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J. Tracy

REPORT OF MINE EXPLOSION

AT THE

RENTON MINE NO. 3, UNION COLLIERIES CO.

RENTON, ALLEGHENY COUNTY, Pa.

BRIEF STATEMENT

About half past three in the morning of July 19, 1920, an explosion occurred in the Renton No. 3 Mine of the Union Collieries Co., at Renton, Allegheny County, Pa., which resulted in the death of nine men and a badly wrecked mine. Following are the names of the men who lost their lives:

John Luteman, Night Foreman and Fireboss.  
Edmund Higby, Fireboss.  
Charles Reese, Fireboss.  
John Marks, Pumper.  
Mike Kostl, Pumper.  
Cross De Blatta, Pumper.  
Nick Matuskenok, Timberman.  
Lewey Kuffer, Timberman.  
Mike Kokard, Supplyman.

LOCATION

The Renton Mine No. 3 is located in Plum Township, Allegheny County, Pennsylvania, about 18 miles east of Pittsburgh. The Unity Railroad, over which the coal is shipped, runs from the Renton Mine to a point near North Bessemer, Pa., at which point connection is made with the Bessemer & Lake Erie Railroad.

### OPERATORS

The Union Collieries Co. owns and operates four mines, Renton No. 1, Renton No. 2, Renton No. 3 and Renton No. 4, all of which are located at Renton, Pa. Renton Nos. 1, 2 and 4 are mining the Pittsburgh seam, while Renton No. 3 is operating in the Twin Freeports.

Mr. W. W. Keefer is President, Mr. W. A. Luce, Vice-President, and Mr. W. R. Calverly is the General Manager of the Union Collieries Co. The main offices are in the Union Arcade Building, Pittsburgh, Pa. The Superintendent of the Mines is Mr. James A. Gould, at Renton.

### SEAM OF COAL MINED

In the field in which these mines are operating, the Pittsburgh seam outcrops along the sides of the hills above the valley in which the main plant is located. Renton No. 1, 2 and No. 4 are drift mines into the Pittsburgh vein. About 500 feet below the surface the Upper and Lower Freeport are supposed to combine into practically one seam about seven feet in thickness, having a binder of about 12 inches between the two seams.

The roof is composed of several feet of laminated sandy slate, light gray in color, very hard and brittle. Above the slate is a strata of sandstone. The floor is a hard tough slate.

### PHYSICAL FEATURES

The Union Collieries Co. owns and controls a large acreage of coal lands in which are the two workable seams of coal mentioned above. The Pittsburgh seam lies above the valley and outcrops at various places. About 625 feet below the Pittsburgh seam is what is locally known as the "Twin Freeport" vein of coal. Ordinarily there is an interval of about 70 feet between the Upper Freeport and Lower Freeport seams.

In this section of Allegheny County, however, the Upper and Lower Freeport seem to merge into practically one vein about seven or seven and one-half feet thick with a band of slate about 12 inches thick between them. It is this seam that is being mined in the Renton No. 3 Mine.

The coal is reached by two shafts about 200 feet apart and 520 feet deep, situated in a narrow valley which runs in an easterly and westerly direction.

About 2000 feet east of the shaft is the tippie over which is dumped the coal from Renton Mine No. 2, which produces about 110,000 tons annually. About the same distance west of the shafts is the tippie of No. 1 Mine which has an annual output of approximately 140,000 tons. Between the shafts and ~~the~~ Mine is the tippie of No. 4 Mine at present producing about 50,000 tons annually.

On the hillside south of the valley, the mining town of Renton is laid out, with well kept lawns and well built houses.

The Unity Railroad, over which the coal from the Renton Mines is shipped, is a short line, built by the Union Collieries Co., and connects with the Bessemer & Lake Erie Railroad a mile or so north of North Bessemer, Pa.

There are facilities for storing between 35 and 40 empty railroad cars and an equal number of loaded cars.

Just previous to the explosion Renton Mine No. 3 was producing about 2000 tons of coal per day.

The hoisting shaft is a two compartment shaft equipped with self-dumping cages which discharge the coal to Marcus screens, thence to a

picking table where the impurities are separated and the coal loaded by means of a loading boom, into the railroad cars.

The material shaft is divided by a curtain wall into an airway and a hoisting compartment. It is equipped with a single cage counter-balanced by a heavy concrete and steel counterweight. All the material used in the mine is lowered into the mine by means of this cage and the rock and slate hoisted to the surface by it. It is also used in transporting the men in and out of the mine. A sketch of this shaft is attached to this report.

The rock and slate are dumped into lorries and carried to the slate pile.

#### POWER HOUSE.

The power house is located between the shafts and is constructed of brick and steel. In the east end of the building is the motor hoist for the main shaft and, in a separate adjoining room, the automatic control apparatus for controlling the speed of the motor hoist is installed. The central portion of the building is used as a repair shop for the electrical equipment and the west end contains the motor generator sets. At the west end of the building the motor hoist for the material shaft is located.

The power is purchased from the Duquesne Light Co. and is delivered at 23,000 volts Alternating Current to transformers, by which it is stepped down to 2300 volts. There are three General Electric motor-generator sets which transforms the current from 2300 A. C. to 250 volts D. C.

The West Penn Power Co. has a high tension line passing

in close proximity to the mine and the writer understands that it is the intention of the Union Collieries Company to connect with this line in such a way that if, for any reason, the power from the Duquesne Light Co. should fail or be shut off, the current from the West Penn will automatically be switched on.

#### HOISTING APPARATUS.

The main hoisting machinery is composed of a General Electric 700 H.P. 60-cycle induction motor operated by an alternating current of 2300 volts at 166 amperes. The maximum speed without full load is 400 R.P.M. and with full load 394 R.P.M. This motor is geared to a Vulcan hoist, equipped with air and hand brakes and also overwind and "slow down" devices. The hoist for the material shaft is equipped with a similar but somewhat smaller, hoist and motor.

The cages are supplied with automatic safety devices. The head frames at both shafts are built of steel with steel sheave wheels and apparently constructed after the best engineering practice and seem modern in every respect.

#### VENTILATION.

The mine is ventilated by a 14-foot Jeffrey multibladed, double inlet fan, 14 feet in diameter, belt connected to an electric motor. The normal speed of the fan is about 100 R.P.M. and delivers about 130,000 cu. ft. of air per minute against a 2-inch water gauge. As has been stated, the air shaft was divided into two compartments by a concrete curtain wall, the air from the mine being drawn up the air compartment by the fan.

