

**REPORT OF EXPLOSION
DERBY #3 MINE, STONEGA COKE & COAL COMPANY
DERBY, VIRGINIA**

By

**Joseph F. Davies
District Engineer**

DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

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Photostat of Explosion Area

Photostat of Large-Scale Sketch of Explosion Area
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List of/Cause of Death of Men Killed

Letter report on Coal Sample

**REPORT OF EXPLOSION
STONEGAP COKE & COAL COMPANY, DERRY #3 MINE
DERRY, WISE COUNTY, VIRGINIA**

By

**Joseph F. Davies
District Engineer**

At about 7:20 A.M. on August 6, 1934, a gas and dust explosion occurred in No. 3 Mine of the Stonegap Coke & Coal Company at Derby, Wise County, Virginia, resulting in the death of seventeen men, injuries to three others, with four others being rescued from dangerous atmospheres.

No other explosion has occurred in this mine.

Location & Ownership:

The mine is located at Derby, Wise County, Virginia, and is served by the Interstate Railway. It is owned and operated by the Stonegap Coke & Coal Company, with offices at Big Stone Gap, Virginia, and Philadelphia, Pennsylvania. The local operating offices are located in the Miner Building, Big Stone Gap, Virginia.

Company Officials:

The officials of the company are:

R. H. Knode	President	Philadelphia, Pa.
R. E. Taggart	Vice-President	Philadelphia, Pa.
J. D. Rogers	Vice-Pres. & Gen. Mgr.	Big Stone Gap, Va.
A. H. Needer	General Superintendent	Big Stone Gap, Va.
G. A. Sims	Safety Engineer	Big Stone Gap, Va.
A. H. Gordon	Mining Engineer	Big Stone Gap, Va.
Brown E. Polly	Mine Superintendent	Derby, Virginia.
Ralph Burchill (Dee'd)	Mine Foreman	Derby, Virginia.

The Mine:

The mine is a drift mine having three main drifts and several outcrop openings.

It is operating in the "Taggart Marker" seam, which varies in thickness from 26 to 42 inches.

The No. 3 Mine is one of a group of three, the coal from all three passing through one tippie. It has a rated capacity of 40,000 tons per month. In July, 1934, it produced 27,963 tons in 18 days and in June 22,772 tons in 14 days. In 1933, 349,485 tons were produced.

Coal Seam:

The coal seam worked is known as the "Taggart Marker". It is a firm, bright bituminous coal.

The "Taggart Marker" seam underlies the Taggart seam with from 30 to 50 feet of massive sandstone intervening, which forms the roof over the Taggart Marker seam. It is underlaid with a hard, sandy shale, which forms a hard, smooth floor. Very little impurities are found in the coal. The coal seam dips generally about 2.1% N. 45° E.

The following are the results of analyses of samples of coal collected and analyzed by the coal inspection service of the Stonega Coke & Coal Company, the average approximate analyses of 9 seam samples collected in Derby No. 3 Mine:

Moisture	1.00%
Volatile Matter	24.74%
Ash	2.42%
Fixed Carbon	59.84%
	<u>100.00%</u>
Sulphur	.67%
B. T. U.	14,975

Ultimate analyses of seam samples were not available. However, the following is an average of many mine run samples of coal which were collected at the tipples:

Carbon	43.02%
Hydrogen	5.29%
Nitrogen	1.52%
Oxygen	7.03%
Ash	2.50%
Sulphur	.64%
	<hr/> 100.00%

Methods of Mining:

This mine is, in a sense, an experimental mine insofar as the methods of working are concerned.

The mine was first worked on a narrow room-and-pillar plan. However, only a small area was so worked. The predominant plan has been one of long, wide rooms with 25- to 30-foot pillars. These rooms average about 60 feet wide.

A panel long wall plan was used for a time.

A retreating long face plan was used. In this plan a face 300 feet long was carried back about 100 feet, then a pillar of 100 feet was left.

Still another plan of wide rooms and thick pillars was used.

Whether or not a definite plan has been decided upon was not learned.

All of the coal is undercut and shot down.

All of the coal is hand loaded onto conveyors. There are 14 conveyors of the 42-X Jeffrey type in use as face conveyors in rooms. There are 14 conveyors of a belt type, using 18" rubber belts. These

are used as room conveyors. There are 4 so-called "Mother" conveyors used. These are of the belt type, using 26" rubber belts. All are electrically driven by means of electric motors of non-permissible types.

Ventilation & Gases:

The mine was ventilated by means of three disk type fans. All of these fans were located inside the mine. The fan which was designated as the main fan was located in the main return aircourse about 125 feet inby the portal. This fan was a 5-foot disk type. It was belt-driven by a 15 H.P. electric motor operating on 275 volt d.c. taken from the trolley wire. This fan was demolished by the forces of the explosion.

Another disk type fan was located in a crosscut at the top of No. 1 Face Right entry. It was a 5-foot fan and was belt-driven by means of a 7½ H.P. electric (Continental) motor.

Another 5-foot disk fan was located in the mouth of 1 Left Butt entry off B heading. It was belt-driven by means of a 15 H.P. (C.E.) motor.

The mine was ventilated by a continuous air current.

These two last mentioned fans were not disturbed by the violence, as they were remote from the area of violence.

The following was copied from the ventilation report as of July 31, 1934:

Main West - intake	7,000 cu. ft.
Main West, in empty chute - return	6,500 cu. ft.
Top of 1 Face Right, East - intake	29,000 cu. ft.
2 Butt Left aircourse at #5 room - intake	6,000 cu. ft.
2 Butt Left heading, East - return	6,500 cu. ft.

No. 1 intake 1 Butt Left - intake	5,500 cu. ft.
Crosscut top of 1 Butt Left - return	4,000 cu. ft.
2 Butt Right Heading, South - intake	6,500 cu. ft.
2 Butt Right Heading - return	11,000 cu. ft.
2 Butt, back of fan - intake	29,500 cu. ft.
Back of fan at Drift Mouth - return	27,000 cu. ft.

The foregoing report indicates that on July 31, 1934, or the sixth day previous to the day of the explosion, there was 7,000 cubic feet per minute passing at the point of intake to the explosion area and 6,500 cubic feet returning.

