



# Reports

Roslyn 1, 2 & 4

EXPLOSION AT ROSLYN MINES Nos. 1, 2, 4.  
of the  
NORTH WESTERN IMPROVEMENT CO.  
at  
ROSLYN, WASHINGTON.

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1909

On Sunday, October 3rd, at about 12:45 P.M. an explosion occurred in Mines Nos. 1, 2, 4, of the Northwestern Improvement Company's Roslyn group of mines, by which ten men lost their lives.

Location of Mines:

The mines are located at Roslyn, Washington on a branch of the Northern Pacific Railway; Roslyn is three miles from the station of Cle Elum which is on the main line of the Northern Pacific Railway.

Geology:

The "Roslyn Seam" which dips at an angle of about 10 degrees at this point, is the only bed at present worked in this field. There are other beds of coal in the Roslyn formation--some of them of economic importance--but they are not being worked here at the present time. The bed makes considerable water, and in these mines nearly all of it is drained into the sump at the bottom of No. 1 slope and is pumped out through the shaft in two lifts, by electric pumps.

Character and Thickness of Bed:

The "Roslyn Seam" is from 4½ to 5 feet in thickness and, near the center, has a band of about 1 inch thickness of bone, which

changes locally to clay or to sandstone. Where hard enough to make it possible to do so, this parting is rejected in mining. There is a layer of "draw slate" from 4 inches to 4 feet in thickness (average about 1 foot) immediately above the bed, which almost always falls with the coal. The main roof consists of about 4 feet to 14 feet of arenaceous shale, above which there is said to be strongly bedded sandstone. Except in a few small areas the roof requires considerable timbering. The cleat of the coal is very pronounced, and extends in a general North-South direction--the breasts of the rooms are kept parallel to the "face" of the coal, thus causing the breasts to be at an angle of occasionally as much as 45 degrees to the direction in which the rooms are advancing.

System of Laying out Mines:

These mines, all of which are connected so as to form practically one mine, are opened by two slopes and a shaft--the slopes, the entrance to which are very near together, are driven at a horizontal angle of about thirty degrees to each other, No. 1 slope being driven straight to the dip of the bed. The shaft (known as No. 4 shaft) connects with the 8th E. level at a point near No. 1 slope. The coal mined in the workings of No. 1 slope is hauled along the levels by mules or electric motors, up the slope to the 8th level by rope, and from there hoisted up the shaft; there is no haulage on No. 1 slope between the mouth and No. 8 level. The coal mined in the workings of No. 2 slope is handled the same way except that there is no shaft, so that it is hauled all the way outside along the slope. The slopes are connected by a system of double entries or pairs of levels driven at intervals of from 300

to 500 feet(horizontal distance). From these levels, batteries of rooms are driven to the "rise"--the number of rooms in a battery (generally six double rooms) and the distance between the batteries, vary with the cover and other local conditions. Each battery is "holed through" to the aircourse above in from one to four places--generally in three places. No. 1 slope is down, past the 14th W.level; No. 2 slope is down to the tenth W. level.

#### Ventilation:

No. 4 shaft serves as a downcast, supplying the air for all the workings except for a small area on the No. 2 side, which is supplied from an air shaft. There is a fan at the entrance to each slope (a Robinson at No. 1) exhausting the air from the mines. These two fans are "boosted" by small disc-fans set in the air-ways (in return air) in various parts of the mines, and connected by belts to electric motors. From the evidence at the inquest the air furnished was ample. Although the mines made considerable gas, they were worked on open lights almost entirely, and no one had been burned by igniting gas for some time--probably more than two years. At the same time, the writer was informed that if one of the "booster" fans stopped, conditions were such that the men in that district had to be immediately removed until that fan was repaired and started.

#### Surface Phenomena Connected with Explosion:

The flames burst out of No. 4 shaft in a pillar, the height of which is variously estimated at from 150 to 400 feet, setting fire to the headframe, tibble, snow sheds etc. and com-

pletely destroying them. The power house and other structures near the shaft were fired, and in fact numerous buildings scattered about the town were set fire to, and there was considerable difficulty preventing further loss of property on the surface. No flame or smoke came out of the returns. The fans were not damaged, but they came to a stop because of the strong draft up the shaft, caused by the first outrush of flame which fired the shaft timbers and thus caused the "natural ventilation" to work against the fans. The fans were almost immediately reversed, with the idea that this would assist in getting the fire in the shaft under control and prevent it from "working into" the mine.

