FINAL REPORT ON MINE EXPLOSION
FRANKLIN COLLIERY, LEHIGH VALLEY COAL COMPANY
WILKES-BARRE, LUZERNE COUNTY, PENNSYLVANIA

DECEMBER 11, 1947

By

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

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INTRODUCTION

A double explosion of methane occurred in the Ross vein workings in the No. 9 slope section of the Franklin colliery, Lehigh Valley Coal Company, Wilkes-Barre, Luzerne County, Pennsylvania, at approximately 11:10 a.m., Thursday, December 11, 1947. An interval of about a minute elapsed between the two ignitions. Of the nine men in the immediate explosion area, five were killed instantly, three died later in the hospital, and one escaped uninjured. Eleven workers in nearby Ross vein workings, where the explosions were felt, escaped uninjured.

Evidence indicates that the explosion was caused by the liberation of a large quantity of methane from the face of a chamber following a rush of coal. It is believed that the methane was ignited by open-type electrical equipment.

The Bureau of Mines office in Wilkes-Barre, Pennsylvania, was notified of the explosion at 11:45 a.m. the day of the explosion by company officials. E. H. McCleary, W. S. Eltringham, D. M. Hart, and C. F. Weber of the Bureau of Mines reached the colliery office at 12:35 p.m.; other Bureau employees were instructed to stand by and be prepared to take the Bureau's mine rescue apparatus to the mine in the event it might be needed. State Mine Inspectors D. H. Connelly, Andrew Wilson, and J. D. Edwards arrived at the mine about 12:55 p.m.

The party of State and Federal inspectors entered the mine immediately and learned that all the bodies except one had been recovered; an accumulation of water and bad roof on the gangway delayed the recovery of the last body until about 12:30 a.m. the following morning.

Two small fires found burning a short time after the explosions were extinguished by company employees.

GENERAL INFORMATION

The Franklin colliery is near the southeastern boundary of Wilkes-Barre, Luzerne County, Pennsylvania. Run-of-mine coal is loaded into railroad cars and hauled by the Lehigh Valley Railroad to another colliery for processing.

The main office of the Lehigh Valley Coal Company is at 133 North River Street, Wilkes-Barre, Pennsylvania, and the operating officials are as follows:

L. R. Close, president
K. F. Arbogast, general manager
H. W. Montz, mining engineer
Osborne Morgan, safety engineer
Harry Spare, colliery superintendent
J. P. Daley, mine foreman

A total of 270 men is employed on 2 shifts in the production of approximately 580 tons of coal a day.

The colliery was opened about 1850 by the Franklin Mining Company. The Lehigh Valley Coal Company acquired the property in 1891 and it continued active operations until 1931. The Franklin Coal Mining Company, a subsidiary of the Pagnotti Coal Interests, Incorporated, secured a lease on the property in 1941 and operated the mine until the lease was canceled on February 16, 1945, at which time operation was resumed by the owners.

The mine is opened by three slopes and an air shaft; the slopes follow the pitches of the veins, and the shaft is 390 feet deep. Although the openings are outside the city limits, the No. 9 slope has been extended, and the underground workings in the affected area are under the city. This slope, which crosses a local basin near its foot and terminates at road No. 859, is about 2,800 feet in length on an average pitch of 25°. Sump space is provided for the main pumps of the section where the slope and its companion airway cross the basin.

The Ross vein averages 7-1/2 feet in thickness in the No. 859 road section, and the active chambers, as well as a number of old places, encountered a "fault" in which the vein rises to a pitch of approximately 50° and pinches out. The method of mining employed when driving the chambers up the fault has resulted in considerable difficulty because of the free running nature of the vein.

The immediate roof in the vicinity of the fault consists of hard slate which contains many slips and which tends to loosen when exposed to the air. Close timbering is necessary for roof support in the chambers and on the gangway.

The floor is hard and smooth.

MINING METHODS, CONDITIONS, AND EQUIPMENT

Mining Methods

The chamber-and-pillar method of mining is followed in the Ross vein, but the pillars are not recovered.

The Ross, Top Red Ash, and Bottom Red Ash veins are worked from No. 9 slope. That part of the Ross vein being worked from this slope lies near a boundary line, and a local basin extends diagonally across the area into which the slope was sunk. First mining has been completed on the east side of the slope, where the vein had pinched out, and a new gangway known as road No. 859 was driven on approximately the course of the fault to connect with the workings west of the slope. It was in this gangway that the explosion occurred.

The workings on the west side of No. 9 slope were developed from a short slope or incline driven from the main lift, and the gangway known as road No. 858 was then driven to follow the course of the fault to the boundary line and is now being driven along the barrier pillar at the west boundary. A back branch driven off road No. 858 holed into road No. 859 on November 13, 1947, but the track had not been connected at the time of the explosion.

Coal is blasted off the solid and is loaded by hand onto shaker or chain conveyors, except in the gangways, where it is loaded into the cars by hand.

Ventilation and Gases

The main fan on the surface is 16 feet in diameter and is operated continuously exhausting at a speed of 100 revolutions a minute by a first-motion steam engine. A similar fan, also operated by a steam engine, is installed in such a manner that it can be used to provide ventilation in the event the main fan should fail. Both the fans are in fireproof structures, and a recording pressure gage and a fan-failure alarm are provided. About 208,000 cubic feet of air a minute was being exhausted from the mine against a water-gage pressure of 3 inches at the time of the investigation.