It is believed that this quantity of air if properly coursed and maintained in circulation would have prevented any appreciable accumulation of gas in this section. Evidently, however, there was no effort made to properly course this air by using the usual stoppings and line curtains. On the contrary, there apparently was a general acceptance of the practice of resorting to the use of auxiliary blowers rather than constructing stoppings or hanging line curtains. This condition has apparently been brought about through the use of blowers and tubing on long faces and in deep, wide rooms with no crosscuts.

The use of booster fans or of blowers and tubing should be discouraged by the management and under such conditions as existed here should be positively prohibited.

In this instance faces had been advanced 300 feet beyond an open crosscut through which probably most of the available air was passing and certainly beyond which there could not have been any appreciable

velocity of the air movement. As additional evidence of this there were two blowers in use at least part of the time. The locations of these blowers is indicated on the large-scale sketch in the appendix of this report.

There were also two long places driven off the No. 2 aircourse (Main West). Evidently these places were unventilated and it is possible that methane accumulated in these places and moved out and may have added to the percentage of methane in the air moving toward the point of origin of the explosion. Such places should be either ventilated or effectively sealed.

It was said that the fan designated as the "main fan" was run continuously, but that the other two fans were stopped at times when the mine was not in operation. In all probability the blowers were stopped when there were intervals of several hours between shifts.

Whether or not there have been accumulations of gas noted before in this area is, of course, known only to the management and men working in the area, as no gas inspections were made except probably at intervals when the Safety Engineer or Company or State Inspectors visited the mine. There were no pre-shift gas inspections of any part of the mine.

Haulage:

Track is laid to 44-inch gauge with rails of 33- or 43-pound weight. All main haulage road is laid with 35-pound rails on wooden ties. Secondary haulage road is laid with 43-pound rails. All of the track is bonded and at frequent intervals it is cross-bonded. There are two locomotives in regular use and a third one used occasionally. They are respectively 13, 15 and 20 tons. All are of trolley type.

Metal and wood composite cars of 119 cubic feet capacity are used. They are of a tight construction and are well maintained.

Lighting:

All persons underground are required to carry portable electric cap lamps. The Wheat type is generally used with a few of the officials occasionally using Edison type. All are well maintained.

At intervals along the haulageways, at switches, and at loading points at conveyor heads lights are located, all taking power from the trolley wires.

MACHINERY UNDERGROUND

Mining Machines:

There are 14 electric mining machines used and 1 is maintained as a spare. Of these, six are of the 35-B type Jeffrey and nine are 35-BB type Jeffrey. None are maintained as permissible, although some of them have been sent from one of the mines in West Virginia and were maintained as permissible while in use there. It is believed that these should be placed in a permissible condition and used in advance places and particularly in the Main West section of this mine.

Conveyors:

There are 14 electric driven conveyors of the 49-B type Jeffrey. All of these are used as face conveyors. None are of permissible type.

There are 14 belt type conveyors used as room conveyors; none are of a permissible type. These use 18-inch rubber belts.

There are 4 large (26-inch rubber belt) so-called "Mother" conveyors in use. None are of permissible type.

Power is supplied to the conveyors, mining machines, blowers, and drills by means of cables which are ripped onto the trolley wires. There is a main cable which leads from the trolley to a master switch box from which leads are taken to the switch boxes from which leads are taken to the units. All of these switches were located within 25 feet of one of the active faces in the area where it is believed the explosion originated. All of these main switches are of an open knife type and, although they are enclosed in metal boxes, these are not safe in dusty or gas laden atmospheres.

Pump:

In this same area one electrically driven pump was located. It, however, was not in use, the motor having been removed and in the shop.

Blowers:

There were two auxiliary blowers used in the explosion area. These were No. 2 Beaver type, using 12-inch cloth tubing and driven by 2 H.P. Westinghouse d.c. motors. They are provided with open knife type switches located in a metal box on top of the blower housing. These blowers are used in lieu of line curtains.

Drills:

There were two portable electric coal drills in the explosion area. One of them was evidently in use at the moment of the origin of the explosion. This drill is manufactured by the Van Dorn Electric Tool

Company, Towson, Maryland. This one was taken out to the electrical shop and critically examined. It has two hollow bar handles. Both are closed at the ends. One is inserted into a metal box in which a spring actuated switch is located. The operating lever of the switch extends through the handle and is operated by a trigger which passes through a slot in the handle. It was found that when the motor was operating there was a current of air entered through the trigger slot, passed through the switch box, and through the motor. A lighted cigarette was placed in the trigger slot and the motor started. The cigarette was very rapidly burned and the smoke passed through the switch box and motor. The switch box cover was taken off and a continuous arcing was noted. The commutator is enclosed in a metal cover which is apparently dust-proof.

The Safety Engineer discredits the belief that this drill may have caused the ignition.

Locomotives:

Two locomotives are used, with a third making occasional trips. These are 13, 15, and 20 tons. All are trolley type and are well maintained. None are of a permissible type.

Fans:

There are three disk type fans. All are located inside the mine. All are belt driven.

Electricity:

There are two underground substations. Power at 2300 volts a.c. is delivered to them from the surface by means of armored cables. Power used underground is 275 volt d.c. and is transmitted by trolley wires. The trolley wire is substantially supported on hangers and apparently well maintained.

Drainage:

Parts of the mine are wet with accumulations of water standing on roadways. In the explosion area a few hours after the explosion the roof and floor were damp with beads of water falling from the roof and fine coal underneath the dust and debris was wet.

Dust:

Judging by the very heavy coke deposits and very heavy dust deposits on timbers and vertical surfaces, there was very appreciable quantities of fine coal and dust throughout the explosion area. Because of the absence of roof falls and impurities being gobbed, all of the fine coal lying on the floor was, in a sense, available and strategically distributed so as to be easily raised by even comparatively light advance waves of pressure. That this occurred was apparently evidenced by appreciable deposits of dust on posts with very heavy deposits of coke which were deposited from a different angle.