At the time of the explosion there were six men working on the tibble and near the headframe, at No. 4 shaft. Of these five lost their lives, the sixth escaping with slight injuries. The bodies of two were never recovered, and it is supposed that they were burned in the ruins. The remaining three were all thrown a considerable distance--two had their clothes burned off and there was considerable difficulty in identifying them.

#### Extent of the Explosion:

Had the explosion occurred on a work day probably between three and four hundred men would have lost their lives. At the time of the explosion five men were known to be in the mine; two trackmen, Pozavich and Tonich working in the 11<sup>th</sup> level not far from the face; two trackmen, Hardy and Bartolero working on the 8th E. near the shaft; and one pumpman, Jones in pump room off the 12th E. near #1 Slope.

While the explosion spread into mines Nos. 1 and 2 to some extent, the evidences of greatest violence were found in No. 4

mine below the 7th level. The tremendous concussion and the subsequent burning out of the timbers, caused the shaft to collapse and probably set fire to the coal at the bottom. A large stream of water was turned down the shaft as soon after the explosion as possible and was kept running for about forty-eight hours until the smoke had subsided. Numerous caves occurred throughout No. 4 mine. No. 1 slope was completely blocked between the 7th and 8th levels and these levels themselves together with the 9th E. and W., the 11 W. and 12 E. levels were so nearly blocked in the immediate vicinity of each slope that it was not possible to find an entrance into the parts of the mine most affected by the explosion, until some days had passed. Numerous very heavy falls occurred between No. 1 slope and the shaft so that the bottom of the West side of the shaft was not reached for about a week or ten days after the explosion.

Exploration and Investigation:

On Sunday night, Oct. 3rd, a party entered the No. 1 slope and attempted to reach the shaft bottom. It was found that the slope had been blocked by a cave so the party returned to the surface and attempted to go in the No. 2 slope; when they had gone about 3000 feet, two of them were overcome by afterdamp and reinforcements were required to bring them to the surface. On Monday evening the two Draeger helmets from the A.Y.P. Exposition arrived, but since the men who brought them had never used them in the mines, the management would not permit their use here. Numerous other attempts were made to gain an entrance into the mine. By bratticing down No. 1 slope to the 5th East Level, then sealing off the slope

and sending all the air to the east side the ventilation was good enough to explore this side. Finally a route to the mule stables was found through the old works between the 5th E. and the 8th E. This route was very difficult to travel, it was supposed before the explosion the places had caved tightly and that it was impossible to get through, but at last a possible if extremely rough way was found. Many places the roof was in such shape that there was great danger of it falling, if the slightest disturbance occurred, in fact subsequently it did fall and a party was entombed for about half an hour, until they dug themselves out.

From the barn the party bratticed down the airway to the 10th East and thence out to the No. 1 slope. They had reached this point when Dr. Holmes and the writer arrived on the evening of the 5th.

On Thursday evening a party of six including: Botting (State Inspector of Coal Mines), Thomas, Corey, Kale, Morris and the writer entered the No. 1 slope equipped with three Draeger Machines (two of them with single oxygen cylinders and good for but one hour each), and Wolfe safety lamps. There were no electric lights to be had. This party proceeded by way of the old works to the mule barn on the 8th level. Here Thomas and the writer put the helmets on and went as far as possible in the direction of the shaft, were stopped by caves opposite the pump house and returned to the party without having seen any evidences of fire. The party then proceeded down the airway to the 10th East and out to the slope, where it joined the bratticing party.

Both parties followed the air down the slope to the 11 West. As the current was good at this point and part of the air was travelling down the slope a small party was sent down the slope to the 12th East

pump house, where the body of the pumpman, Jones, was found. The bratticing party started on the tortuous trip outside with the body, and the other party returned to the 11th West. Thomas and the writer put on helmets, leaving Mr. Botting with the third helmet, and followed at a distance of 50 to 100 feet by Corey and Hale without helmets went in the 11th West to a point just beyond No. 1 room of the third battery. At this point the air became bad and the men without helmets were compelled to turn back a short distance to good air and await the return of the helmeted men. The latter proceeded only four or five hundred feet when enough gas to greatly disturb the safety lamps, was encountered, and they were compelled to turn back, for fear of losing their lights. Since there was very little Oxygen left in the machines and there were no electric lights in the party they then returned to the outside. A bratticing party was sent in to take the air to the point reached by the helmetmen.

