## EXPORT OF EXPLOSION MININ AINE. MULTI COAL COMPANT. PROVIDENCE, WEBSTER COURTY, KANTACKY.

JULA 14, 1939.

By:

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### INDA

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## REPORT OF EXPLOSION INVIN MIRE. DUVIE COAL COMPANY. PROVIDENCE, WEBSTER COUNTY, KEMPUCKY. JULY 14, 1939.

About 7:20 p.m. July 14, 1939, an explosion occurred in the Davin Mine of the Davin Coal Company, Providence, Webster County, Kentucky, resulting in the death of 25 men.

At the time of the explosion there were 38 men in the mine; 33 of whom were in the explosion area, the other five were not in any way affected by the explosion, and in fact did not know of it until word was sent to them although they had felt a slight rush of wind.

of the 33 men in the explosion area, 19 were killed almost instantly by the explosion, 9 were sufficiented by afterdamp after making a vain attempt to seal themselves in by hanging curtains across the entries in which they were working, and five escaped. Four of the five who escaped received minor bruises and cuts. The 9 men who were sufficiented left notes stating they were still alive at 1:25 a.m. July 15, six hours after the explosion occurred; they would doubtless have been rescued alive had they exected good tight stoppings in place of the poorly installed curtains. The bodies of these nine men were reached about 1:30 a.m. in the morning of July 17.

The explosion was of limited extent and violence and is believed to have been due to the ignition of coal dust by the accidental detonation a quantity of permissible explosives while the shot firer was making up primers. The leg wires of the detonator had apparently come in contact with the rail which was on the return circuit for haulage locomotives, with exposed return wires in the splice of the cutting machine cable, or with some stray current.

No rock-dusting was being done at this mine and no water was being used at the face to allay dust.

The Bureau of Mines. Vincennes. Indiana received a telephone call from Providence, Kentucky advising of the explosion about 9:30 p.m.

C. A. Herbert left Vincennes about 10:30 p.m. by automobile, with gas masks and other necessary equipment, arriving at the mine about 1:30 a.m. July 15.

When he arrived at the mine deputy State mine inspectors Cobb and Fugate were on hand with the State-owned rescue truck carrying oxygen breathing apparatus and other mine-rescue equipment. About this same time John Damiel, Chief Inspector, and other deputy inspectors arrived.

L. H. McGuire and G. T. Powell of Norton, Virginia Station of the Bureau, arrived about 11:00 a.m. and A. U. Miller and W. O. West of the Vincennes Station arrived about 12:00 moon July 15.

McGuire, Powell, and West took an active part in the underground recovery operations. Herbert and Miller worked jointly with John Daniel, Chief of the Kentucky Department of Mines, in the general supervision of recovery operations.

#### LOCATION AND OWNERSHIP

The Davin Mine is located just outside the city limits of the city Providence, Webster County, Kentucky, and is owned and operated by the Coal Company of Providence. Mr. F. V. Buckman is president; Mr. D. J.

is general manager; Mr. A. J. Buckman is general superintendent; all

#### EXPLOYEES AND PRODUCTION

The Davin Mine is operated on two shifts and employs from 36 to 38 men underground on each working shift. At the present time it is producing 700 to 800 tons per day on the two shifts. All of the coal now being preduced is obtained from the driving of three pairs of development entries. After rooms are turned more men will be employed on each underground shift and the tonnage will be increased to approximately 1200 tons per day. Under normal operation a total of 140 to 150 men is employed on top and underground.

MINE OPERINGS

The coal bed is reached by a two-compartment hoisting shaft and a two-compartment air and escape shaft. One compartment of the latter serves as the downcast while the other is fitted with stairs to serve as an emergency means of ingress and egress in the event it is impossible to use the hoisting equipment at the hoisting shaft.

The two shafts are about 300 feet apart and approximately 180 feet in depth.

#### COAL BED

The Duvin mine is operating in the Number Rine bed of the West Kentucky Series and correlates with the Number Five bed of Illimois and Indiana. The coal is of bituminous rank and averages 4'-8" in thickness. At this location the coal has a dip to the north of about 3 feet per hundred feet. It is fairly free of impurities, except that it has the irregular bands of sulphur (iron pyrite) common to the coal of the central basin.

The roof is a dark gray shale and is generally good, except when approaching slips or faults.

The floor is a hard fire clay.

A composite of six face samples collected in an adjoining mine and analyzed by the Bureau of Mines, showed the following proximate analysis: Moisture 5.6; Volatile 37.2; Fixed Carbon 47.2; Ash 10.0; Sulphur 3.9; B.T.U. 12330.

#### METHOD OF MINING

The coal is mined on a room and pillar method with rooms 30 feet wide and 300 feet in depth. Boom pillars are 25 feet wide. Entries are 12 feet wide with 20 foot pillars between. The coal is undercut by Sallivan shortwall machines and loaded with Joy mobile loading machines. Hamlage is entirely by electric locomotives. At the present time only three pairs of development entries are being driven and all of the present tomage of seven to eight hundred tons for the two shifts is obtained with three Joy loading machines from these three pairs of entries.

The accompanying sketch shows the plan of room development that will be followed. It will be observed that only twelve rooms constitute a panel and that only two rooms are driven at a time. These are cut and shot and loaded alternately until they reach their distance, after which another two rooms are started. The Joy loaders load onto steel pan conveyors which in turn load onto a mother conveyor. The coal from the mother conveyor loads into a trip of cars on the entry. The trip of cars is backed into the entry and remains coupled to the locomotive which moves out as the cars are loaded. A total of nine to ten cuts is loaded out of the two rooms each seven hour shift.

A cutting machine is kept in each room so that it is only necessary to move it back clear of the loading machine after the cut is finished. The face erew consists of the two drillers who also do the shooting and shovel the bug dust; one cutting machine operator; one Joy loading machine operator; four general utility men who take up bottom, timber, lay track, or move conveyors; and a boss. The cycle of operation is as follows: While the loading machine is loading out one room the other room is undersut, drilled, and shot; the conveyor moved up and the posts set.

The drilling and undercutting are done at the same time. While the cutting machine operator is moving up his machine and sumping in, the holes on the opposite side of the room are drilled. After the machine has cleared the right rib the last rib hole is drilled. After undercutting is finished and while the machine runner is moving his machine back from the face, one driller shovels the cuttings back while the other prepares the shots. It requires less time to do the drilling than it does to undercut, with the result that it had been the practice for the shot firer to prepare his shots thile the cutting machine was still in operation and in close proximity to this machine.

After the cutting machine is moved back in the clear the place is shot. The loading machine is then moved into the place just shot and the drilling and cutting machine men start operations in the place just loaded out.

The cycle of operation at the present time during the driving of only narrow work is identical except that the coal is loaded into cars by the Joy loader instead of onto conveyors.

The mining machines have 6-1/2 feet cutterbars and therefore undercut approximately 6 feet. With crosscuts at sixty feet intervals and requiring three cuts the entries are advanced nearly 50 feet per day of two shifts, including the driving of crosscuts.

With the congestion that is inevitable with such speed of advance it is not believed possible for the work to be done with any degree of safety, no matter how careful the company may try to be. Where the operating company is apparently oblivious to the hazards inherent to the use of electrical equipment and explosives, and to the hazards of poor ventilation, certainly such operating methods are very much more hazardous.

Generally very little timbering is done on entries at the face workings except where alips or faults are encountered. Four rows of posts are carried in the rooms.