The mine is rated "gassy" by the Pennsylvania Department of Mines, and preshift examiners are employed.

Air enters the mine by way of the main slopes and other openings and is conducted along the main haulageways to the working sections, where it is divided into individual splits. The air ventilating the Ross vein workings is conducted along No. 9 slope and a parallel airway to the No. 55 tunnel level and then to road No. 858, where it is divided into two splits. One split continues along road No. 858 to ventilate the working places off that road; the other enters the back branch and ventilates the workings off road No. 859, returning through old workings east of the slope. A single door at the foot of the slope controlled the flow of air in the road No. 859 split.

Wooden line brattices are used to conduct the air to the working faces, and Lamb Air movers are used in several places in conjunction with the line brattices. The air compressors are shut down at the end of the second shift and are started 2 hours before time for the fire bosses to enter the mine. Therefore, these working places depending on Lamb Air movers are without face ventilation when the air compressors are shut down.

The analyses of four air samples collected during the investigation are shown in table 1. Methane contents of 0.32 and 0.37 percent indicate that methane is liberated in the section in quantities sufficient to warrant proper precautions to assure its prompt removal and prevent any accumulation.

Drainage

The mine is normally dry, but considerable water enters the workings from surface breaks and strippings. The water collects in local sumps and basins and is pumped to a sump on the main level, from where it is relayed to the surface.

TABLE 1. - ANALYSES OF AIR SAMPLES COLLECTED December 1947.

Mine Franklin Colliery Company Lehigh Valley Coal Company Collected by C. F. Weber, W. S. Eltringham, D. M. Hart

Bottle No.	Lab. No.	Location in Mine	Percent in Volume				Cubic Feet Air Per Minute	Cubic Feet Methane in 24 hours
			Carbon Dioxide	Oxygen	Methane	Nitrogen		
1911	155450	Still air, No. 3 crosscut, chamber #11, 858 gangway.	0.06	20.81	0.37	78.76		
2412	155451	Return, return of Road 859 at #24 chamber.	0.10	20.76	0.32	78.82	9,650	44,467
3063	155691	Return, west side of main fan.	0.16	20.66	0.14	79.04	90,675	182,801
8018	155692	Return, east side of main fan.	0.13	20.72	0.12	79.03	117,975	203,861

Haulage

Rope systems are used for haulage on the slopes and planes, and electric locomotives are in use for gathering and for haulage between the slopes and planes. The locomotives are operated with power from the 275-volt direct-current system.

Two cable-reel locomotives were used to gather cars in the Ross vein workings, but only one haulage crew was employed. One of the locomotives was used to service the places from road No. 858 and the back branch, and a hoist, operated by a member of the haulage crew, was utilized to pull the loaded cars up the heavy grade to the slope landing. The second locomotive was used to deliver and gather cars in road No. 859 and to place the loads on a branch on the east side of the slope, where they could be reached with the main slope rope.

Lighting

Fixed electric lights are installed at the slope landing and at the permanent pumps and the hoist. Several light circuits taken off the trolley wire at the slope landing have the return wires connected to a pipe line instead of to the tracks. This arrangement might result in a difference of potential between the pipe line and a conveyor line or some other conductor at the face of a working place and cause sparks of sufficient intensity to ignite gas.

Permissible electric cap lamps are used for portable illumination, and permissible flame safety lamps are used by the officials and miners for gas-testing purposes.

Smoking and the carrying of smokers' articles underground are prohibited, and searches are made at irregular times and places. Suitable signs are posted at the mine entrance and at other conspicuous places to warn against carrying open lights and smokers' articles underground.

Electrical Equipment Underground

The electric equipment used underground consists of transformers rotary converters, pumps, hoists, locomotives, and conveyors, and the potentials are 4,000, 440, and 110 volts alternating current and 275 volts direct current.

Nonpermissible electrically operated shaker conveyors are used in chambers Nos. 4 right and 5 left off road No. 859, and a compressed-air driven shaker conveyor is used in chamber No. 4 left.

Two small gathering pumps are installed on road No. 859; one at chamber No. 6 and another in chamber No. 5 right.

The pumps and electric shaker conveyors are driven by 440-volt alternating-current induction motors with push-button controls.

The hoist used to pull the loaded mine cars up the steep grade from road No. 858 and from the back branch is operated by a 25-horsepower 440-volt

alternating-current motor. The hoist and its electric equipment and controls are well installed and suitably guarded.

Two permanent centrifugal pumps are installed on the slope level; one is operated by 440-volt and the other by 4,000-volt alternating current. The pumps are well installed and suitably guarded.

The alternating-current equipment, except the 4,000 volt motor, is frame-grounded to the tracks.

The 440-volt circuit is conducted by a cable made up of three No. 2 insulated wires twisted together and supported on insulators, and the 4,000-volt circuit is in a high-voltage three-conductor cable which terminates at an oil switch near the pump. The feeder for the 275-volt direct-current circuit is an insulated cable installed along the slope the bonded track is the return. The trolley wires in road No. 858 and in the back branch terminated in intake air outby the first working places, but the trolley wire in road No. 859 is in return air throughout its length.

The electric equipment is inspected at intervals by any one of the several electricians who might be in the section, but no written records of the inspections are made.

Explosives and Blasting

Shots are fired at any time during the shift by certified miners.

Permissible explosives are used to blast coal, and dynamite is employed for blasting rock. All blasting is done electrically using either instantaneous or delay (1 to 5) electric detonators.