On the following evening a party of seven including Inspector Botting, Corey, and the writer went in as far as the air was good on the 11th W. aircourse (this was to a point opposite No. 1 room on the third battery). Botting, Corey, and the writer put on the helmets and went up near the face where the two track layers had been at work and found them lying in-by 30-50 feet from where they had been working. As there was a trip of cars and the entry was almost blocked by falls at several points between them and the remainder of the party, no attempt was made by the helmet party to take the bodies out. The bratticing was brought up to them and they were recovered the next morning, without the use of the helmets.



On subsequent trips into the mine, the attempt was made to cover the territory most affected by the explosion and to determine the cause and point of origin. The part of the mine below the 8th W. Level was gone through fairly systematically. One day was spent in entering the mine through the old works on the East side of No. 1 slope and returning via the 10 W. Level out the No. 2 Slope. Another day was spent in the vicinity of the No. 1 Slope dump and the lower levels turned from No. 1 Slope. Several trips were made up the No. 1 Slope from the 10 W. to the 8 W. going in each level as far as falls would permit. Two trips were made to the West side of the shaft bottom, and through the airways in the vicinity.

Cause of the Explosion:

In this as in many other similar cases the cause and the point of origin of the explosion are very obscure indeed. The time that could be spared to the examination was entirely inadequate for a thorough investigation of the area affected by the explosion, and it was possible to cover the ground, only in a very hasty manner. It was originally planned to return for further examination, but subsequent happenings prevented, so that this discussion is admittedly based on rather a meagre supply of data.

As was shown at the inquest, the regular examination of the old works had been made by fire bosses Saturday, the day before the explosion, and nothing unusual had been found. No shots had been fired since the shot lighter made his rounds on Saturday evening before the explosion. The fire bosses made their regular rounds on Sunday morning before the explosion and all was clear with the ex-

ception of the 14 W. level, where some gas was found. This gas had been cleaned out before the fire bosses left the mine as was shown by an incident brought out at the inquest--one of the fire bosses took two of the electricians into the 14 W. to show them the action of gas in a safety lamp; they could not find enough gas to give a cap in a safety lamp although they hunted for some time. So the mine atmosphere must have been in fairly good condition. Since the fire bosses on their rounds had oiled all the auxilliary fans and seen that they were in good condition, and it is known that the outside fans were all right, the ventilating current must have been normal. Hence we are justified in concluding that there was no body of gas sufficiently large to cause an explosion violent enough to cover the large area that this one did, unless coal dust carried the flame, after the ignition started. There are also other factors which will be mentioned later, that leave little room for doubt that this was essentially a dust explosion--whatever may have been its origin.

In attempting to determine the cause of the explosion, only three possibilities presented themselves, or were presented by the discussions, viz:

(1) It was purely a dust explosion, caused by a blowout shot or a badly planted shot which had "smoldered" from the time the shot-lighter made his rounds on Saturday night until about 12:45 P.M. next day when it went off causing the explosion. This seemed rather "far-fetched" and unlikely from the first and on investigation no evidences of blown-out shots could be found. Furthermore, at the inquest, the shot-lighter declared that without any question every shot that he lit that night, went off very shortly afterwards and that he returned and examined the places and found everything in good condition in every instance.

*condition of man*

(2) It was a dust explosion caused by a small gas explosion originated by one of the men. But all of the men were found in the immediate vicinity of their work, their hair was not singed, their faces, hands and clothes were not burned and there was no evidence of fire about them. They had no occasion to use explosives; none was found where they were working, and so far as is known they had taken none into the mine that day. So it is impossible for the writer to believe that these men had anything to do with originating the trouble. If they had started a gas explosion they would almost certainly have been burned.

Jones was found in the pump room on the floor. He had apparently fallen forward from the place where he was accustomed to sit, and was resting on his hands and knees with his face in a small stream of water which runs through the pump house. At first this seemed rather significant--as if he might have thrust his face into the water to relieve himself from the effects of the after damp--but on examination his neck was found to be broken and it was decided that he had probably been killed instantly by the concussion. His hair and clothes were not burned, there were no signs of fire in that vicinity. Although there were numerous pieces of paper, canvas that had been used as curtains, etc. in this part of the mine absolutely no signs of flame could be found--the ravelled edges of the canvas (ducking) had not been singed. On the other hand, there was abundant evidence of extreme violence in this vicinity, an eighteen inch thick concrete dam not more than 100 feet below Jones was shattered, an overcast about 200 feet above him was demolished; the booster fan, a short distance in-by on the 12th East, was broken up and distributed

along the aircourse for a distance of 50 feet or so. But the dust in this vicinity was sooty, and "greasy" as if it had been acted upon by heat.