Three piece timber sets are used along the outby section of the haulage road where the slate roof has broken. These appear to be poorly set in many places and many of the collars are broken and should be replaced.

VENTILATION

The mine is ventilated by a Jeffrey double inlet fan operated blowing and is so designed that the air current may be reversed. The fan is approximately 4' x 10' and is belt connected to an electric motor. The fan is delivering approximately 50,000 cabic feet of air per minute.

There is only one split of air. The intake air passes through old workings for a large part of the nearly two miles from the shaft to the face workings. Wood stoppings between the intake and return are used throughout the mine and the sajor part of air being delivered by the fan is lost before the active workings are reached. Following the explosion, after ventilation had been restored, and after considerable work had been done to repair air lasks, only 4000 cubic feet of air was measured on the 7 main aircourse at the approach to the explosion area. Doubtless considerably less air than this was being circulated before the explosion.

The mine is rated as gaseous by the State Department of Mines, although it does not generally liberate very much methane except when approaching faults or slips, at which times strong gas feeders are sometimes encountered.

1 10

The mine/examined before the day shift enters, by the section bosses who start to work an hour and a half shead of the day shift. Hack section boss in charge of the loading units is required to carry a flame safety lamp and is supposed to examine for gas during the working shift.

Key-locked flame safety lamps are used.

A sample taken on the 10th main at a point just inby where the air enters the old workings and at which point the full return for the explosion area could be obtained, gave the following results:

Semple ∲ 64603 64604	002	02	0.24	II2_
64603	0.23	20.37 20.39		79.16
64604	0.22	20. 39	0.24	79.15

It will be observed that the methane content is only .24 of one percent although the intake air passes through old workings before reaching the section where the sample was taken.

#### KAULAGE

The haulage is entirely mechanical. Trolley lecomotives are used on the main haulage and combined cable, reel and trolley lecomotives are used for gathering.

Sars are of wood construction of the endgate type and have a capacity of approximately two tons.

The cars are hoisted on self-dumping cases by a steam hoisting engine with step-up dram.

The track guage is 42 inches.

Trolley wires are unguarded throughout and poorly hung. The same is also true of the feeder cable which parallels the trolley wire.

Hamlage roads are on the return air and are extremely dirty.

The dirt is piled up so high on the sides in some places that it is continuously sliding down onto the rails where it is ground up into powder, with the result that the rails are entirely hidden in places.

Most of the crosscuts along the hanlage roads, which are ordinarily used as shelter holes, are at least partly filled with refuse.

The track is laid with 30 to 40 pound steel and is very uneven and rough.

#### PICHLIMO

The men all use Mison Model K electric cap lamps. A few incandescent lamps connected to the trolley circuit were observed at the shaft bottom and inside parting, but mone along the hemlage road.

All flame safety lamps are of the key-locked type.

#### MACHINERY UNDERGROUND

The machinery underground consists of trolley main line lessmotives, cable, reel and trolley gathering locomotives, Sullivan shortwall
undercutting machines, three Joy mobile loading machines, motor driven
pumps, blower fans for each Joy loading machine unit and two motor generator
sets. All of the above equipment, with the exception of the motor on the
motor generator set, are operated on 250 volts direct current and all are
of the non-permissible type. The motors on the motor generator sets are
operated by 2300 volt alternating current brought to the motor by cable
through bore holes from high tension lines on the surface. One motor
generator set serves the main line hamlage from the inside parting to the
shaft bottom. The other serves all the equipment from this parting inby.

Power lines are on the return and are poorly bung and maintained, and present not only a shock hazard but a fire hazard as well.

Frailing cables are spliced in the mine and splices are poorly made. Splices in which the bare wires of the return circuit could be seen through the tape, were observed.

It is doubtful if inspections of any equipment are made as long as it continues to operate and then it is merely patched up.

#### **EXPLOSIVES**

Only permissible explosives in 1-1/4" x 8" cartridges are used underground. These are fired with electric detonators by shot firers at any time during the working shift.

At the time of the explosion only narrow work was being driven and three shots of two to three sticks of permissible each were being used to shoot the face.

One of the two drillers in each pair of entries acts as the shot firer and as soon as the place is undercut and drilled it is shot. It was apparently the practice for the driller to make up the primers in close proximity to the drill and cutting machine while they were in operation, whenever he had a moment during which he could be spared from the operation of the drill.

In most instances the shots were being stemmed with dummies filled with rock-dust.

The shots are fired one at a time using either the non-permissible type shot-firing attachment for Edison cap lamp batteries, or, in the case of the shot firer who doubtless caused the explosion, a single flashlight battery was being used.

It has been the practice to boul the explosives and detonators into the mine in their original containers in the empty trips without any precautions being taken to insulate the cars in which they were placed.

The detorators are received in wood boxes, each containing ten paper cartons of 50 detorators each.

The explosives station from which explosives were taken for the last and 2nd right entries, where the explosion had its origin, was located in a crossout between the 5th and 9th mains a short distance outby the two right hand entries. Lying on the floor were six paper cartons of detonators, each containing 50 detonators; an open box about three-fourths full of explosives; and in the 9th main about 10 feet distant there were the remains

of what had probably been to nearly full boxes of explosives. One box had burned completely up and about 50 or 75 sticks were lying scattered around some of which had been charred by the heat.

The explosives station for the 9th and 10th main entries had been located in the third crosscut back from the face and here also the explosives and detonators had apparently been placed together on the floor, as at least 100 detonators, some of which had exploded, and as many sticks of explosives, had been scattered along the 9th main by the force of the explosion.

with as little regard for the safe handling and use of explosives as was very evident at this mine, it is little wonder that an accidental detonation of a quantity of explosives should have taken place with disastrous results.

#### DRAIHAGE

Generally, the mine is dry and dusty. However, where familts are encountered usually some trouble is experienced with water as well as with gas. At the present time the 9th and 10th main entries have cut through a fault and are making considerable water.

When encountered, the water is pumped through drill holes to the surface by electrically operated pumps.

#### WST

The mine is generally dry and dusty except in the vicinity of alips or faults where considerable water is at times encountered.

At the face workings the dust on the roof, ribs, and floor, is nearly pure coal. On the hamlage roads the percentage of incombustible increases materially with the distance from the active workings. This is due to several factors, namely, to the fire clay bottom which softens upon exposure to the air; to spawling of the shale roof; and to the fact that the hamlage road generally has a three percent grade against the loads from the face to the shaft bottom requiring the use of large quantities of motor sand. About 50 tons of motor sand per month is used at this mine.

The cars are not topped to any extent and apparently there is little coal spilled along the haulage roads. Samples of roof, rib, and road dust were collected and the incombustible determined by means of the volumeter, as follows:

Sample	Location	Incombustible
1. Road dust	On 11 & 12 haulage road outby 11 NW Mais.	65%
2. Rib dust	same as above.	34%
3. Road dast	10th Main 300' inby NW Mains	10%
4. Rib dust	same as above.	95
5. Road dust	13 NW Main outby 10th Main	<i>37</i> %
6. Rib dust	same as above.	33%

#### HOCK-DUST

At the time of the explosion no rock-dusting was being done except that rock-dust filled dummies were being used for stemming.

This Company however, was one of the first to purchase a rock-dust distributor in this field and at one time kept the hamlage roads clean and well rock-dusted.

Since the explosion it is understood that the haulage roads have been cleaned and rock-dusted.

#### PIRST-AID AND MINE-RESCUE TRAINING

In years past considerable first-aid training has been done for this Company by the Eureen of Mines. Several mine-resone teams had also been trained but of recent years no interest had been taken by the Company officials in this work.