It was said that previous to the explosion that area was damp to wet and some of the officials remarked that this explosion under these conditions was a lesson and a revelation to them. They believed a widespread explosion would not occur where such conditions existed.

Haulage roads are comparatively free of accumulated fine coal, although at sidetracks and curves and switches there were appreciable amounts of fine coal.

Rock Dust:

Some rock dusting has been done in other parts of the mine, but no general rock dusting program had been effected before the explosion. No rock dust had been applied in the explosion area. Since

the explosion, however, what appears to be a sincere program has been put into effect. When sufficient progress has been made in this, permission will be given to make a complete examination of the results of the rock dusting as also of the changes in ventilation.

Explosives & Blasting:

Permissible explosives are used for all blasting; Duohal No. 4 is used for blasting all coal. This is furnished in small paper cartons and in 1 1/8" x 3" sticks. For all rock blasting Gelobel No. 4, 1 1/8" x 3" sticks, is used. All shots are fired electrically, using No. 6 detonators with 6-foot iron wires. A small 3-volt 2-cell dry cell battery is used (No. 1023 Burgess Blasting Battery). Shots are fired any time, with no person definitely assigned to this duty. Clay is used for stemming. Evidently no rules regarding the storage of explosives underground were in effect or enforced, as explosives were found lying loose on the floor in crosscuts far back from the active area and as indicated on the large-scale sketch in the appendix of this report.

Electric detonators were found scattered at several points. These nor the explosives could have been so scattered had they been properly stored.

Supervision & Discipline:

A gang work plan was in effect in the area when the explosion occurred, there being 9 men, one of whom was designated as gang leader. The attitude of the company toward safety has been apparently earnest and sincere, but whether that attitude has been shared by the minor officials and men is problematic. The superintendent and mine foreman at this mine

have been very active in safety. Every employee of this mine was trained in first-aid by the cooperative training plan and a 100 per cent first-aid certificate was issued on February 7, 1934. There has been considerable discussion among the men regarding compulsory safety rules since the organization of the men. However, there was evidence of a laxity in maintaining safety in the physical condition of the mine just previous to the explosion.

That smoking was indulged in by many of the men underground was evidenced by finding of matches and smoking materials on bodies of some of the victims and apparently no careful search was made for these before the men entered the mine, as there was no apparent effort on the part of the men to hide them. A cardboard box of matches of the usual penny size was found on each of three of the bodies in succession as they were recovered.

Conditions Immediately Prior to Explosion:

The last shift worked in the Main West section was on Sunday morning, August 5, 1934, this crew having left the mine about 7:30 A.M. Sunday, August 5, 1934, at which time the conveyors had been set and preparations made to load coal and advance the faces. It was said that the face of the No. 1 Face Right heading was undercut on this shift and it was not definitely learned whether the bore hole on the right side of this face was drilled on this shift or not, but it was said that it was not.

One of the assistant foremen said that the men were not able to work at the face of the place to the left of this place without the small blower which was located at the intersection of the radius curve

and the straight place because of the lack of ventilation. It is not known if this was reported to the mine foreman or not, but most probably not, as the blowers were provided for just such conditions.

This section had been idle for considerable time and these preparations were necessary to put it on a production basis.

There is no record of the section being firebossed previous to these preparations being started nor at any time during the progress of this work.

It was said that the main fan located near the mouth of the main return airway was in continuous operation. However, with this fan running the area at and near the faces of the Main West section would not have been effectively ventilated, as they were about 500 feet beyond an open crosscut through which probably most of the ventilation passed. These places were going slightly to the rise, which condition would, in theory at least, permit of gas accumulation at these points if gas was being liberated.

Undercutting had been done which would provide fresh dry dust and may have opened a feeder or liberated methane which under the conditions would probably have diffused and formed a more or less intimate mixture in this entire area during the interval from Sunday morning to Monday.

On the morning of August 6, 1934, a crew of 25 men entered the mine. One man preceded the others and went to the two fans located, one on No. 1 Face Heading Right and the other on B Heading. These he started, as they had been stopped after the shift on Sunday. The rest of the men assembled in what was known as the safety room, which was located at the

intersection of the main haulageway and the Main West entry. It was at this point where the mine foreman met and assigned the men. All of the assignments had been completed and the men trip to the East section of the mine had left this point. Two men had been told to go home and report for the next shift. These two men reached the portal and were picked up and carried about 50 to 75 feet by the forces. One of them sustained fractures of the bones of one hand.

A crew of 9 men and one assistant foreman were assigned to duties in the Main West section. All of these men had reached this point. One of the company men, who was a motorman, had been told that his locomotive was in the Main West section. However, when he arrived there he found that his locomotive had been taken outside to the motor barn on the previous shift, and he left the crew and was somewhere near the motor barn outside the mine when the explosion occurred.

A track man had found it necessary to leave the mine to get some of his tools, and he was also outside the mine at the time of the explosion. This left 91 men inside the mine at the moment of the explosion. A group of 8 men, including the mine foreman, was evidently in the safety room at the moment of the explosion. It is known that the mine foreman was at the telephone talking to the outside, in the act of making his report as to the number of men in the mine when the explosion occurred.

The crew of 9 men in the Main West section were located about in the position as indicated on the large-scale sketch accompanying. Evidently two of these men were in the act of drilling a hole near the center of the No. 1 Free Right heading off Main West at the moment of

the explosion. The sugar was found hanging in the bore hole which was approximately 3 inches deep. It was not possible to determine what the other men were doing. One of them was found out on the Main West haulageway just inby the loader head of the mother conveyor. It is probable that some of these men moved a few feet after the initiation of the explosion. However, it is doubtful from the evidence that any of them moved more than 5 or 10 feet.

It is the belief of the writer that the drill was in operation at the moment of the ignition and at least one of the blowers. It is believed by the writer that the inby blower, which is indicated on the large-scale sketch at the intersection of the radius curve and the straight place, was in operation. One of these two pieces of electrical equipment is believed by the writer to have been the source of the ignition.

Story of the Explosion:

The explosion occurred at 7:20 A.M., as near as it could possibly be learned, August 6, 1934.