The shot holes are drilled at an angle to the direction of advance in order to take advantage of a free face. The holes are of ample diameter and are generally drilled about 8 feet in depth. The strengths of the charges range from 1 to 6 cartridges, and from 1 to 10 shots are fired in one round, depending upon the nature of the burden. Two or more tamping bags filled with fine vein material constitute the stemming.

The certified miners supervise the drilling, charge and fire all shots, and make tests for gas before and after blasting.

A substantially constructed car, lined with a rubber composition and equipped with a 4-inch partition for separating the explosives and detonators, is provided for delivering the blasting supplies to the operation boxes underground. The operation boxes, from where the miners carry their explosives to the working areas, are suitably made and are kept in safe places. Standard two-compartment boxes are used for the safekeeping of the explosives convenient to the working places.

Mine Rescue and Fire Fighting

The company sponsors a central mine rescue program. The headquarters of the safety engineer who supervises this program is at the Dorrance colliery

about 3 miles away: the equipment at the station consists of 33 self-contained oxygen breathing apparatus, 36 gas masks, 60 self-rescuers, gas-testing devices, and other necessary units. Each colliery of the company furnishes a certain quota of the personnel necessary to maintain 20 teams, and training is given at monthly intervals; 9 Franklin colliery employees are included in this program.

The breathing apparatus and a number of the gas masks are kept at the central station, but in order to have equipment readily available for local emergencies, a number of the gas masks and self-rescuers are kept at each of the company's collieries.

Periodic inspections are made of all the equipment and it is kept in readiness for immediate transportation and use.

Teams from the Dorrance, Prospect, Westmoreland, and Henry collieries responded to the call for assistance and aided in the recovery operations.

Fire-fighting facilities and emergency materials are available underground, and equipment and personnel of the Wilkes-Barre fire departments are stationed nearby.

PREVIOUS EXPLOSIONS IN NEARBY COLLIERIES

According to former inspection reports, no explosion has occurred in this mine. However, Bureau of Mines Bulletin 437, Coal-Mine Accidents in the United States, 1938, records several major disasters for the immediate district as follows:

Date	Colliery	Nature of Disaster	Killed
1910	So. Wilkes-Barre No. 5	Gas explosion	7
1915	Prospect	" "	13
1924	Loomis	" "	14
1925	Dorrance	" "	10
1926	Pettebone	" "	7
1927	Woodward	" "	7
1947	Nottingham	" "	15
1947	Schooley	" "	10

MINE CONDITIONS IMMEDIATELY PRIOR TO DISASTER

The starting time of the first shift was 7 a.m., and the mine was in normal operation on Thursday, December 11, the day of the explosion. The weather was moderately cold, with a slightly rising barometer.

The weekly barograph chart, appendix "C", for the Wilkes-Barre area indicates a gradual increase in the atmospheric pressure from 28.70 inches of mercury at noon on Monday to 29.35 inches at 7 a.m. on Wednesday. From this high point, the curve dips to 29.10 inches at midnight before it starts a rise which reached 29.25 inches at noon on Thursday, December 11, 1947. These changes in barometric pressure probably had no effect on the liberation of gas.

The assistant mine foreman's book indicates that gas was detected on November 21, 1947. This gas was found in a cavity, where the vein had "run" along the fault, in the heading from chamber No. 10 off road No. 858. Other than on this occasion, the current records covering the Ross vein examinations do not indicate that gas has been found. However, information obtained during the investigation revealed that small "caps" of gas have been observed at times after blasting, and that these occurrences are not entered in the report book.

STORY OF EXPLOSION AND RECOVERY OPERATIONS

The first indication on the surface of any trouble underground was when the mine electrician, who was servicing the "half-way" pump, noticed the air becoming very dusty. Believing that something unusual had occurred, he signalled the hoisting engineer to stop the trip being hoisted. The electrician then went to a nearby telephone and told the engineer that a large fall must have occurred on the slope and that he would make an investigation and call back. In the meantime the colliery office was notified of the explosion by telephone and a request was made for assistance.

As this was "measuring day" Frank Danna, assistant foreman, and Thomas Jones, fire boss, met at the sidetrack near the foot of No. 9 slope. They decided to measure the working places in the Ross vein first, and entering the section by the way of the haulageway (normally called road No. 855) east of the slope, they traveled west along road No. 859. After visiting the Ross vein working places off Nos. 859 and 858 roads, they went to the Bottom Red Ash vein workings off No. 55 tunnel.

The officials had finished the measurements and were on their way out of this area at 10:55 a.m. They had reached the intersection of No. 55 tunnel and the Bottom Red Ash gangway and were discussing the working conditions of the area when they heard a rumbling noise which was thought to be a heavy cave. However, as the air current began to fill with dust, they suspected the noise had been caused by a gas explosion, and they started toward the slope. Just as they reached the sand box where the tunnel crosses the Top Red Ash vein, a second explosion occurred. The distance walked by these men during the interval between the explosions would require approximately one minute.