At the foot of the shafts are fourteen parallel entries

on about 65-foot centers and from 1200 feet to 1500 feet long, running in a northerly and southerly direction, finally terminating at each end into a set of four main entries, known as the North Mains and the South Mains. There are, in addition, four main entries running to the west and four to the east side of the mine. From every section of the mine there are at least two return air courses. The general scheme of ventilation is shown in more detail in the attached plan. The stoppings were built of brick, the overcasts of steel and concrete. The entries average from six to seven feet high and from ten to twelve feet wide.

The mine is developed in a field that has many producing gas wells and from the early development of the mine, gas has been encountered therein and in anticipation of eventually having to take care of increasing amounts of gas, the elaborate scheme of ventilation entries, above described, was adopted.

It was remarked by Mr. Walverly, the General Manager, that he had always wanted to operate a mine in which he might have plenty of air courses and that he thought that he had carried out this desire when he had projected the workings of this mine.

As far as the writer knows, there was no auxiliary power installed to operate the fan in case of the failure of the electric power.

#### DRAINAGE:

The mine is comparatively dry, but on account of the number of entries which are being driven, at the faces of which there is more or less water, there are about 14 electrically driven pumps in operation. Most of these deliver the water to one large pump, placed near the bottom of the material shaft, by which it is pumped to the surface. All the pumps are operated from a 250-volt direct current

circuit except the large pump which operates from a 440-volt alternating current circuit.

#### DUST CONDITIONS:

The main haulage ways, where it was possible to see the condition of the bottom, were thickly covered with crushed coal and dust, samples of which were taken and analyzed. A discussion of this dust will be found in another portion of this report. As far as the writer can ascertain, no provision for rendering this dust inert, either by sprinkling or rock dusting, had been made.

#### HAULAGE:

Electrical haulage is used throughout the entire mine. The coal is gathered from the rooms by 7-ton motors of the General Electric "Crab" type and, in addition, for straight haulage there are three five-ton Morgan-Gardner motors, all of which are operated on a 250-volt D.C. circuit. All haulage roads are on the intake entries. The mine cars, of wooden construction, are exceptionally large, weighing when empty 3500 pounds and having a capacity of about three tons. They are of the single end gate type and substantially constructed.

The track is 48 inch gauge and laid with 40 pound rails in the main entries, 30 pound rails in the side entries, and 20 pound rails in the rooms. Both steel and wooden ties are used.

#### LIGHTING:

The shaft bottom and part of the main haulage road were lighted with ordinary incandescent lamps. The miners used Edison Electric Cap lamps, while the foreman and firebosses used flame safety lamps. No open lights were allowed in the mine. A lamp house, in which the lamps are cleaned and the batteries recharged, is open day and night and is in charge of a lampman who issues the lamps as they are needed.

#### MINING MACHINES:

The coal is undercut by machines, the company owning nine Jeffrey type 35-B shortwall, self propelling machines and one Oldroyd machine,

all operated on a 250-volt D. C. circuit.

#### SHOOTING:

Permissible explosives, Cameron 1 A, manufactured by the Graselli Powder Company are used in shooting down the coal. Atlas No. 6 Electric Detonators are used to detonate the charge. Shotfirers supervise the loading of the holes and fire all the shots.

The explosives are given out from a magazine, situated about half way up the hillside. On the top of the hill, about 300 feet distant are a number of dwelling houses. The building used as a magazine is merely a one story frame shed. There is no protection around it to prevent the firing of the explosives contained therein by means of gun shots fired from a distance. The main magazine is located about 2000 feet northwest of the shaft.

#### ORGANIZATION :

Mr. Calverly, the General Manager, has general charge over all the mines and spends a great deal of his time at the plant. Reporting directly to Mr. Calverly is Mr. Gould, the Superintendent, who has direct supervision over the men and the details of operation. Mr. Thomas Parker, the mine foreman of Renton No. 3 Mine, has the underground work under his charge and under him are several assistant mine foremen and firebosses.

The Company, seemingly, has been extremely careful in selecting its personnel, many of the minor officials having been with Mr. Calverly at other operations at which he had been engaged.

#### GAS WELLS:

There are a number of gas and oil wells in this field, nearly



all, if not all, of which are producing wells. Others are being drilled. The Company has located these, and is leaving a solid pillar of coal, 100 feet in diameter, around them as a protection to the mine.

#### MINE MAPS.

The mine maps are plotted on the "coordinate" plan and contain practically all the information necessary to the economical mining of the coal. The inside surveys are closed in circuits as often as possible. All rooms and entries are driven on sights placed by the engineering corps.

#### STORY OF THE EXPLOSION.

Some time during the week beginning July 11, 1920, the officials of the Union Collieries Co. received notice from the Duquesne Light Co., that on the following Saturday and Sunday the electric power would be shut off for the purpose of making changes or repairs on the line. Consequently arrangements were made to close down the mine during that time.

At about eleven o'clock on Saturday morning, July 17, the power was shut off from the ventilating fan. It was not turned on and the fan was not in operation until about six-thirty on the evening of Sunday, July 18, 1920.

The fan ran until about half past nine of the same evening, when it was discovered that the power company had crossed the phases and reversed the current so that the fan was running backward. The fan was stopped and the Duquesne Light Company power house notified. At two o'clock Monday morning, July

19th, the fan was started and ran normally from then on.

About an hour and a half later, an explosion occurred which completely wrecked the mine.

About half past five Monday Morning the Pittsburgh Station of the Bureau of Mines was notified and by seven o'clock the rescue truck with Messrs. Denny, McCaa and Zorn had left the Station for the mine, piloted by Mr. J. T. Ryan of the Mine Safety Appliances Co. in his own automobile.

Car No. 3, with Mr. Archie Forbes, Foreman Miner, and Mr. Joseph Monohan, First Aid Miner was at the time training at Burgettstown, Washington County, Pa. About nine-thirty o'clock on Tuesday forenoon it was notified to proceed to Renton. A through train from Columbus was stopped at Burgettstown about eleven o'clock, taking the car to Pittsburgh, where a special engine was in waiting and the car arrived at Renton about two o'clock in the afternoon.

In the meantime the work preparatory to the exploration of the mine was organized. It was found that the curtain wall between the air compartment and the hoisting compartment in the material shaft was badly damaged and, although the fan itself was unharmed, it was impossible to force air into the mine.

Under the direction of Mr. P. S. King, State Mine Inspector, of the Twenty-Ninth District, in which district the Renton Mine No. 3 is located, attempts to repair this wall were made. As the cage in the material shaft and one cage in the hoisting shaft had been blown up

into the headframes, a temporary cage was constructed in the material shaft, to be used in repairing the curtain wall. While this was being done Mr. McGaa, wearing breathing apparatus and taking with him a canary bird for the purpose of detecting Carbon Monoxide, was slowly lowered down the material shaft in a small bucket, large enough for but one person. An automobile horn was used as a signal to the men operating the crab which was used in lowering the bucket.

