

REPORT OF EXPLOSION

at

KING MINE NO. 98,

of the

KING COAL COMPANY

VIVIAN, WEST VIRGINIA

March 28, 1916

by

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and

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Pittsburgh, Pa.
April 6, 1916.

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KING MINE NO. 98, VIVIAN, WEST VA.
KING COAL COMPANY,
MARCH 28, 1916.

King No. 98 mine is located in the State of West Virginia, County of McDowell, and about three-fourths of a mile northwest of the town of Kimball. The railroad station nearest to the mine is the West Vivian station of the Norfolk & Western R.R. The operator of the mine is the King Coal Company. The property comprises about one thousand acres and is leased from the Pocahontas Coal & Coke Company, Bluefield, W.Va. The royalty per ton of coal is 10¢. The address of the executive office of the King Coal Co. is Columbus, Ohio; of its operating office, Kimball, W.Va. Mr.

C. H. Boardman is manager of the company; Mr. Bert Hilton is superintendent, and Mr. Chas. Nuttall is mine foreman.

GEOLOGY:

Pocahontas Folio No. 26, and Tazewell Folio No. 44, of the U. S. Geological Survey, give a detailed description of the geology of the district. A few geological features of particular interest at this time, however, are as follows: The Pocahontas No. 3 seam of the King No. 98 mine averages five feet four inches in thickness. Immediately over the coal bed proper and in the order given are about six to ten inches of draw slate, two inches of coal, and ten to sixteen inches of gray slate. The overlying stratum is principally sandstone. The Pocahontas No. 4 seam lies 60 to 80 feet over the No. 3 seam. The thickness of the entire cover of the No. 3 seam is 200 to 350 feet. The mine coal breaks clean from the draw slate and, if properly mined, caves are infrequent. However, roof breaks 6 to 12 feet high sometimes occur. The floor is a hard, dry stratum of fire-clay. The coal is soft and very dry; the roof is also dry, while the floor is wet in places, accumulating dust caking under hand pressure. There is no well-defined faces and butts in the coal.

MINING METHODS:

A detailed mine report of the King No. 98 mine is being prepared by the investigators on the regular A.B.C. sheets and it will be filed at once in the Pittsburgh office. This report can be referred to for detailed mining methods and mechanical and physical features.

The mine is developed on the room and pillar system, with triple main haulage entries and double room or panel entries. Rooms are driven on 80-foot centers, 18 feet wide and 350 feet deep, and pillars robbed on the retreat. The company is allowed by the owners of the coal to pull pillars in but one section of the mine as in this section the overlying No. 4 seam is believed to be less than 4 feet thick. About 80% of the coal is undermined by pick. Some of this can be mined by sledge and wedge but in other sections it must be shot down. One short wall chain undercutting machine is used. Two rows of props are ordinarily used in rooms but little timbering is required in the entries.

PRODUCTION:

The King No. 98 mine has an average daily output of 350 two-and-a-half ton cars, or a total of 875 tons, and operated last year about 300 days. In the late fall and winter months 60 per cent of the output is disposed of by Eastern trade and the balance, 40 per cent, goes North to the Lake Superior region. In the spring, summer and early fall, when the iron boats are operating on the Great Lakes, these figures reverse. Four grades of coal are prepared for the market, i.e.: lump, egg, nut and slack. The respective proportions obtained are as follows: one, one, one-third and three.

WAGES:

Miners are paid 80¢ to \$1.00 per car of coal mined, depending on draw-slate conditions and the amount of timbering required. The average miner mines about five or six cars of coal per day. Much of the actual mining work is contracted, the company providing all supplies but powder and paying the contractor \$1.00 to \$1.25 per car of coal mined. The company's scale of wage is as follows:

Fire bosses	\$75.00 per month
Trackmen	2.50 per day
Bratticemen	2.20 per day
Loaders	2.00 per day
Laborers.	1.75 per day.