The Company does not have any resons equipment but does have access to the State-owned resons station located at Madisonville, Kentucky.

SAFNTY ORGANIZATION

The Company apparently has taken little interest in safety, as no safety organization of any kind is maintained, neither do they employ a safety engineer.

#### SUPERVISION AND DISCIPLINE

The supervisory force at this mine is apparently ample if the supervisors devote the necessary amount of time to looking after the safety of the men rather than to spend all of their time in trying to push the output of coal regardless of safety.

the

Each Joy leading machine unit is in/charge of a foreman on each of the two working shifts and he does not, therefore, have over mine or ten men to supervise. In addition there is a mine foreman. Mr. F. V. Buckman, President, and Mr. James Buckman, a nephew of the president, spend the greater part of their time underground and serve in the capacity of superintendents.

It is believed the men would be very amenable if they were given the proper directions.

#### MINE CONDITIONS IMMEDIATELY PRIOR TO EXPLOSION

Weather conditions had been normal prior to the explosion, with no sudden changes in barometric pressure. The mine had been in continuous operation for several days and was in operation at the time of the explosion. The fan had been in continuous operation and nothing unusual to the regular operation of the mine had occurred which might have been a contributing factor to this explosion.

#### PREVIOUS EXPLOSIONS AT JUVIN MINE

On April 27, 1926, an explosion of gas and dust occurred in this mine in which one man, the fire boss, was killed. The explosion was confined to the one entry in which it originated and did very little damage. At that time the mine was operated with open lights and it is supposed the fire boss, contrary to orders, had carried a carbide lamp in addition to his flame safety lamp and had maked into a body of gas and ignited it with the carbide lamp. A carbide lamp was found mean the body.

On June 14, 1939, just three months prior to this last explosion, a mining machine cut into a feeder of gas and the gas was ignited by the cutting machine. One of the machinemen received fatal burns, while the mine boss who was in the room at the time, and a second workman, were slightly burned.

#### PROPERTY DAMAGE

Very little damage to the mine or equipment resulted from this explosion. Probably two thousand dollars at the outside would repair all of damage that has been done.

The mine could probably have been restored to as good condition as it was in prior to the explosion in two or three days.

#### STORY OF THE EXPLOSION

About 7:30 p.m. July 14, 1939, a telephone message was received by the top foreman from a triprider on the number three, or inside parting, advising that there had been an explosion and that it had apparently come out of the main entry section. The men working on the shaft bottom felt a slight rush of wind but did not realize there had been an explosion.

At the moment of the explosion the triprider was standing near the telephone on the inside end of the parting. He states that there was a rush of wind and dust followed by smoke, but that he saw no flame and although he was knocked down he did not receive any injuries. After notifying the top foreman of the explosion he attempted to go up into the 13th and 14th entries to warn the nine men who were working in that section, but

was unable to do so because of the smoke.

then went to the cutby end of the No. 3 parting to assist the two men he knew were at this point. He found these two men in a dased condition from the smoke and from being knocked down by the explosion and helped them to the telephone on the inby end of the parting. He again called the top and asked what he should do as they could not stay where they were any longer. By this time Mr. F. V. Buckman had arrived at the mine and teld him to help the two men out through the 13th and 14th entries to the No. 2 parting and through a trapdoor to some old workings where they would be safe and to wait there for a car and locomotive which were being sent in for them. It was possible to use the main line haulage as it was on a separate circuit from the inside workings.

In the meantime a motorman who had been on his locomotive on the lith north west parting entry near the junction with the lith hamlage road, made his way out the lith and 12th entries to the No. 2 parting and thence to the shaft bottom. A trip of empties was standing in the lith hamlage road making it necessary for this man to crawl over heavy fails in the 12th entry to get to the parting. A second motorman was on his locomotive at the out end of the empty trip on the lith. He was not affected by the explosion but said he saw sparks of fire at the junction with north west parting entry.

He saw the smoke coming towards him so he blocked the wheels of the outby cars of the trip, disconnected his locomotive and started for the shaft bottom on the locomotive.

The five other men in the mine included the two cagess and three men on a main line trip approaching the shaft bottom.

Although considerable time elapsed between the occurrence of the explosion and the rescue of the three men by motor trip from the Mo. 2 parting, they were in no way affected by the smake and fames, although they were on the return side. The reason for this is, the explosion had largely short-circuited the air from the explosion area and, in addition, the return was apread out through old workings and the velocity of the return air very much slowed up. However, by the time the rescue trip got to the Mo. 2 parting the fames were getting very noticeable, although they had not penetrated into the old workings where the three men were waiting.

Approximately fifty thousand feet of air are being delivered by the fan and prior to the explosion it is probable that only 3 or 4 percent of this quantity reached the face workings, the balance being lost by air leaks between the intake and return aircourses. As a result of this amount of leakage the outby portion of the return was diluted to such an extent that it was at all times possible to use the hoisting shaft during the recovery operations.

Incaddition to the ten men who escaped, above emmerated, there were 19 men in the 7th. 5th, 9th, and 10th main entry section where the explosion occurred, and nine men in a pair of left entries being driven off the 14th.

Ford of the explosion was received at Vincomes by telephone from Providence about 9:30 p.m. C. A. Herbert notified the Washington, D. C., the Pittsburgh, Penna., and Norton, Va., offices of the Bureau and also communicated with A. U. Miller who was at Belleville, Illinds at the time.

teams of the Princeton Mining Company, Princeton, Indiana, and knowing there were no properly trained teams in Western Kentucky capable of wearing oxygen breathing apparatus, Herbert decided on not taking the rescue truck with its equipment. Instead, he left Vincennes for Providence about 10:30 p.m. by automobile, taking with him gas masks, safety lamps, carbon monoxide detectors, etc.; arriving at the mine about 1:30 a.m. July 15.

L. H. McGuire and G. T. Powell of the Norton, Va. station arrived about 11:30 a.m. July 15. and A. U. Miller and W. O. West of the Vincennes Station arrived at the mine shortly after 12 noon July 15.

James Pugate and Lindsay Cobb, Deputy Mine Inspectors, arrived at the mine about 9:30 p.m. with the State-owned rescue truck and equipment from the Madisonville, Kentucky station. James Pugate, with a crew of volunteers from this and neighboring mines immediately went below. This crew was equipped with six gas masks, flame safety lamps, and carbon mono-xide detector.

By this time the afterdamp had found its way out the haulage road a considerable distance, making it necessary to travel the intake aircourse

a large part of the way. This was next to impossible because of falls and water which in places was within 15 inches of the roof.

It took this first crow nearly three hours to make its way from the shaft bottom into the explosion area. By the time they arrived inside to where evidence of the explosion could be observed, the air in the 7th and 5th mains had begun to clear to such an extent that it was possible for the crew to work their way in as far as the 1st and 2nd right off the 7th main. The bodies of a number of the victims were located and it was obvious that the explosion had originated in these entries and that all of the 19 men were dead.