Mr. McGaa found fresh air in the material shaft and he then explored the passages from the material shaft to the main shaft. The air was also found to be fresh in these passageways.

After some time it was found that one of the cages in the main shaft was resting comparatively uninjured on the safety catches about 18 feet from the surface landing. Work was then started to place this cage in condition for operating.

As the temporary repairs to the curtain wall in the air shaft were not entirely satisfactory, it was finally decided to place a canvas stopping over the top of the material shaft, so that the only intake would be the main hoisting shaft.

When the necessary repairs to the cage in the main shaft had been completed, crews were lowered down to begin the work of exploring the mine. Beginning at the bottom of the main shaft, temporary stoppings were erected and the fresh air carried with the exploring parties. At the same time apparatus men from the Bureau of Mines, the Renton Mines, the Ford Collieries Company and the Inland

Collieries Company explored ahead of the fresh air.

Owing to the extremely heavy falls of roof and the extent of carbon monoxide gas, as well as the amount of  $\text{CH}_4$ , progress was necessarily slow.

On Tuesday the first body, that of Mike Kodard, a supply man, was brought out, having been found in No. 8 Face about 300 feet north of the air shaft. A little later on the same day the body of Matuskenok was found on No. 3 Face not far from the Mine Foreman's office.

The work of exploration was continued in shifts of from two to four hours during the day and succeeding night. On Wednesday the bodies of Kuffer, Marks and De Blatta were brought to the surface. Kuffer was found on a motor at the neck of No. 5 Room on 3 Butt West South Entry; Marks on the East Mains at the second breakthrough beyond the North Flat Entries and De Blatta at the pump at the intersection of No. 5 North Main and No. 3 Butt West North.

The two fireboses, Reese and Higby, were discovered the next day, Higby in the chute, running from the foot of No. 1 Face to No. 6 Butt East, near the foot of No. 5 East; Reese at the face of No. 9 Butt West.

On the following Friday, the body of Luteman, the night foreman was found near the face of No. 20 Room on No. 1 East North entry.

Despite an almost constant search the body of Kostl was not located until September 28, over two months after the explosion, when it was found under a fall on No. 3 Butt West South off of the Southwest Flat Entries.

Nearly all of these bodies were more or less burned and

showed indications of violence.

The restoration of ventilation and recovery work was conducted under the direction of Mr. P. S. King, State Mine Inspector, assisted by the following named State Inspectors:

Mr. Alexander McCanch, of the 1st District;  
Mr. Charles P. McGregor, of the 7th District;  
Mr. P. J. Walsh, of the 9th District;  
Mr. J. J. McDonald, of the 11th District;  
Mr. John I. Pratt, of the 17th District;  
Mr. James J. Stoker, of the 19th District;  
Mr. P. J. Callaghan, of the 26th District;  
Mr. Harry Phythyon, of the 27th District.

The representatives of the Bureau of Mines who assisted in the rescue work were:

Mr. E. H. Denny, Ass't Mine Safety Engineer;  
Mr. G. S. McCaa, " " "  
Mr. H. M. Motherwell, Mechanical Mine Safety Engineer.  
Mr. Archie Forbes, Foreman Miner;  
Mr. J. H. Zorn, " "  
Mr. Joseph Monahan, First Aid Miner;  
Mr. Harry Burdelsky, " " "

Car No. 3 stayed at the mine about one week.

By about July 27, the work of cleaning up the falls and putting the mine in shape for operation was well underway and on September 28th, the first car of coal since the explosion was dumped over the tibble, although the mine had by no means been restored to the condition in which it was previous to the explosion.

NOTES OF EVIDENCE OBTAINED BY THE BUREAU OF MINES:

On July 27, 1920, and a number of subsequent days, the writer visited Renton No. 3 Mine for the purpose of inspecting the mine in order to obtain information which might prove of value to the Bureau of Mines in its study of the prevention of mine explosions.

#### SURFACE DAMAGES:

The cage in the material shaft had been blown up into the head frame and lodged there with a tangled mass of cable. Some of the members of the structural part of the frame were somewhat bent, but the structure as a whole was but comparatively little damaged.

The east cage of the main shaft was likewise blown to the top of the headframe, which also had some damaged members. The condition of the anchor bolts seemed to indicate that the entire superstructure had been lifted up several inches and then settled back. The west cage had evidently been blown up the shaft and then fallen back on the safety catches which held it from dropping down the shaft.

The windows in the buildings near the shaft were nearly all broken and the tile roofs of the power house and lamp house were broken in a number of places. A steel rail was blown out of the shaft and came through the roof of the lamp house, just escaping the lampman's head.

The concrete curtain wall in the air shaft was badly injured and the guides in each shaft were more or less damaged.

#### INSIDE DAMAGES:

The mine was so completely wrecked that it is almost impossible to give all the details of the conditions found inside. Many of the entries were so completely blocked by falls that they were impassible. Others were explored only by crawling over falls, under timbers and through the accumulated water. There was not an entry in the entire mine that did

not show more or less signs of extreme violence. Those in the southwest section seemed to have heavier and more continuous falls, owing possibly to more unfavorable roof conditions. It was especially noticeable that heavy falls invariably occurred at the intersection of entries, break-throughs and entries, or where room necks had been turned off from entries.

The writer believes this was due to the fact that the roof at the intersections presented a much larger area of unsupported strata than along the entry proper, an area of approximately 100 sq. ft. The force of the explosion tended to buckle upward this area of roof, and, as the strata was very brittle, caused a fracture at right angles to the rib at the intersection lines of the entries.

When the explosion wave had passed and the upward pressure was removed the entire area came down.

Wherever the roof had been supported by timbers, these would have been blown out at the same time.

In many mine explosions it is possible to trace the direction of force of the explosion wave. But at Renton Mine this direction was most difficult to observe on account of the numerous falls of roof that practically caved all road and airways to a height of from six to seven feet. In fact, the entire length of an entry might be traversed on the tops of these falls without coming below the elevation of the top of the coal. In many cases room necks and break-throughs were so completely covered up by these falls that it was impossible to locate them.

Occasionally, evidence of the direction of the explosion force would be found, but these were so far apart that no definite connection between them could be traced.

The coke dust, so prevalent on the roof and ribs in many explosions

was found only at the face of Nos. 9 and 10 East off the South Mains and also near the face of the South Mains. The absence of the usual evidence of caked particles on the rib may be due to the settlement of dust on the ribs resulting from the clouds of dust raised by the numerous falls of roof.

There may have been coked particles on the ribs, but, owing to the fact that a large part of these ribs were covered by the falls, could not be observed.