VENTILATION:

The mine is ventilated by a 6 x 16 foot Capell force fan, located at the top of the slope and directly over the air course. The fan is operated by steam power and has a capacity of 160,000 cubic feet per minute. The fan is not run at full speed, however, and the daily average capacity is about 130,000 cubic feet per minute. A Pittsburgh recording gauge in the power room records a fairly constant water-gauge pressure of $1\frac{3}{4}$ inches. In the mine there are four main splits, each airing a particular section of the mine. The cross-section of the intake air course at the foot of the slope is 8 x 13 feet in size. The velocity of the air the morning of March 31 (three days following the explosion) was 1200 feet per minute; or the volume of air passing into the mine per minute was 124,800 cubic feet. The barometer registered 28.4 inches. Hygrometer readings were: Dry 52, Wet 49, or approximately

80 per cent humidity. At the foot of the main slope the return air was measured. The cross-section of the slope at this point is 7 x 15 feet in size, and the velocity of the air current, 830 feet per minute, or a return of 87,150 cubic feet per minute. Hygrometer readings were: Dry 61.75, Wet 61.5; or approximately 92 per cent humidity. It is to be noted that 37,650 cubic feet of air per minute returns through the workings of the Tidewater mine, which connects with the King mine at several points.

Sample No. 7387 represents the return air from the affected area. The anemometer recorded 13,680 cubic feet of air in circulation per minute. The air contained .49 per cent methane, or 67.03 cubic feet of methane is being developed up to this point in this split per minute. Furthermore, sample No. 7386 shows .49 per cent of methane in the return air at the foot of the main slope. The anemometer recorded 87,150 cubic feet of air passing this point per minute, or 427 cubic feet of methane is made by the mine per minute. If we consider the 37,650 cubic feet of air returning through the Tidewater mine as similar in composition, the entire mine gives off 613 cubic feet per minute. As shown in the tabulations of mine air sample analyses the return air contained 0.32 CH₄ on December 12, 1914.

GAS AND LIGHTING:

The King No. 98 mine opened up in 1908 as a gaseous mine and flame safety lamps were employed exclusively. The following year the mine was pronounced non-gaseous and open flame lamps came into

use. In the working places oil torches and carbide lamps are used; motormen and trip riders carry oil torches; an electric light circuit is maintained along the main haulage roads.

Three fire bosses run different sections of the mine. They go on shift at 3:30 A.M. and complete their shift at about 12 o'clock noon. The overlying stratum appears to give off no gas; all is made by the coal. However, appreciable percentages of gas are seldom detected. Roof falls are infrequent and brattice is carried close up to the face.

EXPLOSIVES:

Only small amounts of explosives are used in the mine. In slate work, permissible explosives are used; and in pillar robbing and room and entry brushing, black blasting powder (FFF) is used. Where black powder is used the coal is generally shot off the solid. Clay is brought in from the outside for stemming, but several dust "dummies" were found in one of the rooms affected by the explosion.

HAULAGE:

The cars are gathered by mules and delivered to the haulage roads where electric locomotives draw the trips to the foot of the main slope. Here an endless rope, driven by steam power, conveys the cars out of the mine.

DRAINAGE:

The King No. 98 mine does not make much water--probably 100 to 150 gallons per minute. However, one week previous to the explosion (March 28 last) the water made by the Tidewater mine was turned into the ninth East back entry of the King mine through a bore hole driven to the main haulage road of the Tidewater. Previously the Tidewater mine was pumping about 1600 gallons per minute a distance of over one mile and then up a steep slope to the surface, equalizing a vertical lift of 350 feet. Under the present system gravitation is depended upon to carry the water to the foot of the King slope, thence it is pumped to the surface.

HUMIDITY:

The relative humidity of the return air March 31, as determined at the foot of the upeast slope, was 92 per cent. The total volume of return air, including the air returning by way of the Tidewater mine, was therefore carrying about 11.8 gallons of water out of the mine per minute. The relative humidity of the intake air on the same date was 80 per cent and the total intake air carried about 7.7 gallons of water into the mine per minute. In other words, the mine was being dewatered by the air current at the rate of 4.1 gallons per minute.