Forces and dust were observed on the outside of the mine. Two men had just left the mine and had reached the portal. One had stepped to the right and the other to the left of the main haulageway when the forces caught them and carried them about 30 to 75 feet. One of these men sustained fractures of the bones of one hand. Neither was burned or affected by heat. Evidently no flame reached the outside.

Mr. B. E. Pelly, Mine Superintendent, was sitting at a window in the mine office, which is located about 800 feet from the main portals. He heard the explosion and asked someone what had occurred. He was ad-

vised that evidently an explosion had occurred in the No. 3 Mine. He immediately placed telephone calls with the operator of the private telephone system which was located at Big Stone Gap, Va. She placed the following calls: One to Mr. J. D. Rogers, Vice-President and General Manager, Big Stone Gap, Va.; Mr. C. A. Bine, Safety Engineer, Big Stone Gap, Va.; Dr. Booker, Chief Surgeon, Stonega, Va.; and J. F. Davies, U. S. Bureau of Mines, Norton, Va. The connection to Mr. Davies was completed immediately and Mr. Polly, speaking from the mine office, advised Davies that an explosion had occurred in the Derby Mine, and asked that he respond immediately. Davies immediately advised J. S. Ferraro and H. B. Humphrey to report immediately at the Mine Rescue Station. Davies proceeded immediately in Government-owned Ford car, Humphrey and Ferraro following immediately in Government-owned Dodge truck.

Immediately following the completion of the telephone calls, Mr. Polly, Superintendent of the mine, went to one of the crop openings, entered, and assisted in gathering all of the men from the unaffected section of the mine and directing their escape through one of the crop openings. There is no doubt that due to the prompt action and clear thinking on the part of Mr. Polly that some lives were saved. Mr. Polly personally assisted in the removal of one person, affected by shock and afterdamp, through an accumulation of water that reached to within a few inches of the roof.

When Davies arrived at the mine, he found two small portable blowers being placed, one in the main return aircourse and one in the main haulage portal. These two blowers were said to provide approximately 8000 cubic feet of air per minute.

Immediately following the placing of these blowers, a party consisting of C. A. Sine, Safety Engineer, and J. F. Davies advanced along the main haulageway, followed a short distance by A. M. Reeder, General Superintendent, and Mr. Lowman, Company Mine Inspector. At a point approximately 100 feet inby, appreciably high concentrations of CO were encountered. The flame of a safety lamp was appreciably diminished.

While the blowers were being placed, Mr. Polly ordered a group of men to go around to one of the drop openings, enter the mine, and erect a stopping so as to make it possible to operate the two fans located in the East section of the mine. Mr. Davies assigned Mr. Humphrey, U. S. Bureau of Mines, to accompany this crew with flame safety lamp and CO detector to afford them protection. This Mr. Humphrey very ably did. It was later deemed not advisable to operate these fans.

After encountering the CO at the point about 100 feet inby the portal, the first party retreated to near the end of the canvas tubing of the blower and consulted for a moment or so. In the meantime Mr. J. B. Ferraro, U. S. Bureau of Mines, was busily engaged in testing the oxygen breathing apparatus and gas masks at the supply room about 800 feet distant from the portals.

At this time the reflection of two lights was visible and, donning his gas mask and proceeding with a flame safety lamp with a cable fastened to his arm, Davies proceeded to assist to fresh air two men who were in a weakened condition and found moving very slowly on their hands and knees through a dangerous atmosphere.

After this, 3 bodies were removed from the vicinity of the intersection of the main and main west haulageways. All of them were dead, although the first one was removed from the dangerous atmosphere as quickly as possible and artificial respiration resorted to for about 1½ hours, although he was pronounced dead by the doctors.

After all of these bodies had been removed a more substantial stopping was placed across the main haulage portal and a 5-foot disk fan was placed in operation, operating blowing. The aircourse portal was effectively closed with a strong canvas stopping. This fan afforded appreciably more velocity and air which was permitted to blow, part of it going up the main haulageway past the intersection of the Main West entries, and part going into the Main West section. A canvas stopping was placed across the Main West haulage road and across the mouth of the Main West aircourse and two stoppings on the main haulageway were repaired, after which Davies and Sine explored the main haulageway for a considerable distance well beyond the point where any violence or evidences of the explosion were found, in order to be sure that no person was left in that area before the door was closed, making some changes in ventilation.

After this all of the air provided was directed into the main West section and, with Sine and Davies making all the advance explorations, the air was advanced by means of canvas brattices placed in cross-cuts between the Main West haulageway and No. 1 aircourse.

During recovery work a rather heavy concussion was felt, which was no doubt occasioned by a fall of roof, and at about the same time the information was telephoned in that the return had suddenly shown approximately 3½ methane and the carbon monoxide had rather suddenly raised to

about one-half of one per cent from percentages varying from one-tenth of one per cent to just traces. This condition, together with the concussion, was believed by some to have been an explosion somewhere in the Main West section. However, it was reasoned that it had taken probably 14 hours for any gas to have reached the fire if it had been an explosion, and it was also reasoned that if it had been an explosion there should have been reversals of air currents accompanying it, neither of which occurred.

However, it was deemed advisable to send all the recovery party to the outside and wait for this condition to clear up or a second explosion occur. In approximately an hour the percentage of methane had diminished to the point at which only traces were noticed on the flame safety lamp and the carbon monoxide had decreased until only traces could be detected.

After this the recovery crews again entered the mine and from this point the recovery proceeded orderly until all of the remaining 9 bodies had been removed from the mine, after which it was deemed advisable to keep the fan in operation and all persons excluded from the mine until the investigation party was ready to enter the next morning, August 8, 1934.

All of the bodies had been recovered and the affected area of the mine explored by shortly after 6 A.M. August 7, 1934.

No fires were encountered.

Property Damage:

Comparatively little property damage resulted from the explosion. It consisted of a few board stappings, one door demolished, one door dam-

aged, a 5-foot fan installation damaged, and possibly some of the electrical equipment in the explosion area being damaged by flame and heat. There were no roof falls encountered in the recovery work, although there were appreciable areas in which all the timbers were blown out.

There were 8 mine cars damaged. This damage to the mine cars consisted principally of distortion of the metal sides and ends.