Following are a few of the evidences of the violence of the explosion:

In the bottom of the air shaft several mine wagons had been jammed in such a way that a cage could not be lowered completely down. A number of heavy timbers from a pile in a nearby breakthrough had also been blown into the shaft bottom.

On No. 4 Face Entry, near the "main bottom", one motor and three empty cars were jammed together. All the sideboards of the cars had been completely stripped from the iron side frames, leaving only the bottom, trucks and side irons.

On the main north entry for a distance of several hundred feet from the shaft bottom, the roof had been shot down previous to the explosion, and the bottom raised; at the same time the entry had been widened sufficiently to accommodate two tracks, the whole being arched with brick. At this point a passageway had been left underneath the tracks to permit crossing from the eastern side of the mine to the western section. Just before the explosion a trip had been standing on one track over this passageway. After the explosion four loaded cars were found to have been lifted over to the parallel track.



At the intersection of No. 3 East Main and No. 4 North Main entries an empty car had been blown on top of a small fall. A few small pieces of slate were found on the inside of the car. This car evidently had been blown on top of the roof material by a secondary wave following the main explosion wave. Beginning about 700 feet from the shaft, the falls of the North Main entry were practically continuous, some of them being from 50 to 70 feet in length and approximately eight or ten feet high. In a breakthrough between No. 4 and 5 North Main near No. 3 Butt East North, the explosion had piled up ties, posts and rails.

The face of No. 4 North Main had about twelve inches of water lying in it, together with a pile of ties, posts, etc.

Sample No. 13193 of mine air taken near the face of the entry contained 4.67% of methane. There was not a sufficient current of air at this point to register on the anemometer.

Quite a good deal of coal had been spilled on No. 4 Main entry, especially just in-by No. 1 West Butt North.

A large portion of this coal was rather fine. A sample of road (Lab. No. 75512) dust taken in four 6-inch strips equally spaced over a distance of 40 feet weighed about ten pounds, all of the sample passing through a 10-mesh screen. A sample of rib (Lab. No. 75513) dust over a similar section weighed about one pound.

The analyses sheets of these samples are attached.

No. 4 North Main is the principal haulage road in this Section of the Mine.

At the intersection of No. 5 North Main and No. 3 Butt West North was a pump which had been covered by a large fall. It was at this pump that the body of the pumper Cross De Blatta was found.

Another big fall was at the intersection of No. 1 North Main and No. 1 Butt East North.

On No. 1 Butt East North, the largest falls appeared to be opposite Rooms Nos. 4 and 5, and at the intersection of the two line entries off of the East Mains. Nearly all of the rooms in this entry had fallen in, except No. 20 Room. It was in this room that the body of Luteman was found in a crouching position, his safety lamp beside him. It would appear that he had been testing for gas when he was overcome either with the shock of the explosion or by the afterdamp. There was no fall nor any evidence of violence in this room.

On No. 3 East Main, about 100 feet outby the Flat Entries going north, a pile of debris had been left by the force of the explosion. With the exception of numerous falls there was but little damage on this entry. It was noticed that considerable coal had been spilled from the loaded trips as they were hauled down the entry.

A sample of road dust (Lab. No. 75515) taken from four 6-inch sections within a space of 40 feet on No. 2 East Main just inby of No. 1 Face Entry weighed nine pounds, all of the sample passing through a 10-mesh screen. An analysis sheet of this sample is attached.

A sample of rib dust (Lab. No. 75519) taken from corresponding sections on the ribs weighed about  $1\frac{1}{2}$  pounds; 67.9% of this passed through a 200-mesh screen. An analysis sheet of this sample also attached to this report.

On No. 3 East Main, just outby of the intersection of the North East Flats, had been a door. The posts and sills were found about 50 feet inby the original position, as indicated by the hitches in the ribs.

At the second breakthrough from No. 1 Face on one of the East

Mains a 4-inch pipe line had been raised from its position in the center of the entry and blown over against the left hand rib.

A mine air sample (No. 13191) taken about 75 feet from the face of No. 6 Butt East North off of the North Mains contained 1.14%  $\text{CH}_4$ , as indicated by analysis sheet attached.

One of the entries, which showed signs of extreme violence, was No. 2 West Main; this entry was practically one series of falls from No. 4 North Main to the face, these falls ranging from five to ten feet high. At the intersections of No. 2 West Main and the face entries, the falls were especially noticeable.

About 100 feet inby from No. 14 Face on No. 2 West Main the roof was supported by a wooden truss which was still standing, while about 100 feet farther down the entry the timbers had been partially blown out and were lying at the edge of a heavy fall, pointing towards the foot of the entry.

On account of the water in No. 2 Northwest Flat off of No. 2 West Main, it was almost impossible to explore this entry, and the parallel flats were blocked with falls.

At the intersection of No. 4 Northwest Flat and No. 2 West Main the track on the main entry had been moved over to the right rib and a portion had been turned, in a partial curve, into No. 4 Flat, even the rails being bent around.

At the face of No. 2 West Main a mine car had been jammed against the face, the iron frame of the end gate being bent in towards the front of

the car and one of the vertical iron straps to which the sides of the car had been bolted, broken in two.

A sample of mine air, (Lab. No. 13192) in attached analysis sheet, taken at the face of this entry, was analyzed and contained 0.71% of methane in an air current of 5120 cubic feet per minute. This entry was dry and dusty.

Crossing through the last breakthrough to the face of No. 1 West Main, the air was tested for gas with a flame safety lamp and found to contain considerable methane. Returning on No. 1 West Main the entry was found to be very dry and dusty. At the intersection of this entry with No. 4 Flat going south, the floor was swept clean of dust as if someone had used a broom. The four flat entries going south from the West Mains contained heavy falls averaging about eight feet high, especially No. 2 Flat. The same condition existed in No. 3 Butt West off of No. 2 Flat South. It was in this entry that the body of Mike Kosti was found, in the latter part of September, under a fall of roof. Near the face of No. 4 Butt West South was a pump and close to the pump was a breakthrough to No. 3 Butt West South. Just outby this breakthrough on No. 3 Butt was found a shoe, then a battery box; a short distance farther down the entry a coat and a little farther on, a cap and then, under a 10-foot fall, Kosti's body, badly broken. It would seem that the explosion wave traveled up No. 4 Butt West South, caught Kosti at or near the pump and then blew him through the breakthrough and down No. 3 Butt to the place where his body was found, tearing off from his person, the shoe,

battery box, coat and hat on the way.

