East had not been advanced since June, 1916, most or all of this methane was coming from the workings off the 7th right, including 1 and 2 South.

Road Dust: A sample (Lab. 29064) of road dust taken near Room 8, 2 South off 7 Right, upon analysis, air dried, gave a ratio of $\frac{V}{V + FC} = 38.36$, while a composite analysis of face samples of the coal gives a ratio of 40.58. A sample (Lab. 29065) taken on the main dip East at 7 Right, gave a ratio of 43.95.

Sample of soot and granular coke (Lab. 29068) from room 8 off 1 South off 7 Right gave ratio of 27.13.

Sample 29062, taken at 4 Right on Main dip East gave ratio of 42.28.

Sample 29063, taken at 5 right on main dip East gave ratio of 43.84.

and road dust sample 29064

Excepting the coke sample (29068)/all of above samples give a volatile ratio in excess of the volatile ratio for the face sample.

Explosibility of the road dust:

Sample 29064 taken across the roadway at room 8 on 2 South off 7 Right gave a ratio of volatile to total combustible of 38.36. The quantity of 20 mesh dust per foot of entry was at least 25 ounces, and for each cubic foot of air space .347 ounces, of which.079 ounces passed thru 200 mesh. It would require the addition of 26.59 ounces of incombustible material per foot of entry to prevent the propagation of an explosion thru a zone having similar dust.

Sample 29065 taken at the main dip East at 7 Right gave volatile combustible to total combustible ratio of 43.95.

The quantity of 20 mesh dust collected was 777 grams, or 27.75 Oz. over a space 3 inches wide by 12 feet across the entry. In a linear foot of entry there would be 111 Oz. of the dust, or 1.54 Oz. per cu. ft. of air space. The ash and moisture is 72.64 per cent, which is 9 per cent more inert material than is required to stop the propagation of an explosion.

Sample 29063 taken on the Main Dip East at 5 Right gives a ratio of 43.84. The quantity of 20 mesh dust collected was 743 grams, or 26.5 Oz. over a space 3 inches by 12 ft. across the roadway. In a linear foot of entry there would be 106 Oz. of the dust, or 1.47 Oz. per cubic foot of air space. The ash and moisture content equals 70.89 per cent, or 7.89 per cent more inert material than is required to stop the propagation of an explosion.

In like manner sample 29062 taken on the main dip East at 4 Right gave a ratio of 42.28; 566 grams, or 20 Oz. of 20 mesh dust was collected over a space of 3 inches by 10 feet across the entry. In one ~~foot of~~ linear foot of entry there would be 80 oz. and in one cu. ft. of air space 1.33 Oz. of dust. The ash plus moisture was 60.56 per cent, which is within 5 Oz. of the amount of inert material required to stop propagation. The character of the coal dust may be of such a nature that an explosion would not be propagated with 60 per cent incombustible. The road dust, owing to the presence of sand, having such a large percentage of inert material, was not favorable to the propagation of an explosion, and the flame which reached the air shaft was carried by the road and rib dust in the air course.

LESSONS TO BE LEARNED

1. It is a source of danger to allow wholly inexperienced men to travel within a mine without being accompanied by an experienced miner.

2. It is unsafe to employ a fireboss who can not make an intelligent record of his observations.

3. The use of open flame lamps in gaseous places is inviting disaster.

4. The use of canvas in lieu of doors is unsafe practice.

5. The leaving of surplus sand along the haulage ways, instead of hauling it out of the mine, is supremely advantageous in choking down an explosion.

6. Keeping each panel separated from adjacent panels by driving no rooms thru is most commendable, and in this mine these panels acted as cushions for the relief of the explosion pressure wave as it passed the

entrances to the panels.

7. The use of permissible explosives and shotfirers are great factors of safety, especially with men of limited mining experience.

R E C O M M E N D A T I O N S

1. Keep all haulage roads and air courses and rooms free from loose coal, either coarse or fine.

2. On motor haulage roads remove all loose coal and scatter sand or other inert dust along the road and ribs, and in breakthrus.

3. Use either water or shale dust on all room entries for allaying the coal dust. In air courses in each panel install dust barriers.

4. Use either safety lamps or electric cap lamps, bearing the approval of the Bureau of Mines.

5. At all faces where machines are used keep a safety lamp for testing purposes.

6. Shotfirers should be required to test for gas before firing any shot.

7. The use of tight ends on mine cars would effect a reduction in the production of fine coal along the haulage roads.

8. Surface and underground fire fighting facilities should be installed at the mine.

9, All persons entering the mine should be checked and a record maintained on the surface.

10. Selected workmen should be instructed in mine rescue methods

and trained in the use of breathing apparatus, and the mine should have available at a central point a rescue station properly equipped.

11. First aid material should be kept available on the surface, and at stations underground, and the men should be instructed in first-aid treatment for the injured.

APPENDIX A

COMPENSATION INSURANCE

The State of Kentucky has a compensation law applying to the relief of the dependents of miners, but its adoption is optional with the operators of mines. The West Kentucky Coal Company, at the time of the explosion, was not covered by the compensation laws.

At the time of the investigation a financial settlement had been made with over 90 per cent of those dependent upon the persons whose lives were lost in the explosion. The basis of the settlement was not learned.

APPENDIX B

LOCATION OF BODIES

1 body at room 8, 2 South off 7 Right.

2 bodies between rooms 1 and 3, 7 South.

5 " " at main dip East at 7 Right room entry

8 " " on loaded track lyeway, 3 ~~Right~~ Left

2 " " on 3 ~~Right~~ Left between rooms 7 and 8

2 " " on 3 ~~Right~~ Left between rooms 10 and 11.