According to Assistant Foreman Danna's statement: " I then hurried to the slope level and saw the smoke and dust. I met the pumper here and then went to the main slope where I saw the body of the footman and a fire at the bottom of the slope. We obtained wrenches and disconnected the water line and connected water hose to put the fire out. I went through the door but do not remember if it was open or not. We then went to road No. 858 and met Mario Sanitate (survivor from No. 5 chamber), who told us his miner was buried. I sent Jones to road No. 858 and I went in the back branch, and saw the body of Mario's miner. I checked the air and continued along the gangway and saw two bodies, one man was still breathing, and I had him carried out at once. Then we found another body in front of chamber No. 4. The roof was working here and we did not go farther. We returned to the slope level and saw the two burned men from chamber No. 23 off road No. 859, but they would not talk. I then sent the injured men out on the first trip and the others (meaning the bodies) on the next trip. I then returned to road No. 859 to check for fires

and found canvas burning at the end of loaded branch. We extinguished this and traveled as far as the locomotive and found no more fires. We then returned to the slope level."

Up to this time all but one body had been recovered. A short time later, a group of State inspectors, company officials, and Bureau of Mines representatives arrived at the explosion area, but because of an accumulation of water and bad roof which was chipping and falling along the gangway, it was decided to discontinue search for the missing body until the water could be pumped out and timbers stood to protect the searchers. This plan was followed, and the missing body was recovered about 12:30 a.m. the following morning.

INVESTIGATION OF CAUSE OF EXPLOSION

The investigating party consisted of Osborne Morgan, Harry Spare, George Collamer, and John Daley, company officials; Daniel Connelly, Andrew Wilson, John Edwards, and Thomas Beaney, State inspectors; and Charles F. Weber, David M. Hart, and W. S. Eltringham, Bureau of Mines.

The investigation of the cause of the explosion was started on the morning of December 12, 1947, the day after the explosion, and was completed December 22. In order to expedite the work of inspecting the conditions underground, the party was divided into three groups, each of which consisted of at least one company official, a State inspector, and a Bureau of Mines representative; the groups inspected different sections of the explosion area, and also interviewed witnesses and survivors.

PROPERTY DAMAGE

The property damage was rather extensive, especially in road No. 859 and in the old workings. Line brattices and deflecting doors were destroyed in three chambers, and a number of cinder-block and wooden stoppings were destroyed in the old workings. Timbers were blown out at two places along road No. 859 and this permitted large falls of roof. Several mine cars and conveyor pans were damaged, and the starting equipment of a shaker conveyor was destroyed. The trolley wire was torn down, and a feeder cable became overheated and the insulation burned off as the result of a short circuit.

The destruction attributable to the explosion could be repaired and operation could be resumed in a short time.

DETAIL OF EVIDENCE

Forces

As shown in appendix "A", the forces of the explosion traveled west along road No. 859 from the fall inby chamber No. 4. This was evident because the discharge pans of the conveyors in chambers Nos. 4 right and left and No. 5 were bent outward, and the two mine cars at these locations were moved in the same direction and their rear ends were damaged. The control and starting switch of the conveyor in chamber No. 4 right were blown toward chamber No. 5. Timbers, brattice, and other debris were also blown in the same direction.

On the other side of the fall the forces traveled east along road No. 859 and were dissipated in the old workings. A part of the locomotive cover was blown east about 20 feet, and the trolley wire was moved in the same direction against the empty cars which were spotted for loading under the chute at No. 23 chamber. An empty car standing at the empty-track switch was partly turned over, and stoppings in the old workings were blown outward, showing that the main forces traveled east along road No. 855 in the old workings.

While the indications of force were quite pronounced, they were of little value in tracing the point of origin of the first explosion because a second explosion produced confusing evidence.

Heat and Flame

All of the victims except the slope footman were burned, and a piece of canvas was found burning at the loaded-track switch in road No. 859. Evidence of heat, in the nature of charred paper and cloth, was found at several points, and this aided in establishing the limits of flame travel, as shown on the sketch, appendix "A".

Activities in the Working Section

The activities in the affected section during the morning of the explosion are taken from statements of the haulage crew and the hoist engineer.

The two working places on the east side of the slope had been idle since December 4, because of an accumulation of water on the loaded branch, and only one of them, chamber No. 23, was being worked on the day of the explosion. There were seven loaded cars on the loaded branch of road No. 859, and three on the gangway, which had been loaded before the temporary shut down of the road.

The haulage crew placed the three loaded cars on the loaded branch, then placed two empty cars at No. 23 chamber with one car in loading position. As was customary they left the locomotive coupled to the empty cars with the trolley pole "dogged down," the brake set, and the controller in neutral, while they went to service the working places in road No. 858 using another locomotive. They stated that on no occasion had they detected that anyone had tampered with or operated the locomotive in their absence. After the explosion, the locomotive was found parked at the customary place, and everything remained as the haulage crew had left it, except that the cable nip was lying in front of the locomotive and the transfer switch was thrown to the reel-operating position; this leads to the belief that someone may have attempted to operate the locomotive in the absence of the haulage crew and has been considered as a possible source of ignition of the first explosion.

The hoisting engineer stated that a trip of loaded cars was pulled from road No. 859 branch the first thing in the morning by the slope hoist. Then three trips were pulled from the No. 55 tunnel level. The next empty trip was stopped at the switch of the main lift and after about 5 minutes, a signal to go to the No. 859 road branch was received. After lowering the trip to this branch and when pulling the loaded trip out, a signal to stop was received when the trip reached the switch of the main level. Then a telephone message to the engineer advised him to hold the trip, that there was something wrong. This was the first indication on the surface that an explosion had occurred.

The condition of the working places was as follows:

Chamber No. 23. The men in this chamber were engaged in reopening the chute which had caved between the old gangway and airway. The face was just past the old gangway and sheet iron was being used in the chute. The locomotive with two cars attached was parked at this chamber and a portion of the wooden cover of the locomotive with the alarm bell attached was blown about 20 feet outby. The two men who worked in this chamber walked to the main slope lift after the explosion, but they were badly burned and both died later in the hospital.