A sample of road dust, (Lab. No. 75513) was taken on No. 1 West Main near No. 14 Face. The dust was brushed up to a depth of approximately one inch over four 6-inch strips equally spaced over a distance of 40 feet. That part of the sample passing through a ten mesh screen weighed 5 pounds and the sample of rib dust, (Lab. No. 75516) taken from corresponding sections on the ribs weighed about three-quarters of a pound. Analysis sheets of both of these samples are attached. In places along this entry the dust was from four to five inches deep.

On Number 3 Butt West South off of No. 14 Face Entry at number 5 Room neck which was the second room turned on the entry, a motor and two cars were found, badly wrecked. The motor had been blown diagonally across the entry, the front end jammed against the corner of the right entry rib and the inby side of the room neck; the two mine cars were arched in between the sides of the room neck. The body of Kuffer was found so badly wedged between the end of the motor and the rib that it was necessary to use jacks to release it.

A pump, which had been located in a breakthrough between No. 3 Butt West South and No. 4 Butt West South opposite the point at which the motor was found, was blown across No. 3 Butt almost to the right hand ribb.

Beyond this point the entry was practically impassable owing to heavy falls of roof.

A sample of mine air taken at this place on August 5, 1920,

after the ventilation had been temporarily restored, contained 0.77% methane, as shown in analysis sheet No. 13194 hereto attached. The air current at this point, at the time that the sample was taken was found to be 7800 cu. ft. per minute. The entry between No. 14 Face and No. 5 Room was very dry and dusty.

A sample of road and rib dust taken over from 6 inch strips in a distance of 50 feet on Number 2 South Main, about 100 feet south of No. 6 Butt West South, weighed approximately 6 lbs. The sample of rib dust taken in corresponding sections weighed about  $\frac{1}{4}$  of a pound. Sheets Nos. 75514 and 75517, attached to this report give the analysis of these samples.

A Mining Machine at the foot of No. 7 Butt West off No. 2 South Main was apparently uninjured, as it was still standing on the track. A light fall of slate had partially covered it.

Near the face of Number 7 Butt West there was an accumulation of timber which had undoubtedly been blown there by the force of the explosion at the face of the entry considerable water had collected.

Analysis sheet No. 13222 of a sample of mine air taken at the face of this entry gives a percentage of 0.31% of methane in a current of 8470 cu. ft. of air per minute.

On No. 1 Butt West off of No. 14 Face a trolley wire was found under a fall of roof coal.

There were a number of nicks, some of them rather large, which had been burned into the wire. When first found the wire was of a greenish color at the point where the nicks had been burned.

This is one of two pairs of entries in the mine, and the only pair in this section in which there had been any considerable amount of pillar work done. There is quite an area of "gob" and about 150' of stumps and chain pillar have been removed.

Some small coked particles were found at the face of No. 9 and 10 East off the South Mains and also near the face of the South Mains.

On No. 13 Face entry at a breakthrough near the West Mains the bottom ~~was~~ swept clean of dust.

#### TIME OF THE EXPLOSION.

It was learned from the testimony given at the State Mine Inspector's investigation by the man who was in charge of the power house on the night of the explosion, that about 2:30 AM July 19, 1920 Luteman called the power house by telephone and asked that the power be turned into the mine. The power-house man at first declined to do so, but later, after being assured by Luteman that everything was all right, he threw in the switches. About a quarter of an hour later Luteman again called the power house and asked if everything was all right. At 3:10 AM Luteman called a third time saying that " if the circuit breaker goes out, don't get discouraged as I am going through the mine and close the different switches. "

After the explosion a watch was taken from Luteman's body and was found to have stopped at twenty minutes past three.

The pressure chart on the fan showed a violent interruption of the ventilation at about the same time.

From the above evidence it is established without doubt that the explosion occurred at 3:20 AM July 19, 1920.

#### ELECTRIC SWITCHES:

The main switches controlling the current to the greater part of the mine were placed in a brick enclosure situated in a passageway leading from the main bottom to the small bottom at the material shaft. One switch was not connected to a feeder; two were on the same section. The line leading up the main bottom was not connected to the main switch, the current being controlled by the secondary switches near the North, East and West mains.

The following were the only switches which, after the explosion, were found to be closed. At the intersection of Number 4 North Main and Number 3 East Main; at the intersection of number 1 Face and Number 3 East Main; at the entrance to Number 11 Face Entry; at the intersection of Number 13 Face and the Main Haulage Road West; out No. 2 West Main just inby No. 4 Face and in the chute leading into No. 3 Butt West South.

These locations are indicated on the plan attached to this report. It will be noted that the location of these switches corresponds very closely with the probable route which Kuffer would take in order to go from the main shaft bottom to the point at which he was found on the motor.

#### ROUTES OF FIREBOSSSES:

At three o'clock, in the morning of July 19, the two firebosses, Higby and Reese, entered the mine to begin the examination of their respective sections.

It is probable that Luteman in making his rounds would first go to the line entries off the East Mains and then examine the rooms off No. 1 and 2 Butt East North. In fact his body was found in No. 20



room on No. 1 East North as has been stated. Then he would have gone to the face of the North Mains, then the working places in the North West Sections and finally the West Mains and the Flat Entries off the West Mains.

Higby's section was principally in the East and Southeast part of the mine and the four flats going North from the East Mains. He would probably first examine the faces of No. 7 and No. 8 Butt East South, going from there to No. 5 and No. 6 Butt East South, where his body was actually found. From this point he would, in all probability have examined Nos. 3 and 4 Butt East South, Nos. 1 and 2 Butt East South, the faces of East Mains and the Flat Entries going North from the East Mains.

The South and Southwest Sections of the mine were inspected by Reese, going first to Nos. 9 and 10 Butt West South, then Nos. 7 and 8, 5 and 6, 3 and 4 Butts South West, the faces of the Flat Entries going South from the West Mains and then Nos. 1 and 2 Butts West South. As before mentioned his body was found near the face of No. 9 Butt South West.

#### VOLUME OF EXPLOSIVE GAS PRODUCED:

Measurements and samples of the air on the two main returns of the temporary ventilation system were taken. The return from the North Section of the mine contained an average of 0.37% methane in a current of 22680 cu. ft. of air per minute as shown by the attached analyses reports numbers 13261 and 13262. This is at the rate of 121960 cu. ft. of gas per day from this section of the mine.

The return from the south section of the mine averaged 0.57% of methane in a volume of 25830 cu. ft. of air per minute, as shown by analyses sheets Nos. 13263 and 13264, or 221,760 cu. ft. of

Methane every 24 hours. The entire mine totalling 343,720 cu. ft. of gas per day, at the time (Aug. 12, 1920) that these samples were taken.

SUMMARY OF EVIDENCE.