The analysis records of five air samples taken at different points in the area affected by the explosion are given below under heading "Mine Air Samples". It is noted that the average hygrometer readings for this area were: Dry 61.04, Wet 60.2, or 90 per cent

humidity. This figure compared with the figure representing the relative humidity of the return air might give a mean average of 91 per cent humidity for the whole mine. It must be considered that 1600 gallons of water per minute from the Tidewater mine enters the King mine at the face of the ninth East back entry, but throughout the entire mine--probably along the haulage roads and air courses--swags, or siniclines, always hold appreciable amounts of moisture. In most cases the roadways at these points are very muddy. However, as stated under heading "Geology", the coal itself and the rib and roof everywhere appears to be quite dry.

Whenever deemed necessary, the roadways are watered by the use of sprinkling wagons to wet down the dust, (~~see Plate No. 1~~). The wagon employed is of a particular design. Mr. C. H. Boardman, manager of the King Coal Company, holds a patent on the design and it is manufactured by the Superior Supply Company, of Bluefield, West Virginia. The tank is mounted on a truck, the wheels of which are of proper gage. A pipe from the tank discharges into a so-called disk of about 10 or 12 inches in diameter. The disk is high-gearred to one axel of the truck. At a rate of speed of four, five or six miles an hour, a thick spray of water is forcibly thrown in all directions. Figuratively speaking, a vertical section of water passes down the roadway wetting every point in the cross-section. The water wagon is transported by both mule and electric locomotive.

PREVIOUS ACCIDENTS:

In 1908 an explosion occurred in the adjoining Tidewater mine, killing 22 men and seriously burning and otherwise injuring several score more. Open flame lamps were used in the Tidewater mine at the time of the explosion and are still being employed. The cause of the explosion is unknown, but probably resulted from the ignition of a pocket of gas by an open flame lamp.

In December, 1907, a local gas explosion in the King No. 98 mine severely burned four men, one of whom died as a result of his injuries. As was stated before, the King mine in 1908 was designated a safety lamp mine. One "gas ignition" accident (non-fatal) has been recorded during the six months prior to March 28, 1916. A fall had occurred at the face of a room; a miner stepped upon the debris and put his head up into the cavity. He was carrying an open flame lamp (oil torch) in his cap and ignited a pocket of gas.

HOSPITAL FACILITIES:

The State maintains a very good hospital at Welsh, about 12 miles west of West Vivian. This hospital serves the whole Pocahontas field. The single men are assessed 50¢ per month and the married men \$1.00 per month toward the upkeep of the hospital. In cases of accident and all diseases, exclusive of venereal disease (also child-birth) the miners and their families are treated absolutely free of any additional charges.

COMPENSATION:

The State in 1912 inaugurated a compensation insurance fund. Each miner is assessed 5¢ on each \$10.00 earned and the company contributes a like amount.

BUREAU OF MINES

A C T I V I T I E S

The Pittsburgh office was notified of the King No. 98 mine explosion at 10:00 a.m., March 28, by the Associated Press. One hundred men were reported to have been entombed. Mine Rescue Car No. 8, with Foreman Miner Jesse Henson in charge, was engaged in training work at Milburn, West Virginia, and was immediately detailed to the disaster. Mr. Henson telephoned the C. & O. R.R. trainmaster to arrange for the immediate movement of the rescue car and was notified that due to a land slide on the track at Standard, West Virginia, it would be late afternoon before the car could proceed to West Vivian. Mr. Henson then called the Department of Mines of the State of West Virginia at Charleston and was advised by that office that all the men were out of the mine and that only three miners had been ^{killed} ~~filed~~ and twenty additional non-fatally burned. He telegraphed Pittsburgh this information. Meanwhile Messrs. Wolflin, Mason, Strane and Koster left Pittsburgh for West Vivian at 1:30 o'clock p.m., via the Pennsylvania R.R. and Columbus, Ohio. Pittsburgh succeeded in transmitting

the information received from Mr. Henson to Mr. Wolflin at Columbus, so Mason and Strane returned to Pittsburgh while Wolflin and Koster continued en route to West Vivian, arriving at the King No. 98 mine at 8:30 o'clock a.m., March 29. Mr. Henson and Car 8 were ordered not to proceed to West Vivian.