Chamber No. 1. This chamber was driven up past the first crosscut and the crosscut started on each side of the chamber. It had been idle several weeks prior to the explosion because the face ran away. Two men were imprisoned in the crosscut for several hours by this rush of coal from the face at that time. The several officials who assisted with the rescue of the workmen made conflicting statements about gas being released when the face ran away. However, a Lamb air mover was installed to ventilate the chamber.

Chamber No. 2. This chamber was idle on the day of the explosion. A large fall of rock on the gangway prevented inspection after the explosion; however, an interview with the men who worked in this chamber prior to the temporary shut down of road No. 859 revealed that the face had reached the fault and was driven up the pitch a short distance. A battery had been installed to control any possible rush of coal from the face. A line brattice that ended at the battery was used to conduct air from the gangway and the miners had been cautioned to be on the alert for any possible rush of coal from the face.

Chamber No. 4. The face of this chamber had encountered the fault and was driven up the pitch a short distance. A compressed-air operated shaker conveyor was used to convey the coal from the foot of the steep pitch to the gangway. The two men who worked in this chamber were both killed and their bodies were found on the gangway after the explosion. The assistant foreman and the fire boss visited this chamber on the morning of the explosion while they were taking measurements. They stated that the place was clear of gas and that they instructed the miner at the face to blast the rib so that the required clearance would be provided for the setting of a timber. Conditions in the chamber were normal at the time of this visit. However, after the explosions it was found that the face of this chamber had run away and the conveyor pans had been disconnected. The conveyor pans inby the drive were covered and fouled with coal and timbers from the face. The bolt with which the pans are held together was laying on the drive foundations, apparently having been removed before the rush of coal came. The safety lamp used in this chamber was found on the coal badly damaged and the chamber was full of gas. The car being loaded at the time of the explosion was about three-fourths loaded and had been forced outward, overrunning a drag.

Chamber No. 4 right. This chamber worked night shift and was inactive at the time of the explosion.

Chamber No. 5. Mario Sanitate, a contract laborer, who was working at the face of this chamber at the time of the blast and who escaped uninjured, gave the following account:

"My miner tested for gas at starting time while I waited on the gangway. We then tamped six or seven holes in the crosscut, and the boss (fire boss) and assistant came at that time. We fired the holes after the boss left and then started to load coal, shoveling from the crosscut. We loaded two cars; we always both shovel onto the conveyor until the car must be moved, then we both go to the gangway, move the car, and the miner stays to top the car while I go to the face and shovel onto the conveyor until the car is loaded. We had the third car under the conveyor partly loaded, and we had moved the car to finish loading. I started toward the face and the miner stayed on the gangway to top the car. While walking to the face I heard what I thought was a shot fired in the next chamber (No. 4 chamber). I reached the face and put about six shovels of coal on the conveyor when I was thrown down by a severe concussion. I called to my miner and heard him groan. I started toward the gangway and had taken only a few steps when a second concussion occurred and I was struck by boards from the brattice and again knocked down. I extracted myself from the boards and made my way to the gangway; it was dusty and smoky; I couldn't see. I finally found my miner and he was pinned down by the car and debris. I tried to pull him up but was unable to do so. I groped around and found the pipe line that marked the way out and I proceeded to the slope level, where I met other workers."

The shaker conveyor in this chamber is driven by a 440-volt squirrel cage motor and the push-button controls are installed on props in the gangway. The line brattice near the chamber neck was badly damaged but that part of the brattice near the face was not damaged. The safety lamp was hanging on a timber at the crosscut. The survivor stated that he did not see any flame at the time of the explosion.

Possible Sources of Methane

Gas was found in chambers Nos. 10 and 13 and at the face of the gangway in road No. 858, in chambers Nos. 1 and 4 off road No. 859, and in the old workings in the return of road No. 859 during the investigation. The large body of gas in the old workings was concentrated at the faces of the eight old chambers, where the coal had pinched out at the fault. These chambers were driven varying distances from the gangway, and they terminated on a pitch of about 50°. They thus form an ideal pocket in which a light gas could collect. By noting the elevation of the edge of the body of gas at several points, it has been decided that it tailed out very close to chamber No. 23, which is the first working place in road No. 859.

It is reasonable to presume that the large body of methane found in the old workings existed at the time of the explosion. The main ventilating door for the section was latched open at the time of the explosion; however, it was not possible to determine how long it was open prior to the time the ignition occurred. While the open door caused a short circuit of the ventilating current from the working places on the split, the ventilation arrangements were such that the short circuit occurred outby the body of gas, and therefore could not have had any appreciable effect upon it. It is believed by the investigators, therefore, that this large accumulation of gas was not involved in the first explosion, but that it was ignited by fires created by the first explosion, and contributed materially to the severity of the disaster.