1. The mine is located in the eastern part of Allegheny County, Pennsylvania, about 16 miles east of Pittsburgh, and was mining the Twin Freeport seam; having an output of about 2000 tons per day, nearly all the coal being obtained from entry development.

2. The mine is opened by two shafts about 500 feet deep, one a two-compartment hoisting shaft, the other also a two-compartment shaft, used for hoisting and lowering men and materials, and for ventilating purposes. The hoisting compartment in this latter shaft being divided from the air way by a concrete curtain wall.

3. The power is entirely electrical, the current being obtained from the high tension line of the Duquesne Light Company. The voltage is stepped down and the current converted from A. C. to D. C. as needed.

4. Ventilation is furnished by a 14-foot multi-bladed double inlet Jeffrey fan, belt connected to an electric motor and delivering normally 130,000 cu. ft. of air per minute. Two and Four entry systems conduct the air through the mine.

5. Haulage is entirely electrical, both "crab" type and ordinary motors being used, all operated from a 250-volt D. C. circuit. Cars are of wooden construction weighing 3500 pounds, having a capacity of three tons.

6. The mine is a gaseous one, no open lights being permitted. Electric Edison cap lamps are used by the men, flame safety

lamps by foremen and firebosses. There was probably 300,000 to 350,000 cu. ft. of explosive gas being liberated every twenty-four hours.

7. Permissible explosives are used to shoot down the coal and experienced shot-firers are employed to fire the shots.

8. During the week of July 11, 1920, the coal company was advised by the power company that on the following Saturday and Sunday the electric power would be shut off. Arrangements were accordingly made to close down the mine during that time.

9. The fan was stopped at eleven o'clock Saturday morning July 17, 1920, and did not operate until about six-thirty on the evening of Sunday, July 18, 1920, when it ran backward for about three hours, owing to the reversal of the electric current. At 9:30 P.M. Sunday the fan was stopped, the power house notified and at two o'clock Monday morning, July 19, it was again started and from that time on, ran properly.

10. As soon as the fan was operating correctly, or about 2:30 A. M. the night foreman, John Luteman, three pumpers, John Marko, Mike Kostl, Cras De Blatta, two timbermen, Nick Matuskenok, Lewey Kuffer and one supply man, Mike Kokard, went into the mine. Half an hour later, two firebosses, Ed. Higby and Chas. Reese entered in order to make an examination of the mine.

11. It is reported that 2:30 A.M. Luteman directed the man in the power house to turn on the power, which he did after a protest. At 2:45 A.M. and again at 3:10 A. M. Luteman was in communication with the power house.

12. Soon after the above mentioned incidents there was a violent explosion. The fan chart showed an interruption in the ventilation about 3:30 A.M. Luteman's watch had stopped at 3:20 A.M.

13. The cage in the material shaft and the east cage in the hoisting shaft were blown up into the headframes; the west cage in the hoisting shaft resting on safety catches about eighteen feet below the top of the shaft.

14. The curtain wall between the hoisting and air compartments, in the material shaft was badly damaged, thus disarranging the ventilation system. The fan was not damaged and continued in operation.

15. The interior of the mine was entirely wrecked, practically every entry and room being blocked with falls, the heaviest apparently occurring in the southwest section. Wherever two entries intersected, an entry and breakthrough or an entry and roomneck, the falls of roof were especially large.

16. The two most important pieces of evidence pertaining to the cause of the explosion are the finding of a haulage motor and driver on No. 3 Butt West South and the discovery of a portion of burned trolley wire under a fall of roof on No. 1 West Butt of No. 14 Face entry; and also the fact that after ventilation had been partially restored, the air at the point where the motor was found contained 0.77% methane.

17. The closed switches would seem to indicate the route probably taken by Kuffer in going from the shaft bottom to No. 3 Butt West South, and they were the only closed switches found after the explosion.

18. The haulage roads were very dry and dusty, fine coal dust, three or four inches deep, being found in many places. There was also an accumulation of fine coal dust on the ribs. Chemical

The mine was putting out about 23½ cu. ft. of gas per minute at the time that this investigation was made.

CONCLUSIONS:

As has been stated, the roof falls so blocked the entries throughout the entire mine that it was practically impossible to definitely trace the direction of the forces of the explosion.

From the analyses of the samples of mine air taken from different parts of the mine, it is established without doubt that the mine had been giving off a large quantity of methane. These samples were taken after ventilation had been partially restored, there being, at the time, about 50,000 cu. ft. of air per minute on the main returns.

It was also rated as a gaseous mine by the Pennsylvania Department of Mines.

On account of the adequate system of ventilation adopted and the amount of air (130,000 cu. ft. per minute) delivered into the workings, before the explosion no large amount of explosive gas had ever been permitted. Indeed, the writer is strongly of the opinion that the officials in and around the mine did not realize, because of the ample ventilation, that the mine was generating the amount of methane that it was actually giving off.

And it is believed that it was for this very reason that Inteman allowed the three pumpers and the other timber and supply men to go down into the mine before it was thoroughly examined, although this was in direct violation of the spirit of Section 4 of Article 4

of the Pennsylvania Mining Law which provides, "In case of accident to a ventilating fan or its machinery, whereby the ventilation of the mine would be seriously interrupted, the mine foreman shall order the men to withdraw immediately from the mine, and he shall not allow them to return to their work until the ventilation has been restored, and the mine has been thoroughly examined by him or by an assistant mine foreman or fireboss, and reported safe."

After the fan had stopped running on Saturday forenoon, and until it was in operation again on Sunday night, explosive gas must have collected in dangerous quantities.

The fact that the fan ran backward for a few hours, would not, as generally supposed, reverse the direction of the air currents in the mine, but simply decrease greatly the volume of air from that normally produced by the fan.

In the absence of direct evidence as to the direction of the explosion forces, which evidence might lead to the origin of the explosion, it is necessary to draw conclusions from what might be termed indirect evidence.

It has been established that this mine was gaseous and dust to the depth of several inches was found on the haulageway. From an inspection of the dust analyses sheets it will be seen that the average moisture content of the four samples of road dust is approximately 6% and the ash content about 21%, making the total average content of incombustible matter in the dust 27%. In relation to the fineness of the dust about 20% will pass through a 200 mesh screen.

From data obtained by the Bureau of Mines in connection with

the explosibility of Pittsburgh Coal dust at its Experimental Mine, it has been determined that Pittsburgh coal dust having similar characteristics as the dust from Renton Mine requires about 10% additional moisture to render it non-explosive.