The Washington office had received identical notification of the disaster from the Associated Press at 10:30 o'clock a.m. Telephonic communications were made with Pittsburgh and Mr. Steidle left Washington at 3:15 o'clock p.m. for West Vivian, arriving at the mine at 9:00 o'clock a.m., March 29. Mr. Steidle immediately reported to Mr. Wolflin. Mr. McKee reported at the mine the morning of March 30 with the necessary paraphernalia for taking mine air, coal and road dust samples. Mr. McKee came from Car No. 8.

STORY OF THE ACCIDENT AND RESCUE WORK.

The mine worked under normal conditions on Monday, March 27, 1916. According to the report of the fire bosses, 123 places were examined but no gas was detected. The barometer registered 27.3 inches and the temperature was 60° F.

Under the heading of March 28, 1916, the date of the disaster, the following record was found in the fire boss's book:

King Coal Co. Kimball, West. Va.

Fire boss entered mine at 3:30 a.m.

" " left " " 6:30 a.m.

Gas detected: No. 3 room 9 East entry

No. 4 room 3 East entry

10 x A. C.

Signed E. Nuttal

Ed. Isherwood

Foraman C. Nuttal

W. Jones

Barometer 27.3

3/28/16

Temperature 42

121 places examined

The explosion occurred two hours after the fire bosses completed their respective runs. The full shift of two hundred and twenty men was in the mine and at their working places. It is thought that no shots were fired on the morning of the disaster. No electricity is employed in the section affected by the explosion. Probably an open light, either directly or indirectly, initiated the explosion.

As noted above, gas had been detected at the face of room No. 3 off the 9th East entry by the fire boss and he had marked the room closed until a brattice man had established proper ventilation. The brattice man Austin was working with a safety lamp at the head of room No. 3, arranging a line brattice to the face on the morning of the explosion. Tucker, a miner, worked in room No. 3 and was resting at his tool box while Austin was preparing the line Brattice. It so developed that Austin required assistance in his work and, according to Hunter, a miner in this section,

Austin called to Tucker to extinguish his open light (carbide lamp) and come forward to assist him. Tucker called back to Austin to hold his safety lamp in such a position which would enable him (Tucker) to see his way on advancing. Shortly afterward the explosion occurred.

No disturbance was heard or felt by men working a thousand feet from the scene of the explosion and the first intimation of the disaster that the mine officials had was when the men working in the affected area came hurrying from that section.

Parties, under the guidance of Mine Foreman Charles Nuttal, and the fire bosses, immediately proceeded to the ninth East entry to render assistance to those who had been overcome. General Manager Boardman, and Superintendent Hylton, who were at Bluefield, were notified by telephone of the disaster. The Norfolk and Western Railroad furnished a special train and these men, together with the District State Mine Inspector, L. Blenkinsop, were able to reach West Vivian about noon. At the same time a first aid and rescue crew were sent from Gary by Colonel O'Toole of the U.S. Coal & Coke Company, but all bodies were recovered before these men reached the mine.

The rescue party under Foreman Nuttal was able to proceed immediately to the scene of the disaster, as the mine had been damaged but slightly by the explosion and the ventilation in the affected section was in fair condition. The ninth East entry door had been destroyed, but many of the canvas checks on the entry

still remained and this, together with the short circuit of a portion of the air through room 5, gave sufficient ventilating current to rapidly clear the after-damps from the working places.

The men working in rooms Nos. 8, 7 and 6 had come out unassisted. Room 5 was not working. Two men, Dan Arden, an Italian tracklayer, and Moot Hancock, a colored miner, were found in room No. 4 burned and overcome by the after-damp. These men were revived by the Sylvester manual of artificial respiration.

It was necessary to perform artificial respiration on two other men, Will Franklin, in room No. 3, and Clarence Jones, in room No. 2, both colored miners. Of the four men revived in this manner two died some days later in the Miners Hospital at Welch; one, Hancock, recovered, while the other, Franklin, was, on April 21, still in the hospital and in a critical condition.

In the last pillar pocket in room No. 4, and near the head of this room, was found the body of Tucker, a colored miner. He was lying close to the pillar face and on the gob with his head toward room No. 3. This was not Tucker's working place. His body was burned severely from the waist up and a white deposit covered his face and the upper part of his chest. From evidence gathered later, it is probable that Tucker may have been stooping over a jack full of black powder when the powder was ignited, and that the white deposits on his face were nitrate salts.