It was then decided to delay further rescue operations in the 7th, 5th, 9th, and 10th main entry section and to attempt to carry air into 13th, and 14th entries in the hope that the mine men who were working in a pair of left hand entries off the 14th might have had time to seal themselves off and might still be alive. To this end curtain brattices were hing in crosscuts between the 11th and 12th north west main or parting entries. By the time the rescue crew reached the 13th and 14th entries however, the air was all lost and in attempting to push their way into the 13th and 14th entries, several members of the party were partly overcome by carbon monoxide that had been leaking through the curtain brattices behind them and nearly lost their lives before they could get back to fresh air.

a greater volume of air and that the only way this could be obtained was to replace the curtain brattices with tight wood stoppings. Because of the next-to-impassible condition of the intake aircourse, the only way material could

be taken in for these stoppings was by the hamlage road, and in order to use this road it was of course necessary to reverse the fan.

After a consultation between members of the State Inspection Department and representatives of the Euresa of Mines it was decided to reverse the fam.

The fan was reversed at 4:00 p.m. on the 15th and it took until 1:30 a.m. the 17th to build the wood stoppings and to carry the air into the left hand entries off the 14th where the bodies of the nine men were found.

These men had hing curtains across the left hand entries in a futile attempt to keep out the afterdamp. The curtains however, were poorly hing and were of little benefit. Despite this fact, the men were still alive at 1:25 a.m. six hours after the explosion, as was evidenced by notes they left. Had they built good tight barricades by using brattice impler that was at hand, they would unquestionably have lived until the rescuers reached them.

After the bodies of these nine men had been removed the three northwest main, or parting, entries were scaled off near the 10th main and the main entry section was ventilated. The nineteen bodies in this section were then removed and recovery operations completed by one o'clock the morning of the 18th.

An official investigation was made by the State Department of Mines on July 24. W. H. Tomlinson and G. T. Powell of the Bureau were present at this investigation.

On July 30 C. A. Herbert, W. O. West, and P. P. Senio, visited the explosion area in order to verify some of the notes taken by Mesurs.

Powell, McGuire and Tomitason during the recovery work and the subsequent investigation.

From the information obtained during the recovery work and esbsequent visits to the explosion area, it would appear certain that the explosion had its origin near the face of the 1st right entry off the 7th
main entry.

The direction of force was outby on the lat and 2nd right hand entries. On the main entries the force of the explosion went both into and outby from these entries.

Strong gas feeder and lighted the gas issuing from the kerf. This gas ignition resulted in the death of one man and the serious burning of two others. Because of this recent experience and because the let and 2nd right entries were approaching a fault it was surmised that this explosion might have been due to a similar occurrence.

At first inclined to try and fit the egidence to the preconceived theory of an ignition of gas by the cutting machine as the initiating cause of the explosion. They gave up this theory however, and were finally unanimous in the belief that gas did not enter into the explosion; that it has purely a dast explosion, and that the ignition of the dust was due to the accidental explosion of a quantity of permissible explosives.

The reasons for this conclusion are: 1st, no gas had been detected in these entries prior to the explosion; no gas was found in these entries by the recovery crews following the explosion, although there had been no air circulating in them from 7:20 p.m. Thursday evening until Monday morning. It would seem almost certain that if the cutting machine had cut into a gas feeder and liberated enough gas to have been ignited by the cutting machine, some gas would have been found in these entries by the rescue crews.

and who had apparently been shoveling bug dust behind the machine, was found face downward with his face in his hands and his head as nearly in the kerf as he could get it. If the flame had come out of the kerf he unquestionably would have thrown himself away from the kerf instead of towards it. In addition, he was not very badly burned and certainly he would have been had the flame come from a feeder in the cut.

There had been six men at the face of the let and 2nd right entries and of these, only the body of the shot firer was mutilated. His left leg had been blown off at the hip and blown 30 feet out the entry. The Mison cap lamp battery he had been wearing was blown to pieces. Some of the parts had been blown outby while the cable and part of the head piece were found on the cutting machine. The box in which he carried his supply of explosives and detonators could not be found, apparently having been blown to pieces.

A number of primers with the shorting clips removed from the leg wires were found near the face, also a number of extra detonators.

It was apparently the shot firer's practice to make up extra primers in advance whenever he had a little time and to also keep a large enough

supply of explosives and detonators at the face to run him through the shift. This dengerous practice was almost necessary on his part in order to keep up with the rapid cycle of cutting, drilling, shooting, and leading operations that was being maintained. Under this cycle a place was being cut, drilled and shot on an average of every 45 mimutes. Taking from this the time consumed in moving the Joy leading machine from one entry to the other; also in moving the cutting machine and setting up the drill, it did not leave very much time for one of the drillers to make up the shots and to lead, temp, and fire the shots.

handling of the explosives. If it had been his practice to remove the shorting clip from the leg wires of the detonators before placing the primers in the shot hole, it is very possible for the wires to have come in contact with a stray current or to have contacted the rail carrying the return circuit of the haulage locomotives, or to have contacted one of several poorly made splices in the trailing cables.

#### RECOMMENDATIONS

#### Operating Nethods

1. While undoubtedly there is such to be said in favor of a reasonable amount of concentration of work in a mine, thus permitting closer supervision and increasing efficiency of operation, but it is also possible to overdo it and thereby greatly increase the hazards of operation. It is believed that at this mine the work had been so concentrated that it is difficult to operate with a maximum of safety. It is therefore recommended that the cycle of operation of the crews constituting a leading machine unit, be spread out over enough additional working places to permit each phase of operation to be carried on safely and properly without interfering with the

work and safety of the men engaged in some other phase of operation.

It is not believed safe for a cutting machine crew and a drilling machine crew to both be working in a twelve foot entry at the same time. Neither is it believed safe for a shot firer to prepare and fire shots in close proximity to power cables and electrically operated machinery. Neither of these practices would be necessary if the work were spread out more. At the same time, a less concentration of work would also permit closer inspection of the roof and give time to do any timbering found to be necessary, or to take down any loose rock. It would also permit the tracklayers and brattice men to work with a greater degree of safety and efficiency.

In order to spread the work out more at the present time while only narrow work is being driven it would doubtless be necessary to purchase more equipment and start up additional narrow work and then to move the crews from one pair of entries to another. While there would of course be some delay in moving the crews from one pair of entries to another, it is believed the time thus lost would be made up by greater efficiency while the crews were at work because of less congestion.

#### Ventilation

1. One of the contributing factors in the loss of the nine men who were suffocated was the fact that the haulage road, the one means of ingress and egress, was on the return. Had this road been on the intake these nine men could have doubtless made their escape, or at least the rescue crews could have reached them in a very short time. It is recommended

therefore, that the ventilating current be reversed so agto make the houlage road the intake.

- 2. It has been the practice at this mine to use wood stoppings throughout. These have deteriorated and are leaking to such an extent that a very small percentage of the air being delivered by the fan is reaching the active workings where it is needed. All wood stoppings along the main hamlage road should therefore be replaced with tight masonry or concrete stoppings.
- workings and the small passageway for the ventilating current, it would be in the interest of safety and efficiency if an additional air and escapement shaft were suck near the face workings; the face workings being ventilated by a fan at this shaft while the haulage road and the old workings would be ventilated by the fan at the present airshaft. The new air and escapement shaft should have an upcast and a downcast compartment. The downcast compartment should be equipped with an emergency cage and hoist, while the upcast compartment should be connected to the exhaust fan.

4. At the present time small blower fans are being used in each pair of entries now being driven. These are so set that they merely recirculate the air and their use would be entirely unnecessary if there was enough general ventilation to carry off the smake following shooting.

Fans of this type have been responsible for a number of gas ignitions and explosions and their use should be discontinued at once.