Further inspection of the analysis sheets of the road dust will show that the average ratio of volatile matter to total combustible matter is approximately 36.6%, the average total incombustible matter being 27%. From data obtained from the Experimental Mine Tests made by W. L. Ege and G. S. Rice, Pittsburgh Coal dust, having the same analysis, would require about 72% additional incombustible matter to make it inert, or about 45% in addition to that which it already contains. It can be assumed, therefore, that this dust is explosive when raised in a cloud, mixed with the proper proportion of air and brought in contact with an open flame. This assumption is further strengthened by the great violence indicated in this explosion, which was undoubtedly a combined gas and dust explosion.

As there was no person shooting down coal or otherwise engaged in any work which would raise and ignite a dust cloud, the obvious conclusion is, that a body of explosive gas must first have been ignited, which raised and ignited the fine dust and thus propagated the explosion throughout the mine.

This conclusion having been formed the question remaining to be solved is that of the initial ignition of the gas.

In the mind of the writer, there were found but two bits of evidence which have any bearing on this subject. First:-the burned trolley wire which was found under a fall of roof on No. 1 Butt entry off of No. 14 face. Second:-the haulage motor, together with the body of Kuffer,

which was found on No. 3 Butt West South.

In considering the first of these possible causes, the burned trolley wire, the evidence shows that none of the bodies was found near a closed switch, that of Kuffer, the nearest, two hundred and fifty or three hundred feet away.

In order to initiate an explosion at the point at which the burned trolley wire was found, the fall which grounded the wire would have had to have occurred after the switch controlling the current in this part of the mine had been thrown in, this switch being one of those in that section of the mine in which Kuffer's body was found. Otherwise, whoever would have thrown the switch, presumably Kuffer, would have been found in very close proximity to it. As stated above, Kuffer's body was found quite some distance from the nearest switch. If the wire had been grounded previous to this time, the explosion would have occurred at the instant the switch was thrown in and whoever threw the switch in would have been found in the immediate vicinity, which is contrary to fact.

The above reasoning seems to definitely eliminate the fallen trolley wire as the means by which the body of gas might have been ignited.

In regard to the haulage motor found on No. 3 West South entry as being the primary cause of the explosion, the following facts should be considered. Although there is no direct evidence that this haulage motor had not been left in the entry in which it was found, when the mine closed down on the Saturday preceding the explosion, yet it would be contrary to general custom to leave a haulage motor standing on a Butt entry so far from the shaft during the time the mine was idle. Moreover, the evidence shows that at 3:10 A.M. Luteman, probably from the shaft bottom, called the power house for the third time stating



that he was going to close the switches; it also shows that the explosion occurred at 3:20 A.M., and that Luteman's body was found approximately one-half mile distant from the shaft-bottom. While it is possible, it does not seem probable, that he could have walked this half mile in ten minutes, especially in view of the fact that he was making an examination of the mine, and that he had probably inspected several rooms ahead of the one in which his body was found. The natural conclusion, therefore, is that he and Kuffer, not believing there would be any gas on the main bottom, (which was the main intake) rode the motor to the intersection of the North and East and West Mains where they separated, Luteman walking to the East Section of the mine and Kuffer taking the motor to the West Section. This theory seems to be strengthened by the evidence which shows that the switches which were found closed were on the route, probably taken by Kuffer on the motor.

Why Kuffer would take a trolley locomotive into a part of the mine which had not been examined for explosive gas can only be accounted for by the fact that as he was on the intake he probably thought the fresh air would have cleared out any gas which might have been standing there.

It is very probable that there was, however, a body of explosive gas in the entry which had accumulated during the time that the ventilation was stopped and which had not yet been removed by the air current. As the motor was travelling up the entry, the trolley sparked and ignited this body of gas. Kuffer's body was found wedged between the motor and the right hand rib and as the con-

trolley on the motor was closed it would appear ~~that~~ as if a comparatively small amount of gas was at first ignited, and that he had attempted to escape. Before he could get away, however, the flames had extended up the entry and ignited a larger body of gas. This raised a dust cloud causing an explosion, which lifted the motor from the track, pinning Kuffer between it and the rib. Nearly opposite this point is a breakthrough to Number 4 West South entry in which a pump had been located. After the explosion, this pump was found almost against the right hand rib of No. 3 West South entry and from this evidence and the fact that the motor and two cars were blown against the same rib it would appear that the explosion wave travelled down No. 4 West South and through the Breakthroughs, blowing out the stoppings as it went; when the wave reached this particular breakthrough, blew the pump, motor and cars against the rib of No. 3 West South entry.

That there was gas in this entry at this time is pretty well substantiated by the fact that a mine air sample, taken at this point after the explosion and when ventilation had been partially restored, when analyzed was found to contain 0.77% methane.

The conclusion of the writer, therefore, is that this explosion originated in the ignition of a body of explosive gas by a spark from the trolley of the electric motor which was being driven by Kuffer, and that it was increased in violence and intensity by the presence of a large amount of explosive dust.

It is also believed that Luteman was at fault in allowing any person, except the firebosses, in the mine before it had been thoroughly examined for gas; that in doing this he violated the Penna.

Bituminous Mining Law which expressly prohibits the entrance into a gassy mine by any person, except the mine foreman and firebosses, whenever the ventilation has been interrupted, until the same has been thoroughly examined.

However, in the opinion of the writer, the officials of the Union Collieries Company endeavored to employ the best and most responsible men attainable and tried to safeguard the lives of their employees.

#### RECOMMENDATIONS:

It is suggested to the management that in the purchase of new coal cutting equipment, the adoption of those machines which have passed the Bureau of Mines' tests and are commonly known as "permissible", be seriously considered.

As the mine grows larger and more rooms are driven, the writer believes that storage battery locomotives should be used for gathering purposes. The Bureau has already approved "as permissible" for use in gaseous mines one such type, and other types are under consideration by the Bureau.

All haulageways should be kept free from coal which is liable to be ground to a fine dust, and if possible either a systematic method of sprinkling should be worked out or the entries and ribs should be dusted with some incombustible material, such as rock dust, in order that the percentage of inert material mixed with the coal dust may be sufficient to render the entire mixture non-explosive.

For the purpose of sprinkling the mine in order to moisten the dust and thus reduce the hazard of a dust explosion, it might not be

impracticable to pump a supply of water into a tank on the surface; and from this tank to install a system of water lines two or two and one-half inches in diameter, having connections every three or four hundred feet for a  $\frac{3}{4}$ " or 1" sprinkling hose. One line on each pair of butt entries and a line along each main haulage road would probably prove sufficient. One or two reels of garden hose, each containing two or three hundred feet should be kept in the mine.

In some mines, instead of water lines, a sprinkling car drawn by a motor is used. To be effective, sprinkling should be systematically done as the ventilating current, especially in winter, tends to dry the moisture in the dust very rapidly.