1 " " on Main Dip East 80 feet outby 6 Right

1 " " on slant at face of 5 Right

1 " " on 5 Right aircourse 100 feet from face

2 " " on 5 Right entry - 1 on each side of 1st breakthru

2 " " on 2 Left on loaded track at lyeway

2 " " on Room 21, at face

1 " " on 2 Left between rooms 21 and 22

1 " " on Main Dip East 80 feet inby 3 Right aircourse

13 " " on Main Dip East 200 ft. inby 3 Right aircourse

1 " " do 60 ft. do

1 " " do 75 ft. outby 2 Right entry

1 " " do 100 ft. inby 1 Right aircourse

2 " " on Main Rise entry near 1 Right

3 " " at foot of main shaft

1 " " at foot of air shaft

1 " " at entrance to main Dip East

54

8 died after removal from main shaft.

62

APPENDIX C

LOCATION OF DEAD MULES

1 on Main Dip East at 5 Right

1 on 2 Left loaded track at lyeway

1 on 2 Left empty track at lyeway

3 on loaded track lyeway, 3 Left

1 on 7 left empty track lyeway

1 in first breakthru in 7 Left.

8 total.

SECTIONS OF COAL IN WEST KENTUCKY No. 7 MINE

Lab. No.	19148	19149	19150	19151	19152	19153
Main Roof: Gray shale, Immediate roof: Shaly fire clay	1 to 2 ft.					
	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.
Roof coal left up *	1 6	*1 6	*1 0	*0 6	*0 6	*1 0
Coal, clean	2 10	5 6	illegible			
Coal with diagonal bands of sulfur			6 2			
Coal, bright and brittle				1 4¼	0 7½	1 0½
Coal with sulfur streaks	0 0½					
Mother coal				0 0½		0 0¼
Sulfur band, soft					*0 0¼	
Coal, clean	2 7½			0 9	2 8½	
Coal streaked with mother coal						4 10
Sulfur band				*0 0¼		
Mother coal					0 0½	
Coal				3 0	0 2½	
Mother coal					0 2	
Coal strkd with sulfur and mother coal					1 9½	
Bottom coal *				*0 6	*1 6	*0 6
Total thickness	7 0	7 0	7 2	6 2½	7 6¾	7 4¾
Bed sampled	5 6	5 6	6 2	5 2¼	5 6½	5 10¾

Floor: Hard fireclay, shaly.

*Not included in sample.

APPENDIX E

ANALYSES OF COAL SAMPLES FROM No. 7 MINE

Lab. No.	19148	19149	19150	19151	19152	19153	19154
Moisture	5.73	5.24	6.38	5.65	5.09	5.80	5.58
Volatile matter	36.14	36.16	34.50	35.37	36.18	33.42	35.04
Fixed carbon	50.62	52.17	49.27	52.04	50.14	52.04	51.32
Ash	7.51	6.43	9.85	6.94	8.59	8.74	8.06
Btu	12916	13100	12328	12967	12769	12600	12755
Sulfur	2.00	1.30	1.09	1.17	2.78	1.13	1.59
Hydrogen							5.32
Carbon							7149
Nitrogen							1.50
Oxygen							12.04

LOCATION FROM WHICH ABOVE SAMPLES WERE TAKEN

19148 Face of dip entry aircourse on west, 1850 ft. from shaft

19149 Neck of breakthru between 3 and 4 off 2 Right, 1600 ft. from shaft

19150 Face of 4 South off 2 left entry, 2800 ft. from shaft

19151 Face of 10 room off 1 left, off West dip entry, 2000 ft. from shaft

19152 Face of 14 room, 1 South off 2 Right entry, 1600 ft. from shaft

19153 Last breakthru at face 2 left entry, 3000 ft. from shaft.

19154 Composite of 19148-49-50-51-52 and 53.

APPENDIX F

SAMPLES OF ROAD DUST, COKE, etc. FROM NO. 7 MINE

Lab. No.	29062	29063	29064	29065	29066	29067	29068
Moisture	3.67	5.02	26.39	3.72	5.27	11.08	18.65
Volatile matter	16.67	12.76	24.23	12.03	21.56	29.05	19.98
Fixed carbon	22.77	12.76	38.94	15.33	58.82	47.46	53.67
Ash	56.89	67.87	10.44	68.92	14.35	12.41	7.70
Moisture plus ash	60.56	70.89	36.83	72.64			
Ratio Vol.Comb to total combustible	42.28	43.84	38.36	43.95	26.82	37.97	27.13
On 20-mesh, rejected %	38.1	44.8	76.2	44.2			
Thru 20-mesh anal.	61.9	55.2	23.8	55.8			
Sample submitted, grams	913	1347	1015½	1393.6			
Wt. analyzed, gms.	565	744	241½	777	29.03	46.85	6.97
Thru 48-mesh %	49.8	41.2	59.0	48.1			
Thru 100-mesh	25.8	16.3	37.1	27.4			
Thru 200-mesh	15.4	9.3	23.0	18.9			

LOCATION OF SAMPLES

29062	East dip at 4 right entry	Road dust
29063	East dip heading, at 5 right	do
29064	2 South off 7 right at room 8	do
29065	East dip heading at 7 right	do
29066	2 South off 7 right, by room 8	Coke crust off side of car
29067	do do	Granular coke on bumper of empty car
29068	1 South off 7 Right, Room 6	Soot and coke from props on floor

MINE AIR SAMPLES FROM NO. 7 WEST KENTUCKY MINE

Lab. No.	Location	CO_2	CH_4	Amount of air
9244	First South off entry, 3" from roof left face	.25	.27	still
9245	3 Left near inby end of side track	.09	.23	4200 ft.
9246	do do	.10	.22	"
9247	Room 10, 1 South, 3" from roof	.24	.27	still