5. Due to the rapidity with which the entries were being driven at this mine and the congestion on the entries during the two working shifts, the building of stoppings or otherwise closing of the crosscuts between the intake and return, was being neglected, with the result that it was the

neglect should be stopped at once and only the last crosscut next to the face should be left open. Unless this is done it is almost impossible to properly ventilate the face of the entries and prevent the accumulation of gas should a feeder of gas be encountered.

- 6. Only key-locked flame safety lamps are used at this mine. In the past a number of disastrous explosions have been attributed to the disastembling of this type of lamp in the presence of gas, in order to re-light them. It is for this reason that the Bureau of Mines recommends the use of only permissible magnetically-locked flame safety lamps.
- 7. The flame safety lamps of the two section foremen in the explosion area were found back some distance from the face, showing that they were not carrying them with them at all times as they should have been doing.

#### Electricity

- 1. The trolley wires and feeder line along the heulage road are poorly hung and unguarded their entire distance, although they are selden more than four and one-half feet above the rail. They should be properly hung at a uniform distance outside the rail; should be guarded at least at points where men are obliged to cross under them, and preferably their entire distance.
- 2. Trailing cables of the concentric type are used and splices were observed in these cables in which the outer or return wires could be seen through the tape.

Whenever it is necessary to splice a trailing cable underground the splice should be carefully made and well taped. At the first opportunity a cable on which a temporary splice has been made should be replaced and the cable sent to the shop where a permanent splice can be made and the rabber sheathing vulcanized.

3. The Bureau of Mines recommends that all electrical equipment used in a coal mine, except that used on strictly fresh intake air be of the approved type. It is suggested therefore, that all electrically operated machinery that may be purchased in the future be of this type.

#### Explosives and Blasting

The transportation, handling, and use of explosives at this mine are marked by extreme carelessness. In part, this may be attributed to the rapid cycle of face operation. It is recommended that:

- 1. Only one day's supply of explosives and detonators be taken into the mine and that they be taken into the mine in an enclosed insulated car.
- 2. That the day's supply of explosives for each loading unit be atored at a convenient point, as far away from all electrical circuits as possible.

That the explosives be kept in a strongly constructed wood box with lid and lock.

That the detonators be stored in a locked receptable in a nitch in the coal rib at least 30 feet from the explosives box, and that only the shot firers have keys for the receptables in which the explosives and detonators are stored.

- 3. That the shot firer be provided with separate insulated carrying cases for the explosives and detonators and that only enough explosives and detonators be taken to the face for the holes to be shot. After these holes are the shot the surplus should be taken back to the storage receptables.
- 4. Primers to be made up at the face for each shot hole as it is loaded and that the shorting clip be kept in place until ready to connect up the leg wires.
- 5. No explosives should be taken to the face of a place to be shot while electrical equipment is in operation at the face or while power is connected to any such equipment.
  - 6. That only permissible shot-firing units be used for firing shots.
  - 7. That only non-combustible stemming be used in all shot holes.
- S. That the shooting cable be kept short-circuited until ready to connect with the shooting device.
- 9. That blasting be done only at the end of the shift after everyone except the shot firers are out of the mine.
- 10. That the shot firer be required to test for gas before and after firing each shot. No shot to be fired in the presence of emplosive gas.

#### Cleaning Roads and Rock-Dusting

- 1. That all readways be thoroughly cleaned and all refuse now piled along the sides of the roads be leaded up and taken out of the mine.
- 2. That crosscuts along the hamilage roads be cleaned out to provide shelter holes at intervals not exceeding 100 feet.
- 3. That all roadways be thoroughly rock-dusted and re-dusted at intervals in order that the incombustible content of the roof, rib. and road

dusts passing through a 20-mesh screen be maintained at not less than 60 percent.

The rock-dusting should be maintained as close to the working face as practicable.

#### Timbering

- 1. That all broken crossbars along haulage roads be replaced.
- 2. The crossbars should either be hitched into the ribs or the lege supporting the crossbars should be set back tight against the ribs to give the maximum of clearance and to make them less likely to be knocked out in case of a wreck along the hamlage road.

#### Mine Track

1. The main line track should be realigned and retied in many places. In fact, most of the main line track should be relaid with heavier rails.

#### Supervision

I. While there appears to have been an ample number of supervising officials underground, yet, the supervision was apparently very lax as far as safety in operation was concerned. In addition, it would appear that general supervision was lacking during the second shift, as the mine foreman, the superintendent and the owner Hr. F. V. Buckman, are generally at the mine only during the day shift. It is recommended therefore, that a general underground foreman be employed during the second shift as well as on the day shift.

#### Water at the Face to Alley Dust

Water should be applied to the mining machine cutterbars to allay dust during undercutting. In addition, after the coal has been shot and before loading of the coal begins, the broken coal as well as the roof and ribs at the face should be thoroughly sprinkled. This will not only largely remove the coal dust hazard at the face and prevent the

leaking of fine coal dust through the cracks in the cars during transit, but will also tend to increase the efficiency of the men at the face. (See Technical Paper 593 for description of methods.)

This mine some years ago was maintained in excellent condition. At that time the coal company was making some money. Of recent years it has become increasingly difficult for mines in the Central Coal Field to operate at a profit and this is particularly true of mines in Western Kentucky because of the additional freight rate from this field to the northern markets.

Therefore, in order to keep operating, this company has neglected to maintain the mine as they formerly did and as it should be maintained in order to be operated with reasonable safety.

Fo further cut down cost the company was not carrying any compensation insurance and it is therefore doubtful if they will be in a position to pay anything to the dependents of those killed, as they are practically insolvent.

In the Appendix following will be found statements of observations by Bureau personnel made during the recovery work and subsequent visits to the mine; also maps showing the explosion area of the Duvin Mine.

Respectfully submitted.

Amervising Engineer.

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#### LETTER REPORT OF ACTIVITIES OF PERSONNEL OF NORTON STATION AT RECENT MINE EXPLOSION DUVIN MINE, RUCKMAN COAL COMPANY, PROVIDENCE, KENTUCKY

The writer in company with Mr. G. T. Powell left this station at 11:30 p. m. on the night of the explosion, July 14, 1939, after first determining from Mr. G. W. Grove whether or not a rescue truck was on its way from Vincennes, Indiana, Station. We arrived at Providence, Kentucky at 11:30 a. m., July 15, after covering 427 miles from Norton Station, and immediately contacted Mr. C. A. Herbert, who had arrived at 1:30 a. m., July 15, 1939. After going over the situation we found that there was an exploration crew headed by James Fugate, District Mine Inspector, that had gone in about 10:00 p. m. the night before and that this crew had reported in at 9:15 a. m., July 15, by telephone and had not been heard from since. They stated that 19 men were dead in the section of the mine in which the explosion originated in 4 North Main because of the signs of destruction, and ll bodies that they found, 10 of them being in 1st and 2nd Hast off 7 North Main, and the 11th body approximately 400 feet inby from No. 3 parting on No. 10 North Main. They were unable to penetrate much beyond land 2 Right off 7 North main along the four straight main entries known as 7, 8, 9, and 10 because of the high percentage of CO present, but were certain that there was no one that could possibly be alive at the faces of 9 and 10 North mains because of the violence in that section of the mine.