In visiting a number of mines the writer has found that there is quite a good deal of misunderstanding relative to the amount of moisture required to render coal dust non-explosive. In some cases the mine officials believed the dust safe because the surface was slightly damp, although underneath the dampened surface the dust was quite dry.

In experiments conducted at the Experimental Mine of the Bureau of Mines, it was demonstrated that dust, passing through a 20-mesh screen, and 20% of which passed through a 200-mesh screen, and containing 27% of incombustible matter, will require about 23% moisture to render it non-explosive.

An average of the road dust samples taken from Renton No. 3 contained approximately 27% incombustible matter and about 6% moisture; 100% of the sample passing through a 20-mesh screen and 20% through a 200-mesh screen. Referring to the figures for moisture in the foregoing

Paragraph about 17% moisture would have to be added to make this dust inert.

In respect to rock dusting, the average amount of total incombustible matter contained in the four samples of road dust from Renton #3 was 72.91% and the average amount of volatile matter was 26.7%, or a ratio of 36.6%. The Bureau has found from actual tests that with dust similar to the samples obtained from Renton #3 it would require about 73% of incombustible matter to render the dust non-explosive or an addition of 43% to that already contained in the dust. These figures are based on the fact that there is no explosive gas present in the air. Where a quantity of methane is present the required amount of additional incombustible material would have to be considerably higher.

The use of rock dust barriers to limit the area traveled by an explosion is recommended to the serious consideration of the Union Collieries Co. Such barriers have been developed by the Bureau of Mines and have been found effective in extinguishing both light and severe explosions. Installation of barriers of this type have been installed in some of the mines in the Illinois fields and it is claimed that on several occasions serious explosions have been prevented.

Had such barriers been properly installed at Renton Mine #3 at the time of the explosion, it is reasonable to believe that the extent of the damaged area would have been considerably lessened; possibly confined to the west section of the mine.

If it has not already been done, provision should be made for some auxiliary power to operate the fan in case the electrical current should be shut off at the Duquesne Light Company's power house. If the contemplated connection with the high tension line of the West Penn Power Company is made, this contingency will have been provided for. However, there is a possibility that in an electrical storm both power lines

might temporarily be put out of commission. In that case the ventilation of the mine would be stopped and there would be no means of egress from the mine. This situation was well illustrated during the rescue work at the time of the explosion when all of the rescue crews were withdrawn from the mine for fear the power might be cut off by an impending electrical storm. The writer has been advised of a large mine in Indiana at which electricity was used for driving the fan, but the company had installed a small upright boiler and an engine which could very easily be connected to the fan in case of an emergency. It is believed that a similar arrangement, if possible, should be installed at Renton No. 3. It is true that the question of a water supply for a boiler at Renton is somewhat of a problem. But there is reason to believe that enough water for a small boiler can be obtained without great expense.

If it is not practicable to install a steam plant, it would be possible to provide an internal combustion engine which could be connected to the fan so that in case of failure of the electric power, the fan would not have to be shut down.

Whether or not an auxiliary steam plant is provided for the fan, the writer is strongly of the opinion that where hoisting and man shafts are wholly dependent on electrical power in order to bring the men out of the mine, an independent means of egress from the mines should be provided. That, it is believed, could be accomplished at Renton No. 3 by installing a series of ladders in the eastern end of the hoisting shaft as indicated on the attached Sketch "A".

The evidence shows that considerable difficulty was experienced in restoring ventilation owing to the fact that the partition wall dividing the air shaft into an intake and return had been badly wrecked.

This brings up an interesting point as to the advisability of constructing a shaft to be used for other purposes than ventilation. While it would probably have made no difference in this particular explosion, as the men would have lost their lives, no matter whether ventilation had been quickly restored or not, yet it is not difficult to imagine an explosion where the maintenance or rapid restoration of ventilation would be invaluable in saving life.

The Bureau has knowledge of perhaps a dozen explosions in mines having shafts of this type of construction and in each of which the dividing portion was blown out.

It would seem better practice to have the man and material shaft entirely independent of the ventilating. The writer recognizes the fact that this would add considerably to the first cost of the development, but it might be more economical in the end.

Some months ago an accident occurred at a shaft in Pennsylvania which caused the death of six men. A mine car filled with supplies fell several hundred feet down a shaft around the bottom of which the men were working. The cause of the accident, it is understood, was the fastening back of the safety blocks which had been provided to check the car in just such an emergency. The blocks being held back, the car was allowed to run unchecked over the edge and down the shaft.

The violence of the explosion at both shafts of Renton No. 3 Mine may have disarranged any similar safety device, and it would be a wise precaution if the mine officials would thoroughly inspect all safety gates, blocks, overwinds and safety catches on the cages, in order to avoid any future accident.

The writer recently inspected a large mine in the Pittsburgh District in which the names and numbers of each and every entry were painted on the rib or other convenient place in large white letters. These names and numbers exactly correspond with those on the mine map. The object being, in case of an emergency, to better enable a rescue crew to find their way around the mine; for in nearly every disaster, these crews are not absolutely familiar with the mine. To an outsider, Renton No. 3 Mine is a difficult one in which to find his way around unless accompanied by some one acquainted with it. And it is believed that if the above mentioned suggestion was carried out it would be of great assistance in any future emergency.

As has been noted, the distributing magazine is of wooden construction and is no doubt, merely a temporary structure. When replaced by a permanent distributing magazine, it is suggested that the building be constructed of a very lean cement mortar of about one part cement to six parts of sand. In the event of an explosion in or near a magazine constructed of cement mortar, there is no danger of large blocks of stone, brick or concrete being blown over the surrounding country. Complete details of a magazine recommended by the explosive section of the Bureau of Mines is given in Technical Paper No. 18 of this Bureau.



It is understood that the company has already employed an experienced man whose sole duty is to patrol the working sections of the mine for the purpose of detecting any dangerous body of explosive gas.

On account of the numerous oil and gas wells which are being drilled in this territory it is extremely important that a careful watch be maintained against live wells and especially that any wells which may have been drilled in the past and abandoned be accurately located and plotted on the mine map. Every precaution should be taken to see that any gas which may leak from these wells does not find its way through the strata into the mine. The Bureau of Mines has published in Bulletin No. 65 methods of protection from the dangers incidental to gas and oil wells.

ACKNOWLEDGMENTS.

The writer desires to acknowledge the assistance and courtesy of Mr. Calverly and Mr. Gould in placing at his disposal every facility in order to make this investigation. He also wishes that these officials would convey to Mr. Parker, the mine foreman, Mr. Johnson, the assistant mine foreman and to Messrs. Haas and Haddock, firebosses, his appreciation of their aid in accompanying him at various times through the mine.

Respectfully submitted,

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