Seventeen persons were killed. One man received fractures of the bones of one hand and bruises of the body. Another received bruises. Another was in a serious state of shock. The two men who were recovered alive on the main haulageway were sent to the hospital, both recovering in a comparatively short time.

The mine was placed in operating condition after the debris was cleaned off the haulage roads, stoppings erected, and a complete fireboss inspection made of the entire mine, including abandoned sections. The report of this firebossing inspection was that no accumulations of gas were found in any part of the mine, with exceptions of a small amount of gas in the face of the Main West section.

Forces:

Evidently the explosion originated near the face of the 1st Right heading off the Main West section, with forces radiating from this point. Slight forces moved toward the face, with increased forces moving from this point outward. Evidently these forces were comparatively light for about ⁶⁰⁰~~300~~ to 1000 feet from the point of origin. Here the forces evidently rapidly increased and along the Main West haulageway from just entry the second open crosscut between the Main West haulageway and what is designated as the "Empty Bay". A scrubbing effect of roof and ribs was

evident, increasing very materially until just inby the intersection of the three face left entries and the Main West butt headings. Evidently the forces were very materially reduced due to relief of pressures through the three face left entries, and again the pressures were evidently very materially reduced further at the intersection of the Main West entries with the two face left or main haulageways. Comparatively light forces passed out through the portals to the outside. It will be noted by examining the accompanying maps that the direction of forces from point of origin to the portals was almost in effect a straight line. This relief of pressures no doubt prevented violence from extending any farther into the mine. The extent of forces is indicated on the photostat copies of the map of the explosion area.

Evidence of Heat or Flame:

At the point of origin there is evidence of intense heat on the roof and by coking on the floor, the flame evidently involving an appreciable area. The remains of a rubberized fabric explosives bag and charred papers of several sticks of explosives were found on the right hand rib about 22 feet inby the inby corner of the 1st Right heading off Main West. Fifteen electric detonators which were lying only a few inches from this bag of explosives were not detonated, although the paper wrappings were scorched and burned. Nine electric detonators lying about 5 feet inby this same corner and about 17 feet outby the burned explosives were found undetonated with the papers scorched. A post about 6 feet from the burned explosives had an appreciable deposit of coke on the outby face. None of the ventilating tubing nor any of the rubber belting had been burned in this area.

The body which was found at the intersection of the radius curve and straight place, and which is designated as No. 3 on the large-scale sketch, was very severely burned and was the worst burned body recovered. All of the bodies in this area showed evidence of intense heat. Slight streamers of soot about 2 inches long were hanging on the lower edges of the auger which was in the hole in the face of the 1st Right heading off Main West.

Very heavy coking was found on most of the timbers outby this point, the heavier deposits of coke being on the outby faces with coking on all sides. A few of the timbers near the two mine cars on the Main West entry at the mouth of the radius curve had no coking on them at all. These timbers were evidently somewhat protected by the curved rib and the two mine cars. Heavy coke deposits were found on the outby faces of timbers in the long deep place or extension of the Main West heading. These timbers were all placed under the roof beyond the point where the rock had been shot on the Main West haulageway. Long heavy soot streamers were hanging from the roof and projections along the ribs in the area from the loader head of the mother conveyor inby as far as the rock had been shot. These heavy soot streamers extended 3 or 4 feet down from the roof, which is very high in this area, below which the soot was not in evidence.

Very heavy dust deposits were found on the inby faces of posts in the wide place to the left of the Main West haulageway, with appreciable coking, and in some cases heavy coke deposits, on the sides of the posts toward the left rib or evidently deposited at right angles to the dust deposits. Near the crosscuts, timbers in this place showed coking.

with the heavier deposits varying from the right hand faces to the outby faces, the inby faces, and to the faces toward the left hand rib. Coking very rapidly diminished on the timbers in this place between the second crescent outby and the third crescent outby. From this point outby, no coke deposits were observed. In the wide place, indicated as No. 1 air-course, the coking was deposited on outby faces of posts with no coking deposited on timbers in protected places or where protection was afforded from the forces and flame evidently traveling from the face outby.

The position of the coking, together with the rather heavy ^{just} deposits, was interpreted as indicating a comparatively slow explosion. Evidently the explosion received added impetus when it had reached a point about 200 feet outby of the loader head of the mother conveyor. What gave it added impetus at this point was not in evidence. However, about 500 feet outby of the loader head the trolley wire was pulled in two, resulting no doubt in a very heavy arc, and again about 100 feet outby of that it was again broken and about 100 feet outby of that the end of the trolley wire at the sidetrack was pulled loose and thrown over the main trolley wire.

How far the flame actually extended was not evidenced. There was no evidence of any flame entering the three face left entries or of passing over the loaded cars on the sidetrack inby this point.

The body of the mine foreman, who was probably farthest inby of any of the group of men at the intersection of the Main and Main West entries, did not show any evidence of flame. His hair was unsinged. Neither did any of the other bodies found near him show evidence of flame, although they probably were subjected to heat.

It was said that flame passed out of the portals. However, this was not verified by eye witnesses nor by evidence, as all of the deposits along the ribs inby the portal and on posts directly in front of the portals and outside the mine showed only dust deposits, no soot being evidenced.

State Mine Inspectors' Conclusions:

Mr. P. H. Williamson, State Mine Inspector, represented the State Mine Inspection Department in the investigation. Mr. Williamson accompanied the investigating party into what is believed to have been the point of origin. Here while evidence was being examined and immediately following the finding of the remains of a burned match and the remains of a partly burned cigarette, which was approximately $\frac{2}{3}$ of an inch long, Mr. Williamson, together with Mr. H. H. Bodey, Inspector for the American Re-Insurance Corporation, left the party without advising anybody that they were leaving. On the road out of the mine they encountered a part of the investigating party and advised them that they had learned all they wanted to learn, and that in their opinion the explosion had been caused from smoking. Neither Mr. Bodey nor Mr. Williamson viewed all of the evidence.

Summary of Evidence as to Cause, Origin, and Propagation:

Evidently the electric drill was in operation at the moment of ignition. Critical examination of this drill showed conclusively that it was capable of igniting gas and was no doubt held only a few inches from the roof while in operation at the time.