Two other dead bodies were recovered. That of Manns, a white man, was found in room No. 3 about 200 feet from the face. His body was not burned nor injured and death had apparently resulted from breathing the after-damps. This man, together with Hunter, a colored miner, worked in room No. 3 in the second pocket from the face. Hunter stated that when the explosion occurred both started out, but that Manns stopped to secure his coat and bucket and the delay cost him his life. Hunter was at work the next day little the worse for his experience except that he bemoaned the loss of a 17-jewel watch, which may have been rescued by some one else in the excitement.

The body of the third dead man, Thomas Abbott, negro pillar boss, was found in the last cross cut from room 3 and room 2. He was burned about the head and face.

The injured men were assisted to the surface, the bodies recovered and ventilation restored by noon. The first-aid work done at this disaster was crude but effective in several cases. If trained and organized first-aid crews had been available more lives might have been saved.

F A T A L I T I E S

Killed at the Time of the Explosion

Name	Color	Occupation
C. H. Manns °	White	Miner.
John Tucker °	Colored	"
Wm. Abbott °	"	"

Died in Hospital within 48 hours

Joe Davis °	Colored	Mine Foreman
Torpey Ford	"	Miner
Howard Jordan	"	"

Died in Hospital after 48 Hours

Dan Arden	Colored	Miner
Jack Bowman	"	"
Tom Evans	"	"

Non-Fatally Burned

Han Harden	Colored	Miner
Jim Brown #	"	"
Harrison Baumer	"	Trapper
Walter Hawkins	"	Miner
Will Wade	"	Trapper
Sam Bailey	"	Miner
Eugene Wallington	"	"
Sandy Alameel	"	Driver
Moot Hancock °	"	Miner
Clarence Jones	"	"
Norman Martin °	"	"
Jim Foster	"	"
Will Franklin #	"	"
Jim Fitts °	White	"
Sam Raney °	Colored	"
Jim Austin	"	Bratticeman

Total Fatalities 9

Total Non-Fatalities... 15

° Indicates those miners legally married.

Indicates those miners in serious condition April 21, 1916.

STATE MINING DEPARTMENT INVESTIGATOR

Eleventh District Mine Inspector, L. Blenkinsop, inspected the mine the afternoon of March 28, 1916. His report is not available at this time but it is stated that it was his belief that the explosion originated from the ignition of gas by an open light in room No. 3 off the ninth East entry.

BUREAU OF MINES INVESTIGATORS

An investigation for the Bureau of Mines was carried on by Messrs. H. M. Wolflin, E. Steidle and J. W. Koster on March 29, and by Messrs. E. Steidle, J. W. Koster and C. J. McKee on March 30 and 31, 1916.

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BUREAU OF MINES INVESTIGATIONS

Investigations relative to the probable cause and extent of the disaster were conducted March 29 by Messrs. Wolflin, Steidle and Koster, and on March 30 and 31 by Messrs. Steidle, Koster and McKee. Evidences of the explosion were confined to the ninth and tenth East entries and the room and pillar workings off these entries.

NINTH EAST ENTRY:

The floor was wet from the line entry to room No. 6; in fact, there was standing water in a number of places. From room No. 6 to the 1st butt off, the road/^{dust} was quite damp. The dust on the roof and ribs, however, was quite dry.

The frame door at the mouth of the entry was blown outward and into the line entry, while sections of some of the canvas checks along the entry were blown down.

There is no timbering in the entry with the exception of a few props near the head end where the entry chain pillar is being robbed. These props had coke on their north and west sides. The coke was quite heavy and extended from the roof to the floor. The roof also showed evidence of heat at this point; it was sweating.

An empty car at the chain pillar was derailed, its movement being in the direction of the ninth East air course. A hole about four feet deep had been drilled in the face and the coal had been undercut by pick mining for a depth of about two feet. The miners' drilling tools were still at the face. From the heavy coking on the props in this vicinity it is evident that the flame endured for some time. This was Martin's working place. He, together with Hawkins and Bowman, two company men employed in these sections, were burned about the head and body. Bowman died later in the hospital at Welch.