Chamber No. 4 which was on the fault was visited by mine officials approximately 2 hours before the explosion. Conditions in this chamber were normal and the men were engaged in timbering. Following the explosion it was found that a rush of coal had occurred and the place was filled with methane. The contract laborer in chamber No. 5, who survived the explosion, heard a sound a short time before he felt the effects of an explosion, which may have been produced by the disturbance at the face of chamber No. 4. It is presumed that the rush of coal was accompanied by the liberation of a comparatively large volume of methane. Under normal conditions the ventilating current would have carried the gas into the return without encountering any operating electrical equipment, but because of the main ventilating door being open at the time the gas was released, the direction of air flow past chamber No. 4 was reversed, hence it is presumed that the methane liberated in chamber No. 4 was carried toward the mouth of chamber No. 5 where an electric conveyor drive motor was in operation. Since the working places were visited by mine officials approximately 2 hours before the explosion and found, according to their statements, to be in normal condition with respect to gas and ventilation, and since no operations were being conducted in the working places that would have the effect of releasing gas, such as blasting, it is believed by the investigators that the gas was liberated suddenly by the rush of coal in chamber No. 4.

Possible Sources of Ignition

The following agencies could have ignited the gas, and they are mentioned only as possible sources:

1. An electric spark caused by the locomotive being operated in road No. 859.

2. An electric arc or spark at one or both of the motors or controls of the two pumps on the back branch.

3. The flame of the damaged safety lamp found in chamber No. 4.

4. Blasting.

5. Smoking.

6. An electric arc or spark at the motor or controls of the shaker conveyor at chamber No. 5.

The locomotive parked in road No. 859 evidently had been tampered with after the haulage crew left it and before the explosions, because the cable nip and the transfer switch were not in the position that the motorman stated he had left them. This suggests that one of the workmen may have operated the locomotive to shift the car under the loading chute, or for some other purpose. However, it is contended that if either workman was in the locomotive cab operating the locomotive or on the gangway at the time of the explosion , he would have been killed instantly, because in this position he would have been in the direct path of the forces of the explosion. It will be recalled that both of these men walked out to the main slope after the explosions and died of burns later in the hospital.

Any arcs or sparks at the two pumps are discounted as ignition sources because both pumps are located outside the flame zone.

The damaged flame safety lamp found in chamber No. 4, probably was hanging on a timber near the face before the rush of coal, as is customary in anthracite mines. The rush of coal, which could have caused a liberation of gas, might have struck the lamp and exposed the flame which in turn could have ignited the gas. On the other hand, the lamp could have been damaged by the explosions and not by the rushing coal and other material from the face. Moreover, had the lamp been damaged by the rush of coal it would seem that the flame would have been extinguished before it could have ignited the gas and the lamp probably would have been covered by falling material.

Blasting is discounted as a source of ignition because no evidence was found to indicate that shots were fired in the explosion area immediately before the blast.

Smoking and the carrying of smokers' articles underground are prohibited, and searches are made at irregular times and places. Suitable signs are posted at the mine entrance and at other conspicuous places to warn against carrying open lights and smokers' articles underground. However, one of the investigators called attention to some matches in a jacket found in the explosion area. No evidence was found to indicate that anyone was smoking when the explosion occurred.

An electric arc or spark produced at the motor or controls of the conveyor at chamber No. 5 could have ignited gas that might have been present in the gangway because of interrupted ventilation. It is known that the miner who worked in chamber No. 5 was on the gangway at the time of the explosions and he could have caused a spark or arc at the starter switch if he attempted to stop or start the conveyor. This conveyor and its controls were located in the violent force and flame zone.

SUMMARY OF EVIDENCE

1. Accumulations of methane were found in chambers 1 and 4 off road 859 and a large body of methane was found in the old abandoned chambers inby 23 chamber and along road 849 and its monkey heading during the investigation. It is reasonable to presume that this accumulation existed before the explosion. An inspection of the old workings failed to reveal any recent inspection dates, and it was established at the interviews that no regular program for inspecting old workings was in force. The record book listed several reports of old works inspections dated at widely separated times.

2. The single door controlling the ventilation of the split was open at the time of the explosion. Tests made during the investigation proved that this open door would have the effect of short-circuiting the air from Road 859 and would reverse the direction of air flow carrying any methane liberated in chamber 4 toward chamber 5.

3. A rush of coal occurred in chamber No. 4 at some time during the morning, not more than 2 hours before the explosion. Methane is usually liberated freely when a rush of coal occurs in a chamber that is being driven

on a fault. A short time before the explosion, probably about a minute before, the survivor who was working at the face of chamber 5 heard a sound, "like a shot," which may have been produced when the rush of coal started.

4. A second explosion following closely after the first one indicates that a large body of gas must have been involved. Evidently the initial explosion produced a further derangement of the ventilation and disturbed the large body of gas inby No. 22 chamber and may or may not have ignited it. It is believed that this body of gas may have been ignited by fires in the loaded branch created by the initial explosion, and that the second explosion probably increased the severity of the disaster.

5. No evidence could be found to indicate that blasting was being done in the area involved at the time of the ignition.

6. No evidence could be found to indicate that employees were smoking in the area involved at the time of the ignition, although evidence was presented to indicate that employees sometimes violate the rule prohibiting the carrying of matches underground.

7. The locomotive on road 859 would not have been in operation under normal conditions and evidence indicated that it was not in operation.

8. Evidence indicates that the conveyor in chamber No. 5 was in operation; moreover, it is possible that the miner on the gangway may have been operating the controls. This conveyor drive and its controls would be in the path of the methane-laden air, assuming that the methane was released in No. 4 chamber and the air current was traveling in a reverse direction because of the door having been left open.

9. The conveyor drive consisted of a squirrel cage induction type motor fitted with open-type control equipment. While this type of motor will not ordinarily ignite gas, it is capable of igniting gas under certain faulty conditions and the control equipment is capable of igniting gas any time it is operated.