While the evidence is not so conclusive that one of the auxiliary blowers was in operation at the moment of origin, it is the belief of the writer that it was, and in support of this belief it was found that the control switch located on the top of the fan housing was in running position and two pieces of weatherproofed insulated wire led from this knife switch on the blowing unit to the terminals of a knife switch located in a switch box adjacent to the master switch box. All of the contacts and switches were in live positions, although the two ends of these wires were loose at the knife switch terminals adjacent to the master switch when found on the morning of the investigation, but the switch box lid was open and these wires were inside the switch box.

No other parts of the electrical equipment were in operation at the moment of ignition. No open lights were found in this area, all persons being required to use portable electric cap lamps for all illuminating purposes. No remains of incandescent lights were found nor any socket available for their use in this area.

No shots had been fired.

The remains of a burned match was found, partly covered by fine coal, lying about 20 inches outby the handle of the electric drill. A portion of a burned cigarette, which was about three-fourths of an inch long, mashed flat, was found about 5 feet outby the electric drill and at a point where one of the bodies had been found.

The writer believed that there was evidence indicating that explosives had detonated at a point 10 feet distant outby and near the left rib of the radius plate. There was very heavy deposit of coke on

the coal faces at this point with a characteristic bluish cast on the coal and on the roof at this point. However, the report of analyses of this sample did not show any sulphates, chlorides, or nitrates, and it was believed that because of the absence of these the sample did not indicate that explosives had produced the coke. A copy of the letter report of this analysis is incorporated in the appendix.

The evidence indicating the point of origin was evidences of heat radiating from this area and of forces radiating from this area.

The exact cause of the ignition is not definitely known, but in the opinion of the writer the electric drill is the most probable cause, the electrically driven blower the second, and while evidence indicated that smoking was indulged in, this, in the opinion of the writer, would be the last accepted cause, as the evidence was found, in view of the evident practice of smoking, could not be accepted as conclusive proof that smoking was being indulged in at the moment of ignition.

Lessons to be Learned:

This explosion emphasizes:

1. That pre-shift examination, including gas inspection, of all active faces is imperative if maximum safety is to be realized.
2. That all active places should be effectively ventilated so as to prevent any accumulations of methane.
3. That the adoption of auxiliary methods of ventilation is decidedly hazardous in mines in which methane is apt to be liberated or is liberated.

4. That the operation of non-permissible electrical equipment in inadequately ventilated places or in places in which gas is apt to be liberated is hazardous.

5. That smoking in closed light mines should not be permitted.

6. That in every mine where closed lights are used, a pre-shift fireboss inspection should be made and at frequent intervals during the shift.

7. That all ventilating fans should be located outside the mine and protected from direct forces and should receive their power from power lines independent of any power lines located inside the mine.

Recommendations:

With the view of preventing a recurrence of such disaster, the following recommendations are offered:

1. That all active portions of the mine be thoroughly inspected by a regular, competent fireboss previous to each and every shift and at frequent intervals during the day. A written report of all pre-shift inspections should be recorded in a book kept for this purpose on the surface.
2. That the ventilating currents and air be so directed and coursed as to sweep all active faces and prevent the accumulation of gas.
3. That careful consideration be given to the use of line brattices in all ventilating currents in preference to using auxiliary blower units.
4. That if auxiliary blowing units are used, the blowing unit, together with all wiring and connections, should be located at a point on fresh intake air at a distance of at least 50 feet out-

by the breakthrough, crosscut, or opening through which the return air provided by the blower shall pass.

5. That regular complete survey of the ventilating system should be made at least once a month. Such survey should include air samples with analyses at strategic places at the return of all splits. These findings, together with interpreted analyses, should be recorded in the form of reports, a copy of which should be sent to the General Manager's office, the General Superintendent's office, and the Safety Engineer's office. In lieu of chemical analyses of air samples, the CH_4 may be determined by means of one of the several modern methane indicators now on the market and used by many mining companies.
6. That smoking shall be positively prohibited in any portion of a closed-light mine, and that if tobacco for chewing purposes are permitted, such tobacco shall consist of plug type tobacco and all types of tobacco that may be used in either pipe or cigarette should be excluded.
7. That the installation of any type of electrically operated equipment, including auxiliary blowers, if used, should be inspected by the mine foreman and their location and condition be approved before placed in operation.
8. That serious consideration be given to the adoption of only permissible types of electrically operated equipment in advance places or in sections known to be liberating methane or suspected of possibly liberating methane.

9. That if open type switches are used on cable assemblies, these knife switches shall be located at least 100 feet distant from dusty areas, active faces and on intake air.
10. That all cable connections shall be provided with fuses of proper capacity to afford protection.
11. That serious consideration be given to the adoption of only permissible types of electric drills that are to be used in advance places or at active faces. This recommendation is made because electrical drills are used at points where gas accumulation is most apt to be found. They are also used usually immediately following or during undercutting, which is a time when sudden outbursts of gas are most probable. The boring of the hole may liberate gas suddenly in an otherwise clear place. Thus the potential hazard of a gas ignition by means of unapproved and improperly maintained electrical drills is imminent.
12. That the storage of explosives and detonators shall be only at such points and in such manner as shall be designated by the Safety Engineer, and that any infraction of this rule shall be dealt with with the strictest disciplinary action, such disciplinary action to be invoked on the management as well as the miner.
13. That a rule be promulgated and strictly enforced prohibiting any but authorized persons from operating, attempting to place in operation, or otherwise handling or tampering with any electrical equipment.

14. That a rule be promulgated and strictly enforced providing that if electrically driven blowers are used, their location shall be designated by the mine foreman and that no person shall be permitted to change their location without their position being redesignated by the mine foreman.
15. That a system of checking men into and out of the mine be established, such check board to be located outside of the mine, such system to be so designed and operated that the location of every person underground is, with reasonable accuracy, indicated.
16. That only magnetically locked permissible type flame safety lamp or other permissible type methane indicator or detector be used for all gas inspections.
17. That the mine be thoroughly and effectively rock dusted, such rock dusting to be maintained to within 30 feet of all active faces.