They then proceeded back to No. 3 parting entries known as 11, 12, and 13 N. W. mains and proceeded down 11 N. W. entry bratticing as they proceeded to carry the air with them in the hopes that they might get to the 9 men who might be barricaded and rescue them. They

were able to get down to the third breakthrough on 13 Right off 13 N. W. (No. 3 parting) by bratticing when the CO drove them out. They were then approximately 150 feet from the entries in which the 9 men were supposed to be barricaded and when they returned to the telephone situated at the intersection of 11 N. W. parting entry with 13 Right, reported in at 9:15 a. m., July 15. While making this last exploration, James Fugate, James Wilson, and James Cluster almost lost their lives by CO. The CO detector that the state had was defective and because of high percentage of CO (0.3% every place I tested on the CO detector later) in the old workings on all sides and leaks from temporary stoppings behind made the air foul that they were traveling in, causing the crew to become somewhat saturated by long exposure. They could not make it back the way they came in so had to return through the old workings and arrived at the surface at about 3:00 p. m. Saturday, July 15, so completely exhausted that most of them had discarded their electric cap lamps on the way out.

In the meantime, Mr. C. A. Herbert, Mr. John Daniel and I had gone over the maps which were incomplete beyond the new parting entries and decided since the distance was approximately 2 3/4 miles from the shaft bottom to where the recovery work was located that after the men were all out it might be best to reverse the fan, placing the haulage road on intake air instead of return air so we could gain about 1 3/4 miles in carrying supplies by motor instead of hand power to facilitate the rescue and recovery work. After all the crew was out, the fan was reversed at 4:00 p. m. exhausting under direct orders from Mr. John F. Daniel, Chief, Department of Mines and Minerals, State of Kentucky, in the presence of Mr. C. A. Herbert, Mr. L. W. Huber and me.

After waiting 30 minutes Mr. G. T. Powell, Mr. L. W. Huber of

Mine Safety Appliances Company, Mr. W. E. Wheeler, State Mine Inspector, Mr. W. O. West, Bureau of Mines, Vincennes, Indiana, and party went down the shaft at 4:45 p. m. with instructions to nail and wire trap doors shut and carry the ventilation ahead as far as they could along the main haulage road from the shaft bottom down 13 and 14 Right off No. 2 parting and then cut the trolley wire and return feeder, and return to allow the next crew to proceed with supplies to carry the ventilation ahead. Mr. G. T. Powell and crew returned at about 8:15 p. m. and reported that they had advanced far as 13 Right off the No. 2 parting entries down 13 Right about 450 feet. The air would not move down 13 and 14 Right entries because of large falls and 1 canvas stopping placed across 13 Right by the first exploration crew at the junction of 11 N. W. main with 13 and 14 Right. The distance, 1600 feet, was too great to go ahead and tear down the canvas stopping blocking 13 Right with either breathing apparatus or gas masks so it was decided to come out and talk things over. The CO content indicated 0.3% at this point on my detector. There were old workings on both sides of 13 and 14 Right or a total of 108 rooms turned off which were loaded with CO and connected to 13 and 14 Right. There were also 108 rooms turned off 11 and 12 Right plus 32 more rooms turned off No. 22 which were all loaded with CO and connected with the haulage entries.

After Mr. Powell warned me on the CO situation in the old workings it seemed to all of us the best plan would be to proceed down 9 and
10 Main air course entries, walking and packing brattice canvas, timbers
and supplies necessitating building only 6 stoppings to cover 2,000 feet
to the new No. 3 partings 11, 12 and 13 N. W. mains as there were solid
pillars on the left side of number 10 North main in between the 6 stoppings

that would have to be built.

The leaders in our crew were Arthur Wilson, Ed Starling and I and with 20 men, brattice canvas, timbers, lumber, gas masks, nails, hammers, saws, 3 CO detectors, 1 flame safety lamp, etc., we went down at 9:00 p. m. I had the trip stopped on the 45° haulage road, which was through old workings on both sides, to inspect the board stoppings before coming out on the 4 straight mains as I noticed we didn't have much air and there was danger of "afterdamp" backing up with the presence of some gas. I noticed several bad leaks in the old wooden stoppings but didn't find any doors open. After walking ahead about 300 feet and carefully testing for CO and gas, the trip was allowed to proceed up to where we were. By steps in this manner the trip moved up to within about 1400 feet from where Powell and crew quit. We found the same situation as Mr. G. T. Powell had reported previously so dropped back and placed two good board stoppings covered with canvas across both of the old No. 2 parting entries near No. 10 North main entry, cut the trolley wire and return feeder, and kept an experienced responsible man there with a CO detector, after properly instructing him in its use as the CO would back up as much as 50 feet in a few minutes. Mr. C. A. Herbert called my attention to this just before going in with crew. Considerable pressure from the old workings did develop afterward against these seals. Since we were working ahead and only had between 600 and 800 cubic feet of air per minute I knew very well if the stoppings were not well built we would have a leakage on the air we were using which would endanger ourselves as the CO indicator showed 0.3% after 10 squeezes, using a fresh tube in the old workings. This man was to warn us if the stoppings leaked so we could get out or repair them.

We proceeded ahead then to where rooms 13 and 14 were necked through into No. 10 main discovering gas behind one fall in No. 10 main air course which gave a 1/2" cap, but found no CO along the air course. The men were then brought up after everything was made safe to erect these stoppings. We did an excellent job here and posted a man with a CO detector to warn us if any infiltration took place. Two notes were sent out at 2-hour intervals. At rooms 21 and 22, which were necked through into # 10 air course, there was very little air movement and 0.3% CO. Since the first crew had erected canvas stoppings across the ends of these entries at No. 3 parting 11 N. W. main we knew that the only air circulating was due to short circuiting from leaky stoppings so at this point I opened the door between 8 and 9 N. main entries to short circuit the air back into the return side which was 7 and 8 North mains and even then had only between 600 and 800 cubic feet of air. It was necessary at this point to clear the air for 45 minutes before allowing the crew to come up as I kept them back 300 feet until it was safe to work. Room 21 was well sealed with boards and canvas and the framework was constructed at room 22 with lumber and materials to finish the job at about 7:00 a. m. Since the crew was tired out by then it was decided to go out. The plan was to take three men equipped with gas masks and proceed up the air course approximately 1200 feet to tear down the canvas stoppings to ventilate the whole air course. At 8:00 a. m. Sunday, July 16, I reported to John Daniel giving him specific instructions to fix up leaky stoppings and have some one who was familiar with the mine to check up on all doors and find out the cause of why we were not getting any more air up the "straight mains" when the fan was delivering approximately 50,000 cubic feet of air per minutes Also, to have Mr.

James Fugate and crew build a good board stopping at room 22 and cover it with canvas and use gas masks to open up the temporary canvas stoppings at the intersection of 9 and 10 N. mains with No. 11 N. W. main, No. 3 parting entry. Also, have men posted at the seals constructed along No. 10 main air course, each with a CO detector to warn the advance crew if any leaks developed.

I then reported to Mr. C. A. Herbert at the hotel of developments so far. A telegram was sent to Forbes and Harrington.

G. T. Powell and crew relived Fugate at 3:00 p. m.

I was told to report at 6:00 p. m. for duty after sleeping from 10:00 a. m. to 3:00 p. m. I found out from Mr. C. A. Herbert that Burley Fugate and crew had followed the air in from the shaft bottom and had repaired stoppings and made other necessary changes and now had plenty of air and the crew was advancing along 11 N. W. main, No. 3 parting, towards the entombed men, Sunday July 16.

The crew and I waited until 12:20 a.m. Monday when we went down to relieve Mr. G. T. Powell and crew which had advanced within two breakthroughs of the two entries in which the entombed men were supposed to be barricaded. There was a telephone dlose by to report overso that communication was maintained at frequent intervals. On our way in we inspected the seals that we had put up the night before and found ours to be tight and O. K., but the one room 22 that James Fugate and crew had put up was leaking. He had failed to board it up, even after my previous instructions, and had simply nailed two pieces of canvas over the framework. We plugged up the cracks the best we could and went on in.