PROBABLE CAUSE OF THE EXPLOSION

Investigators of the Federal Bureau of Mines are of the opinion that the explosion was caused by the liberation of methane resulting from a sudden rush of coal from the face of a chamber, that the methane was carried to its ignition source because of derangement of the ventilating current when a main ventilating door was left open, and that it was probably ignited by open-type electrical equipment.

LESSONS TO BE LEARNED FROM THE CONDITIONS AS THEY RELATE TO THIS EXPLOSION

1. Placing dependence upon a single door to control the ventilation of a split is too great a risk to take in a mine which liberates methane, especially a mine which is subject to sudden liberations of considerable volume.

2. While air locks, consisting of double doors, are generally recommended, a more positive method of controlling the ventilation, such as the use of overcasts, would lessen the chances of derangement.

3. The elimination of sources of sparks and open-flames from working areas where there is a possibility of the inflow of methane, would afford an opportunity to discover and remove the gas before it is ignited. Assuming that permissible explosives are used and that men do not carry matches or other igniting devices underground, this could be accomplished by the exclusive use of permissible electric equipment or by the use of air-driven equipment.

4. This disaster emphasizes the necessity where feasible for maintaining ventilation in abandoned areas and for inspecting them regularly. Good mining practice demands preshift examinations, not only of live workings, but also of all old workings adjacent to live workings, where this is possible.

RECOMMENDATIONS

The following recommendations are limited to such conditions as related to this explosion, and they are made in the belief that their adoptions will materially lessen the possibility of an explosion occurring in this mine in the future.

1. Only permissible electrical equipment or compressed-air driven equipment should be used in return air. Non-permissible electrical equipment should be operated only in intake air.

2. Trolley wires should be installed only in haulageways ventilated with intake air.

3. The return conductors of electric lights taken off the trolley wire should be connected to the rail.

4. Searches for smokers' articles should be made in such a manner as to assure that these articles are not taken into the mine.

5. Accessible old workings should be inspected weekly and records of the inspections kept; the date and the initials of the examiner should be left as evidence of his visit.

6. Where doors are used to control the ventilation of a split, they should be installed in pairs to form air locks. Overcasts should be used in lieu of doors wherever feasible.

7. The fire bosses' records should include accounts of the detection of gas by the fire bosses, regardless of the percentage detected or the time of detection.

8. Idle or abandoned places adjacent to active workings should be inspected daily by mine officials, if this is possible.

ACKNOWLEDGMENT

The authors herewith acknowledge the courtesies and assistance extended by the officials of the Lehigh Valley Coal Company and the cooperation of State Mine Inspectors Daniel Connelly, Andrew Wilson, J. D. Edwards, and Thomas Beaney.