Respectfully submitted,

Joseph F. Davies
Joseph F. Davies
District Engineer

APPROVED:

APPENDIX

COPY OF DR. C. E. BOWYER'S RECORD OF MEN KILLED IN DUNBY EXPLOSION

AT HAULAGE INTERSECTION:

<u>Number designating location of body on sketch.</u>	<u>Name</u>	<u>Cause of Death</u>
2	R. L. Marshall	Body burns
4	Charles W. Milam	Asphyxiation
5	Ransom Slomp	Asphyxiation
	Jessie Doyle	Asphyxiation
	Clyde Ward	Asphyxiation
	Alex Payne	Asphyxiation
	Clarence Reed	Asphyxiation
	C. W. Reese	Asphyxiation

**LOCATED NEAR VAGHS OF MAIN WEST IN EXPLOSION AREA AND INDICATED ON
LARGE-SCALE SKETCH:**

1	Ted Johnson	Body burns
2	Roscoe Smart	Heat & body burns
3	Walter Moore	Body burns
4	Lester Day	Heat & body burns
5	W. E. Burns	Heat & body burns
6	Don Jenkins	Body burns
7	Lafayette Blandell	Heat & body burns
8	E. L. Smith	Body burns
9	Kyle Fields	Body burns

C O P Y

Pittsburgh, Pa.,
August 29, 1934.

Mr. J. F. Davies,
U. S. Bureau of Mines,
Horton, Va.

Dear Mr. Davies:

This will acknowledge receipt of your letter of August 10 in connection with a can of coke deposits from the ribs in the Derby No. 5 mine, Stonaga Coke and Coal Co. It is noted from your letter that the sample of coke was picked from a rib at a point where you suspect some explosives had been detonated and that you desire an analysis to determine whether explosives entered into the coke.

Please be advised that the sample, on its receipt, was taken to Mr. Cooper of the Coal Laboratory, and we are in receipt of the following memorandum from him:

"In regard to the analysis of coke particles submitted by Mr. Joseph F. Davies from Derby #5 Mine.

"The type of analysis required for the sample is not usually made in the Coal Analysis Section. However, we tested the sample for sulphates, chlorides and nitrates, with negative results on all.

"Since we have no explosive chemists in our section I am not making any comments on whether an explosive entered into this coke. The sample should be referred to some one who has had experience with explosives."

Inasmuch as the tests made disclosed no sulphates, chlorides, or nitrates, it would seem to indicate that no explosives were present, or at least no solid particles sufficient to be detected by analysis.

The matter was also referred to Mr. Crawshaw of the Explosives Section who makes the following statement:

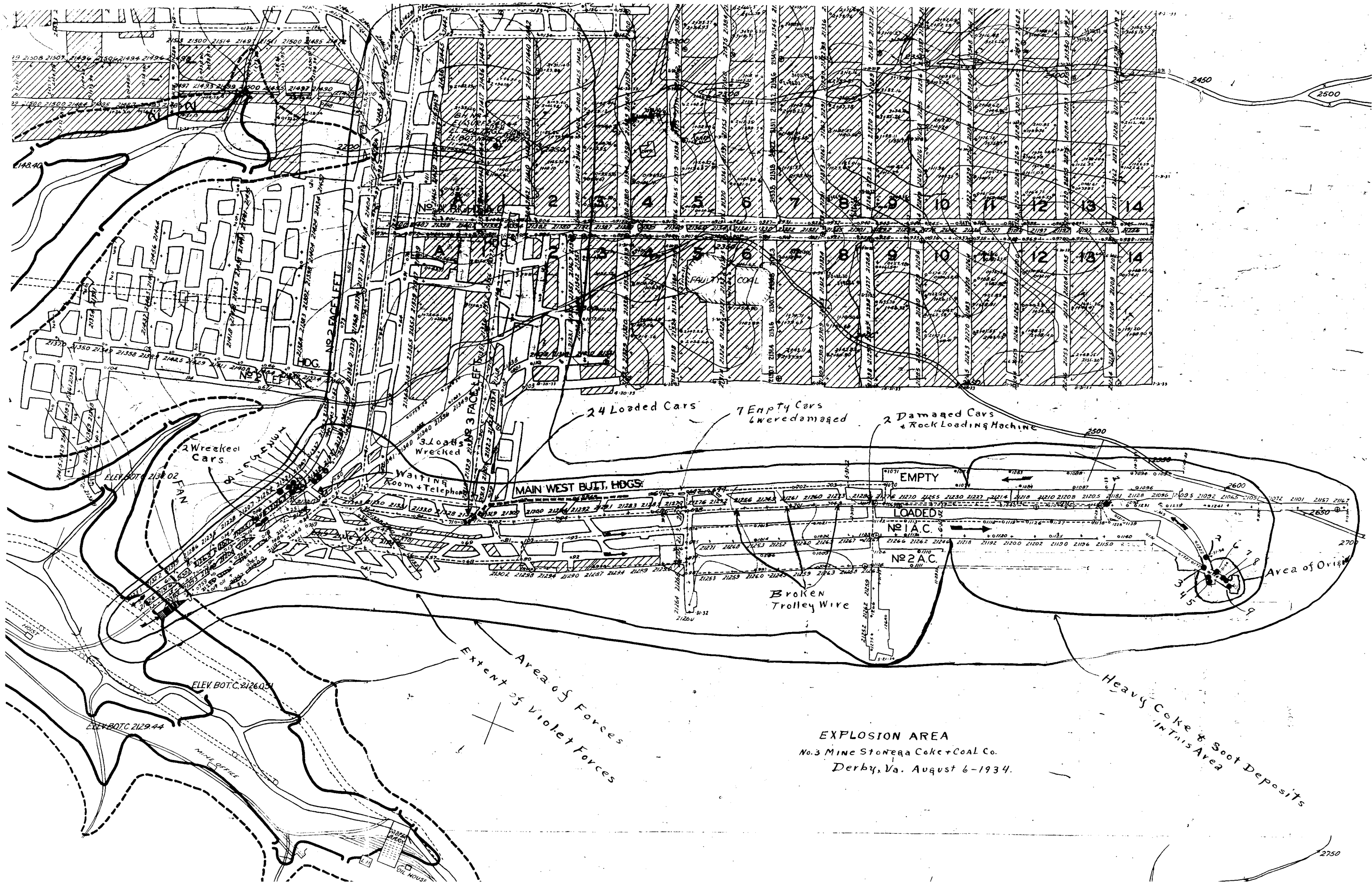
"I have never seen coke under the point where an explosive had detonated, as at that point the coal would be cracked and broken off below where any heat effects would remain."