After coming up to Powell and crew which was composed of Mr. Louis Huber, Mine Safety Appliances, Mr. Lindsay Cobb, District Mine

Inspector, as leaders I found that about 20 men under Carl Ramsey, Section Foreman, were finishing bratticing at the point of where the two development entries 1 and 2 Left took off 13 and 14th Right off 13 N. W. mains in which the 9 entombed men were supposed to be barricaded. We found that the entombed men had erected a temporary stopping on the first haulage No. 1 Left entry about 30 feet inby from the first "pickup!" which was on 45° and served as a haulage switch entry containing a wooden trap door. There were nails and hammer left in a paste board box on the pillar rib side of the entry outby indicating that this was the last temporary stopping erected and that the crew had crawled under to get behind it. We next went through the first trap door and tore down the other temporary stopping which was made from the curtain that was used to direct the ventilation around the faces of the development entries. The temporary stoppings were constructed of coarse woven, heavy burlap and were crudely constructed, not tight; in fact, you could place your arm over the top and under them. After tearing them down this allowed the air to move ahead slowly down the haulage entry. I had been previously informed on the outside that the entries were from 850 to 900 feet long by Mr. James Ruckman and the "pickups" to the parallel entry were placed at 200 foot intervals with two board stoppings between.

After going over the situation with Mr. G. T. Powell, Mr. Arthur Wilson and Mr. Ed Starling and I proceeded cautiously ahead down the haulage entry to see if we could see a permanent seal and if so, put on gas masks and tear out the last stopping to ventilate around the wooden seals until it was safe to open them. We proceeded cautiously testing for CO and gas and proceeded up to the edge of the fourth "pickup" door where my CO detector had turned green to 0.3% on the color chart. I motioned

to them to retreat as my flashlight did not indicate any seals ahead or bodies. We came back and Starling, G. T. Powell and I opened the second trap door to short circuit the air around back through the parallel air course entry and see if there were any bodies in the parallel air course between that point and outby. On shining my light outby I saw several dinner buckets along the pillar rib with the odor of bodies that told the story. Hight of the men were lying close together between the track and pillar rib with their lunch buckets at their head. China Sails, the foreman, was lying parallel with the stopping and was the last man to write a note at 1:25. The bodies were within approximately 40 feet of the temporary stopping. Arch Gold had evidently written on the three ties by chalk marks on his hand, the following message: "12:45 still alive and singing praises to the Lord. All that is unsaved are saved tonight." China Sails wrote on the tie facing him "1:25 still alive". The explosion occurred at 7:22 p. m. as indicated by Randall Green's watch which had stopped and was found on him near the point of explosion origin. This I can verify as I was present when the watch was removed from his pocket. This means that the men were still alive 6 hours after the explosion occurred. Why the men did not kick out the board seals or use two trap doors and retreat back and put up permanent wood seals air tight and use the mud which was present in this section of the mine which is on a 3% dip and contained some water, I do not know. There is a possibility that CO and dust swept in on them in a low percentage at the time of the explosion and the air was already foul to start with before they tore down the curtain to short circuit the air and put in their temporary stoppings and they were too weak to retreat back and place permanent seals and lie down near the face. There seemed to be no confusion and no indication of struggling. The lunch buckets were full of food and water. Only two Edison closed electric cap lamps had burned out.

Bodies of the 9 men were found at 1:30 a. m. Monday. Mr. G. T. Powell and crew went to the outside after the bodies were found and Mr. Powell reported to Mr. John F. Daniel and Mr. C. A. Herbert the finding of the bodies.

I made notes of everything and chalked up location on roof and we proceeded to get the bodies out, taking them to the intersection of 9 and 10 main air course with 11 N. W. main new parting entry (No. 3). They were wrapped in canvas, properly identified and taken out on stretchers partly by pushing car and partly by hand power. All equipment was taken out too the same point as I had in mind to cut this section of the mine off as it would require several days to ventilate the old workings to get into where the 19 bodies were located. We recovered one more body approximately 400 feet inby from 13 N. W. on No. 10 North main, Carl Holloman, trapper. Holloman's clothing was blown off. We proceeded approximately 100 feet further to where a hole had been cut through into No. 10 from the old workings. The CO was strong at this point. It was decided to allow it to bleed off for a while before trying to use a wing curtain to put up a seal. The crew was tired by this time and since nothing more could be accomplished for a whole we went on out. Starling and I again inspected the seals as I had done once before during the night at room 21 and 22 off No. 10 North main. This time I found the presence of 0.3% CO 5 feet out from room No. 22 seal that had been put up by James Fugate and crew. I reported in to Mr. John Daniel at 9:00 a. m. and informed him that room No. 22

seal should be rebuilt and made tight before Fugate and crew proceeded ahead to seal the room neck from the "old workings" into No. 10 North main beyond 11, 12, and 13 N. W. mains where we had stopped to ventilate the faces of No. 9 and 10 North mains and No. 1 and No. 2 Right off 7 North main where 18 bodies were located.

G. T. Powell, L. Huber and W. E. Wheeler went in at 12:30 p. m. with a crew of 40 men, 20 men to relieve crew working recovering bodies, and 20 men as stretcher bearers and also to determine cause of explosion.

Arthur Wilson, Ed Starling and I went in at 5:00 p. m. with 12 men to relieve Powell and crew and bring out remainder of bodies and determine cause of explosion. The 10 bodies that our crew placed at the intersection of 9 and 10 Mains with 11 N. W. started coming to the surface at 3:30 p. m. July 17.

About half way down 9 and 10 Mains we met G. T. Powell, L. Huber and W. E. Wheeler with crew of stretcher bearers bringing out 8 bodies from faces of 9 and 10 Mains. Mr. Powell advised me to get into land 2 Right off 7 main before the stretcher bearers started moving bodies out to make notes of conditions that I saw.

We proceeded on in and left crew to rest at the intersection of 9 and 10 mains with 1 and 2 Right, instructing them to wait until we returned. All Starling, Arthur Wilson, Wynn McCormick and I visited the faces of 9 and 10 mains merely to take a brief look of what had occurred as the bodies had been moved out and Mr. Powell had the notes of this region. I had the flame safety lamp and made frequent tests and observed a slight deficiency of oxygen near the faces. On approaching the Joy loader near the face of No. 9 main I obtained a 1/2 inch to 1 inch gas cap near the roof and as my lamp went up into the cavity over the Joy

loading machine left by the fall on the machine, the lamp encountered an explosive mixture and went out. No hissing of escaping gas could be heard. About one foot of water was under the loading machine. A fault crossed the entry at this point necessitating heavy timbering and cross collaring. The Joy loading machine was not running at the time of the explosion indicated by the fact that the empty trip of cars were out on No. 10 Main at the last "pickup". The fall had occurred before the explosion as the bodies of Dick Byron and Dan Byron were found on top of the fall. At the final investigation the flame safety lamp belonging to Foreman Dick Byron was found behind the booster fan next to the pillar rib on No. 9 Main outby approximately 5 feet from the last "pickup" which shows that the foreman was not using his lamp or he would have had it with him which is in direct violation of the Company rules which require foremen to keep flame safety lamp lighted with him at all times. The cutting machine had just sumped in on No. 10 face and the controller was on. According to the company rules the cutting machine must stop 3 times across the face and an examination made by the foreman for gas. There is a possibility that the foreman did test for gas before the machine sumped in and then went over to No. 9 Main to supervise the timbering work there and put out his safety lamp and set it behind the booster fan on his way over. According to the experience of other foremen including Wynn McCormick in crossing this fault they generally encounter gas feeders. The foremen should have been with the cutting machine making frequent tests with the flame safety lamp for gas while the crew was setting timbers at No. 9 face as he knew very well that he might cut the fault or a gas feeder at any time. the timbering in No. 9 required his supervision then the cutting machine