Respectfully submitted,

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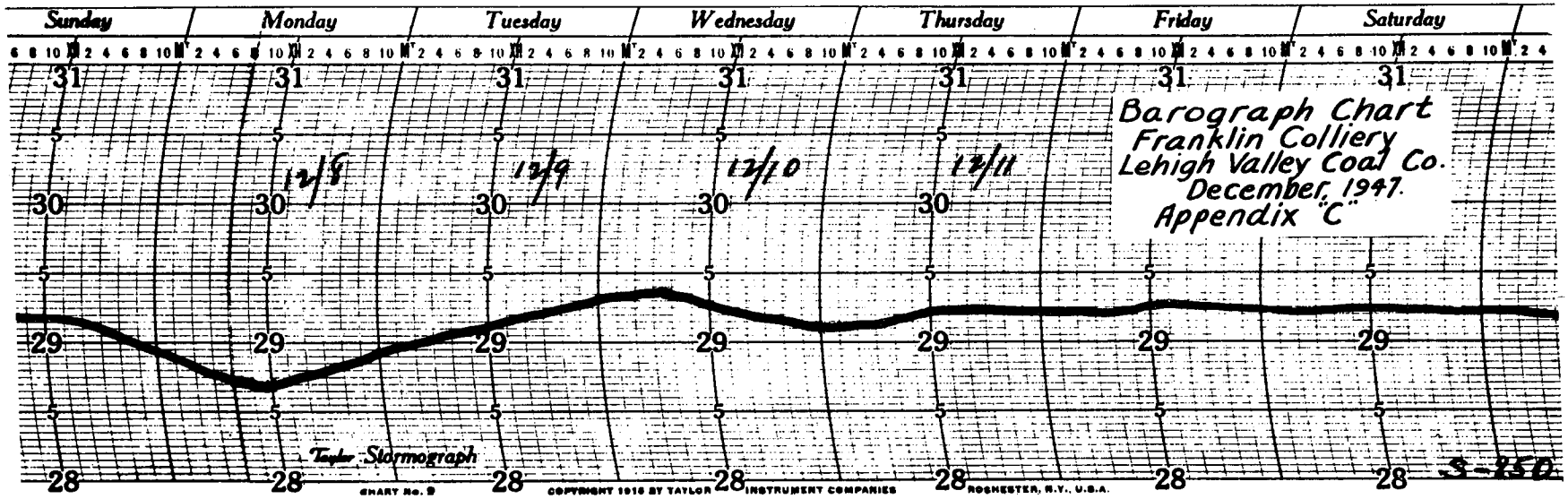
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
31
30
29
28
12/8
12/9
12/10
12/11
Barograph Chart
Franklin Colliery
Lehigh Valley Coal Co.
December, 1947.
Appendix "C"
Taylor Stormograph
CHART No. 9
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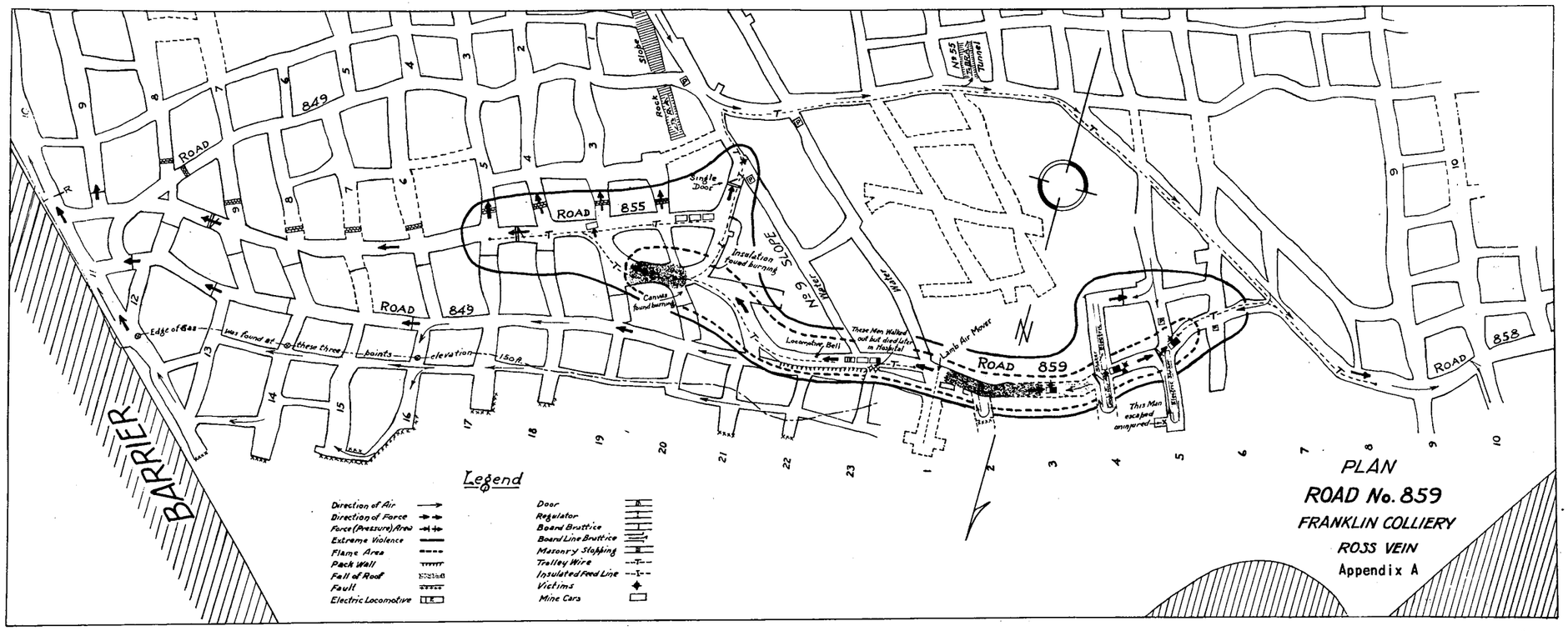
Appendix C

APPENDIX "D"

Victims of the Explosion

Name	Age	Occupation	Working Place	Dependents	Mining Experience	Extent of Injuries
Stephen Sillup	47	Footman	No. 9 slope	Widow	24 yrs.	Traumatic amputation both legs; fracture crevical spine; avulsion of soft tissues of neck.
Roger F. Jones	41	Miner	No. 4 chamber	Widow - 2 children	25 yrs.	Extensive burns; compound fracture of skull.
*Casper Pulak	24	Laborer	do.	Widow	6 mos.	Compound fracture of skull, left tempero-parietal area, with loss of brain substance. Extensive burns; shock.
Michael Guidaitis	66	Co. laborer	No. 859 gangway	Widow	40 yrs.	Extensive burns; crush injuries and skull fracture.
Ignatz Skzynecki	57	Co. miner	do.	Widow	37 yrs.	Extensive burns; compound fracture of skull.
*Edmund Oljeski	42	Miner	No. 23 chamber	Widow - 5 children	25 yrs.	Extensive burns; shock.
*John Gasper	25	Laborer	do.	-	2 mos.	Extensive burns; shock.
Frank Chudlio	54	Miner	No. 5 chamber	-	26 yrs.	Traumatic amputation of left leg; burns, hemorrhage and shock.

* Died upon reaching hospital or shortly thereafter.


ROAD
849
ROAD
855
ROAD
843
ROAD
859
ROAD
858
SLOPE
No 9
Single Door
Insulation found burning
Canvas found burning
Locomotive Bell
These Men Walked out but died later in Hospital
Lamp Air Mover
This Man escaped uninjured
Edge of Gas
was found at
these three
points
elevation
150ft.
BARRIER
Legend
Direction of Air
Direction of Force
Force (Pressure) Area
Extreme Violence
Flame Area
Pack Wall
Fall of Roof
Fault
Electric Locomotive
Door
Regulator
Board Brattice
Board Line Brattice
Masonry Stopping
Trolley Wire
Insulated Feed Line
Victims
Mine Cars
PLAN
ROAD No. 859
FRANKLIN COLLIERY
ROSS VEIN
Appendix A