Apparently, from the information received from the Coal Laboratory and Mr. Crawshaw, there is no way of making a more definite determination with respect to the presence of explosives. While no one can absolutely say that there were no explosives present, on the other hand, there is not sufficient evidence to warrant the statement that explosives were involved.

Yours very truly,

cc D. Harrington
Files

J. J. FORBES.




The map illustrates the Derby No. 3 Mine, showing a complex network of mine workings including shafts, tunnels, and air shafts. The mine is situated in a hilly area with contour lines indicating elevations. Key features include the 'Point of Origin' of the mine, the 'Main West Butt Headings', and various branches like the 'Boggs Branch', 'Wells Branch', 'Napier Branch', and 'Taggart'. The map also shows the 'Left Fork' of a creek and the 'Barrier Pillar'. A scale bar indicates a distance of 400 feet, and a north arrow is present. The map is titled 'DERBY NO. 3 MINE' and 'STONEGA COKE & COAL CO. DERBY, WISE CO., VA.'.

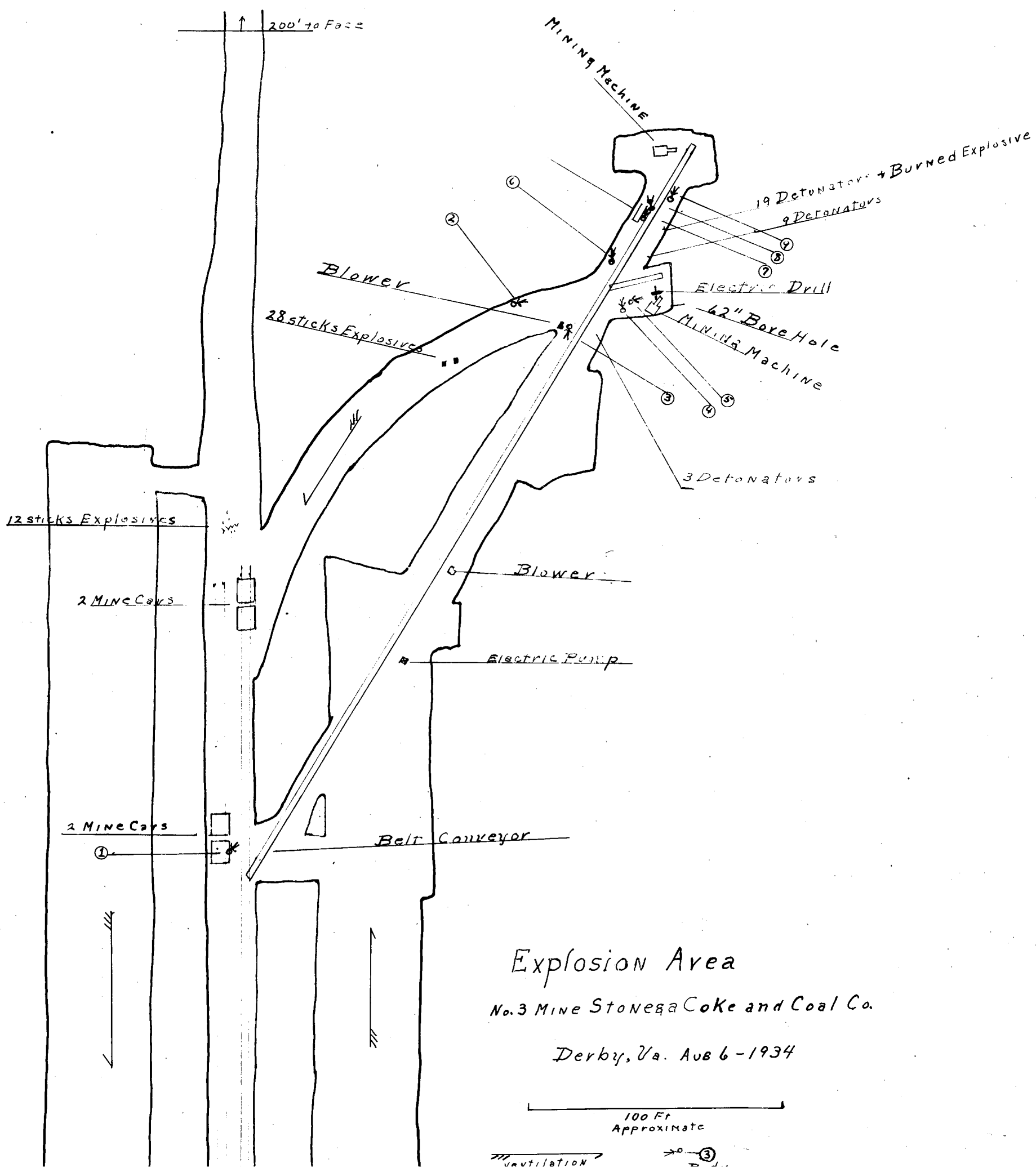
DERBY NO. 3 MINE
STONEGA COKE & COAL CO.
 DERBY, WISE CO., VA.
 ENGR. DEPT. BIG STONE GAP, VA.
 DATE _____ SCALE 1" = 400'

400 200 0 400 800 1200
 MARKER SEAM

DERBY NO.3 MINE
STONEGA COKE & COAL CO.
 DERBY, WISE CO., VA.
 ENGR. DEPT. BIG STONE GAP, VA.
 DATE XXXXXXXXXX SCALE 1" = 400'



MARKER SEAM



Explosion Area

No. 3 Mine Stonega Coke and Coal Co.

Derby, Va. Aug 6 - 1934

100 Ft. Approximate

Ventilation