should have been shut down and the men in this entry assisting the timbering crew in No. 9 until such a time that the foreman and crew were through and could return to No. 10 face and resume cutting under the foreman's supervision and the foreman should have been at the cutting machine with his lighted safety lamp stopping the machine and testing very frequently for gas feeders. Evidently the lesson on April 14, 1939 exactly 3 months earlier in which one man was burned fatally and two others severely burned was forgotten. (Report submitted by Mr. G. T. Powell). While exploring the No. 9 and No. 10 Main faces the writer observed long soot whiskers hanging from the roof and ribs indicating that the flame from the explosion burned a while before going back out. The main explosion forces were pointed inby towards the faces indicating positively that the explosion did not originate here.

The writer and accompanying leaders then proceeded back to the crew left at the junction of 1 and 2 Right with the mains.

Ed Starling, deputy state inspector, and I went ahead of the recovery crew to test for gas and CO in 1 and 2 Right and make notes of location of bodies and to determine cause of explosion. The recovery crew fell in behind under Arthur Wilson and started spraying the bodies with lysol, identifying and wrapping them with canvas, and placing them on stretchers and carrying them out. I made all notes and noticed which way the forces went, marked up in chalk on the roof over the bodies their location. Upon passing through the last breakthrough into No. 1 Right I observed the shot firers leg (James Gaither, colored) lying between the track and corner of pillar rib 50 feet outby from the face. Clothing was still on the leg. The trunk and body of James Gaither were bare and lying between the rails showing upon close examination to be badly

peppered and mutilated. The clothing was burned and blown off. Pieces of the shot firer's battery and lamp cord were scattered out from the body along the floor of the entry. The forces all went out from this point in No. 1 Right. One force went to the face of No. 1 Right, and down No. 1 entry outby in the opposite direction. The force passed through the last breakthrough into No. 2 entry inby to the face and outby from the last breakthrough down the entry. Everything pointed to the "Shot Firer" as the cause of the explosion. The cutting machine lacked about 2 feet of finishing his cut and the controller of the cutting machine was on full. Hobart Williams, the machine runner, dived into the right hand corner of the face with his head down in the kerf. His clothing was unburned. All the lamp batteries were found except the "Shot Firers" which was blown into small pieces by the blast. The holes had all been drilled and were partly filled by bug dust. Three sticks of "monobel" permissible explosive were found along the right rib about 5 feet from the face, one of which was a primer stick with an electric blasting cap in the end with the lead wires disconnected which could be set off by coming in contact with a stray electrical current. Several loose caps were lying next to the right rib scattered around the powder. One wood stopping was intact which was the third back from the face. The Joy loader pan was bent inby at the face of No. 2 Right. The dinner buckets were only slightly disturbed at the second breakthrough from the face. On opening them they contained food and water untouched. Some of the plates were broken.

In the final investigation 3 more primers with electric blasting caps unshunted were found in the cuttings at face of No. 1 Right. Wident-

ly the "shot firer" was preparing more primers to have on hand as he already had more than he needed for the 3 holes in No. 1 Right. The shot firer whose habit, from the evidence seen, was to leave the cap wires unshunted probably was sitting on the rail or next to the track when the unshunted wires accidently touched the rail or damp ground in the entry causing the primer and whatever other powder and caps to go off by a stray return current. The booster fan was blowing towards the face which would throw considerable dust into suspension along the entry besides what the cutting machine was making at the face because it was running dry. They were shovelling out dry bug dust from the kerf as the long handled shovel was on top of the bug dust. The Joy loading machine had been running at the face of No. 2 entry which would also leave considerable dust in suspension so with what dust the permissible powder kicked into suspension and an unconfined flame made it possible for the dust to ignite. No gas was detected in either entry at the time of the writer's visit.

Later at the final investigation, Section Foreman Barnett
Barnes' safety lamp was found next to the wood stopping on No. 1 Right
alongside of his lunch bucket at the third breakthrough from the face
indicating that he also broke the Company rules in not keeping it lighted and with him at all times, stopping the cutting machine and examining
face 3 times as it moved across. At the final investigation a primer
with 60 d spike taped on one end was found at the third breakthrough
from the face on No. 2 Right entry. From the evidence found in No. 9
main between the second and fourth breakthroughs with electric detonators
and powder scattered up and down the entry and the 50 pound powder box
container that a strap is nailed across the ends of box and powder with

caps placed into the same box together and carried to the face and stored in this manner. The handling of the powder was contrary to all safety practices and the foremen in these two sections were certainly "lax" in their supervision in the handling of powder as well as examining for gas while the cutting machines were operating.

Mr. Hi Starling and I supervised and helped with the last of the bodies and brought out everything with us, checking everything, as we proceeded out arriving at the surface with the remainder of the bodies, workmen, and leaders at 1:00 a. m. Tuesday, July 18, 1939. I immediately contacted Mr. C. A. Herbert and Mr. John F. Daniel, Chief, Department of Mines and Minerals, State of Kentucky, and held a conference with these two men until 2:30 a. m. giving them the information that I had obtained as to the cause of the explosion.

In the morning Mr. C. A. Herbert and I sent telegrams to Mr. D. Harrington and Mr. J. J. Forbes stating the indicated cause. During the forencon I prepared a rough map of 1 and 2 Right off 7 mains from my notes for Mr. C. A. Herbert.

At 1:15 p. m. Mr. C. A. Herbert, Mr. A. U. Miller, Mr. John F. Daniel, Chief Kentucky Department of Mines and Minerals, Mr. F. V. Ruckman, Mr. D. G. Ruckman, Mr. James Ruckman, Mr. James Fugate, Mr. G. T. Powell and I met in private to go over our findings. Mr. G. T. Powell added his notes to the rough map prepared. After the conference was completed it was decided to wait a few days to reventilate the "old workings" so that a man trip could be taken up to the No. 3 parting for the party making the final joint investigation comprising Federal, State and private disinterested parties. It was decided to hold the final investigation on Monday, July 24. Mr. F. V. Ruckman asked me if Mr. Powell

could return for a few days, before the final investigation took place to assist in the reventilation of the mine. I agreed to this as I knew they were old friends and that Mr. Powell knew practically every man in the mine by name as well as his ability and character. The meeting was concluded at 3:00 p. m.

The writer and Mr. G. T. Powell left for Norton Station after the meeting was over traveling all night and arriving in Norton, Virginia at 8:00 a. m. Wednesday, July 19, 1939.

The writer gave Mr. G. T. Powell instructions to take air measurements, dust and air samples at strategic points in the mine upon his return. Also, find the extent of flame and force for marking up on the map for Mr. C. A. Herbert. Also, wire Mr. D. Harrington and Mr. J. J. Forbes the results of the final investigation on Monday, July 24, 1939.

This concludes the writer's part of the recovery story at Duvin mine following the explosion.

Respectfully submitted,

L. H. McGuire

Assistant Mining Engineer