A rapidly moving stream of water about four feet wide and 3 to 4 inches deep flows down the ninth East air course and this undoubtedly quenched the flame and prevented the explosion from propagating to the eighth East entry workings. This water drains from the adjacent Tidewater mine of the same company entering the King mine through a 12-inch opening in the barrier pillar at the head of the ninth East entry.

The brattice in the last closed cross cut between the ninth East entry and air course had been blown out and in the direction of the air course. This brattice was constructed of canvas and wood.

All brattices outby of this point was intact, except that there was a slight leakage through the one opposite room No. 5. These, however, are rock and cement brattices and filled with gob for their entire length.

ROOMS OFF NINTH EAST ENTRY

Rooms Nos. 8 and 7:

These rooms are advancing. No evidences of heat or violence were found in either room and the men working in these rooms escaped without injury. Canvas line brattices in the rooms were intact.

Room No. 6:

This room is advancing. No evidences of heat were found and the two miners working in the room escaped without injury. A canvas line brattice about 100 feet long conducts the air from room No. 5 cross cut to the face. The first 15 feet of this brattice was blown down. A road dust sample (No. 24804) was taken in this room. The bottom was generally damp.

Room No. 5:

This room was holed through to the tenth East air course and was not working. A canvas brattice was stretched across the

room, 200 feet from the entry and inby the open cross cut to room No. 4. This canvas had been blown down and was charred on the edges.

Room No. 4:

This room had been driven to its full length and the pillars were being robbed. There was a fall of rock in the roadway about 150 feet from the ninth East entry. This had fallen prior to the explosion and two rock men were cleaning it up when the explosion occurred.

Three miners' caps and a metal jack half full of black powder were found near the solid rib opposite the last pillar pocket. A cap with carbide lamp attached was found at the entrance to the last pillar pocket. These belonged to Dan Arden, an Italian tracklayer, who was working at this point. At the time of the explosion there were seven or eight men in this room: two slate men, Franklin and Bailey, working on the fall in the roadway; four miners, Ford, Brown, Davis and Jordan, from the two pillar pockets; the tracklayer, Arden, working at the head of the room, and Hancock, a miner, from room 3, whose working place had been marked off on account of gas. Tucker, whose working place was in room No. 3 and who was a buddy of Hancock, was found dead in room No. 4, but the evidence seems to show that he was in room No. 3 when the explosion occurred and traveled to room No. 4 afterward. All of these men were badly burned and three -- Arden, Franklin and Hancock--had been overcome by the damps and

had to be revived by artificial respiration. Ford, Davis, Arden and Jordan died later in the hospital.

Room No. 3:

The pillar was being pulled in this room. Two exploded powder jacks (8-lb.size) were found in the gob and near the head of the room. A wooden nail keg along side of these jacks was charred and coked and a roll of cartridge paper within the keg was partially burned. The keg also contained two sticks of permissible explosive Aetna AA, a roll of fuse and a dummy cartridge containing coal dust. A dinner-pail alongside had its cover blown off and its contents charred and scattered about. Opposite this point the inby wheels of an empty car were off the track and shifted a few inches in the direction of room No. 2. Two dinner buckets nearby were overturned. A canvas across the head of the room had been blown down and charred. In the last pillar pocket were found the safety lamp, carbide lamp and axe of the brattice man.

Some of the props near the head of the room showed heavy coking near the bottom and further outby the props were slightly charred. Opposite the first pillar pocket and near the roadway was found a powder jack containing about five pounds of black powder.

The miners (Manns and Hunter) who had worked in this pocket had not been burned. Hunter escaped unassisted, but Manns delayed to secure his coat and was overcome by the damps, losing his life.

There was a car at the face in this pillar pocket, half full of coal and on the track. The inside pillar pocket in this room had been marked off on account of gas on the morning of the disaster and the brattice man, Austin, was replacing some canvas which a small roof fall had dislodged when the explosion occurred. This was the working place of Tucker and Hancock.

According to Hunter and, as previously stated under heading "Story of the Accident and Rescue Work", the brattice man had called to Tucker, who was in room No. 3, requesting his assistance in placing the canvas brattice and instructing Tucker to extinguish his carbide light before coming to the head of the room. Hunter stated that Tucker did this and that a short time afterward the explosion occurred.

A road dust sample and a face coal sample were taken in this room.

Open Cross-cut Room No. 3 to Room No. 2.

The dead body of Abbott, the pillar boss, was found in this cross-cut. He was severely burned about the head and shoulders.

Room No. 2:

Four miners were working in the two pillar pockets in this room. The two men, S. J. Evans and Taylor, in the first pillar pocket from the entry escaped uninjured. There was very slight coking on the West faces of props in this pocket, but the coats and shirts of the miners which lay nearer the face had not been scorched. A half loaded car was at the face.

Thomas Evans and Clarence Jones, the miners working in the second pillar pocket, were each badly burned. Jones was overcome and it was necessary to revive him by artificial respiration. Evans died later in the hospital.

There was some coke and charring, especially near the top of the props. Also it was rather dry and dusty in this pocket. A car on the track at the face was undisturbed. A drivers' cap and lamp was found near the room neck, the cap slightly charred.

Room No. 1:

The pillar in this room had been robbed to within 20 feet of the entry. There was a small fall in this room, but no coking.

Both miners escaped unassisted.

First Butt off:

A coat^{was} hanging on a prop a few feet from the entry. The coat was burned but eight detonators in the coat pocket were, from outward appearance, in perfect condition.

Tenth East Entry:

The rooms off this entry had been worked out. One which had not caved was full of water and the entry roadway was damp. Two men were working on the chain pillar, which is opposite room No. 5 off the ninth East. One of these men was burned about the head and chest. There ~~was~~ no other evidence on this entry of heat or violence, and the car on the track at the face was not disturbed. The Pittsburgh recording gage card for March 28th (the day of the

explosion) was examined. At 8:30 o'clock a.m. a water pressure of $1\frac{3}{4}$ " was indicated. From 8:30 until 12 o'clock noon the pressure was slightly less. Shortly after twelve o'clock all brattices that had been destroyed in the affected section of the mine were recovered and the water gage pressure become normal once more.

COAL SAMPLES

COAL SAMPLES:

Lab. No.	Location	Moist.	Vol. matter	Fixed: carbon	Ash	Ratio V.M. to T.C.
24799:	Room No. 3, 1st pocket, off ninth East entry, 7500 ft. N.E. of opening.	2.02	16.64	76.48	4.86	17.86
24800:	Face room No. 12, Scotland entry, 2700 ft. East of opening.....	2.09	16.88	76.59	4.44	18.05
24801:	Composite of Lab. Nos. 24799 and 24800.....	1.98	17.17	76.19	4.65	18.40

ROAD DUST SAMPLES:

Lab. No.	Location	Moist.	Vol. matter	Fixed: carbon	Ash	Ratio V.M. to T.C.
24802:	Room No. 3, off ninth E. entry: opposite point where two exploded powder jacks found....	4.12	15.16	66.66	14.06	18.52
24803:	Tenth E. entry, sample taken from car load of road dust	4.29	15.94	68.55	11.22	17.68
24804:	Room No. 6, off ninth E. entry: taken along 100' of roadway, starting at X-cut to room 5 and traveling inby in room 6..	4.59	16.19	68.80	10.42	19.05
24805:	Vicinity of chain pillar, face: head of ninth E. entry.....	8.98	15.16	68.59	7.27	18.10

MINE AIR SAMPLES: 4-12-16.

Lab. No.		CH ₄	CO ₂	O ₂	N ₂
7385	East butt, between No. 1 butt and No. 1 room26	.07	20.61	79.06
7386	Return air at foot of main slope.....	.42	.12	20.41	78.99
7387	On tenth East entry (return from affected area).....	.49	.09	20.51	78.91
7388	Small roof break near <u>face of room No. 3</u> ...	1.53	.10	20.28	78.09
7389	At <u>face of room No. 3</u>28	.03	20.56	79.13
5691	200' down main slope from pit mouth..... (Last sample taken by Mason 12-12-14)	.32	.09	20.65	78.94

It will be noted that the coal from the King mine has about the same ratio of inflammability as L. Kittanning. A 50-per cent rock dust mixture will probably prevent propagation of an explosion started in a zone of explosive dust, even when one per cent of gas is present.

None of the analysis records show more than 20 per cent of 200-mesh dust, as compared with almost 80 per cent in the explosion tests at the Experimental Mine. It appears, therefore, that the 50-per cent rock dust mixture could be somewhat weakened without greatly increasing the degree of danger.

MINE AIR SAMPLES

Mine air samples were taken at pertinent points in the mine and the analysis records are appended. The data contained in these records has been tabulated for the purpose of ready reference and comparison. These analyses indicate that there is considerable methane generated in the King mine and particularly in the section affected by the explosion.

C O N C L U S I O N

As no shots were reported as having been fired on the morning of the disaster and no electricity is employed in the affected section, it is highly probable that the explosion was initiated, whether directly or indirectly, by an open flame. The fire boss reported the presence of gas in room No. 3 at 6:30 o'clock in the morning of March 28. Austin was working with a flame safety lamp in room No. 3, which is evidence that the gaseous condition still existed. Austin had called to Tucker to extinguish his open light and come forward to assist him. Tucker had called back that Austin should hold his lamp in such a position that he (Tucker) could see his way. Shortly afterward the explosion occurred.

A white deposit seemed to have formed on Tucker's badly burned head and upper body, which is evidence that he was in the neighborhood of the two powder jacks when they exploded. Perhaps after assisting Austin, Tucker returned to his coat and lunch basket which were located near the powder jacks. In relighting his carbide lamp, or in stooping over his dinner basket (lighted carbide lamp attached to his cap), or in examining the powder jacks, he accidentally ignited the powder in the jacks.

The powder in other jacks nearby had not ignited, which is evidence that the caps may have been off the jacks in question at the time of the accident. Furthermore, all the severe burns on Tucker were above the waist line and other evidence of flame was near the roof. This would seem to indicate that it was, in a large

measure, a gas explosion, or a light dust explosion incited by the presence of a relatively high percentage of gas. Of course the floor was fairly damp and very little or no dry dust existed there. The ribs and roof were very dry. Large scale tests at the Experimental Mine prove conclusively that one per cent or even one-half per cent of CH_4 appreciably increases the explosibility of bituminous coal dust.

The ~~efficacy~~^{effect} of plenty of water in limiting an explosion is clearly shown in this case and none the less clearly is it illustrated that where there is dry dust in the gob, on the roof and on the rib and gas is present, conditions are most favorable for an explosion even if the floor is thoroughly damp.

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RECOMMENDATIONS FOR GREATER SAFETY ONLY.

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1. When any section or room of a mine is marked off because of its gaseous condition men should not be allowed, in immediately adjacent workings, with open lights.
2. Closer supervision should be exercised over the handling and care of explosives. Detonators and explosives should be kept separately.
3. In Room No. 6 off the 9th East entry, a canvas line brattice, 150 feet in length, was used to conduct the air from the last open crosscut to the working face. The ventilation of the rooms would

be more efficient if the room face was never advanced over 80 feet beyond the last open cross-cut.

4. It is believed that in all gaseous mines an emergency engine for the fan and, if possible, an emergency fan, should be provided.

5. Samples of return air should be taken and analyzed at intervals. A Burrell methane detector could be secured for the purpose of making daily tests.

6. First aid materials should be provided underground and full and complete crews of five men each should be organized and kept in proper first aid training. These teams should consist of both surface and underground members, and the underground first aid men, in particular, should be well distributed throughout the mine.

7. In addition to the efficient sprinkling system employed on the haulage roads at this mine, it might be desirable to introduce a system of rock dusting. The sprinkling should be carried into the rooms, particularly in dry sections of the mine and before shooting.

8. It is believed that the operators in this vicinity would find it to their advantage to establish a centrally located and cooperative mine rescue station.

9. Miners should be cautioned of the quick action of afterdamps, as illustrated at this mine in the case of Manns, who probably lost his life in his attempt to recover his coat.

10. It is understood that shortly after this explosion Edison electric lamps were purchased for use in this mine and that open lights are not longer employed. The management is to be commended in this step.