Pozarich was found on the 11th West some 30 or 40 feet inbye from the track laying tools, at a point indicated on the map. He was lying with his head against the rib, in the crosscut, part of his body being in the crosscut and part of it in the entry. There was a piece of 8x10" timber about four feet long, lying across his neck and apparently his head had been crushed between this and the rib.

Tanich was found in the crosscut indicated on the map, nearer to the tools. He was lying face downward with his head in-bye. There were no signs of flame found in this vicinity. Neither of these men had their hair or clothes burned and the edges of the canvas near them were unburned.

Bartolero and Hardy were found under the rock at the bottom of the shaft, some months after the explosion. The details of their positions are unknown to the writer. In the vicinity of the shaft bottom there were no evidences of flame; the writer picked up a new piece of "gunny-sacking" from the floor near the shaft bottom, and on making a most careful examination was unable to find any trace of flame.

So there seems to be absolutely no ground for the belief that the trouble was originated by one of the men in the mine at the time of the explosion.

(3) The only other cause that suggested itself to the writer was "sparking" electric equipment coming into contact with a small body of gas, igniting it and thus starting a dust explosion. On further investigation this was found to be the most reasonable con-

clusion. The mines were so badly wrecked--especially that part of No. 4 already mentioned--that it was in many instances practically impossible to trace the "direction" in which the explosion had travelled. Very often, in fact probably in a majority of cases, the evidence showed that the "blast" had travelled "down and back"--in one instance in particular such evidence was unmistakable. The blades of the auxiliary fan on the 10 W. were bent in one direction, while the whole fan was moved in the other; in another instance a large piece of sheet iron and some rope-sh<sup>o</sup>ives were found blown a long way down the slope (No. 1) while some loose wires were found wrapped around bolts (on a hoist sitting near this point on the slope) in such a manner that there was no room for doubt that they were being carried up the slope at the time they caught on the bolts. In still other instances there was fairly good evidence to show that the blast had travelled along the entry three or more times. We know from past experiments on the Gallery in Pittsburg that a vacuum almost always follows a violent explosion. In other explosions it has often been noted that the blast travels down and back, so that the idea of finding the point of origin by tracing down the "directions of force" had to be abandoned. An attempt was made to plot on the accompanying map the direction of the "initial blast"--or perhaps better, the direction in which the heaviest articles had apparently been moved. But often times this was rather uncertain, so that it would not be surprising to find that there are some errors in this plotting.

In the exploration, one part of the mine--viz: the 10th West

level and air course, from the auxiliary fan to the face, and in the rooms turned from the level between the fan and the face--was found to show much greater evidences of flame than any other. There was considerable coke on the props in the rooms, and on the timbers in the level, between the fan and a short distance in-by the No. 2 slope. On the aircourse, between the fan and the No. 2 slope, there is evidence of very great violence. The crosscuts between the level and the aircourse had been stopped with wooden stoppings<sup>and</sup> piled partly full of rock; the explosion picked this material up, drove it across the level and piled it against the upper rib, overturning the track and leaving it turned on its side between the piles of rock and the rib. In some cases the writer estimates there was as much as eight or ten tons of rock from each cross-cut piled up in this manner. Out-by (toward the No. 1 slope) from the fan the disturbance was relatively rather slight on the level. The blades of the 10" fan were bent as if they had been struck a blow from the direction of the No. 2 slope while the whole fan had been moved toward the No. 2 slope.

At the inquest it was found that the men working in the rooms of the third battery of the 11th West level, had removed their tools on the evening before the explosion, because the pillars had been drawn and it was expected that a cave would occur before they would return to get their tools. On investigation after the explosion it was found that this cave had occurred. These rooms had been holed to the tenth West Aircourse at a point some distance out-by the fan mentioned in the preceding paragraph, so that the air travelled up these rooms into the 10th W. aircourse, through the fan and on out the No. 2 slope.

Almost all the gas in these mines comes from the roof--so much so that the men know that they must be careful where the roof is bad or a fall is expected. Now it is the idea of the writer and the evidence is such that Mr. Botting, State Inspector of Coal Mines and others who investigated the explosion are agreed that the fall of roof in the rooms mentioned above must have occurred some time on the morning of the explosion, liberating a considerable quantity of gas. This gas was carried by the ventilating current, out past the 10th W. fan. After most of the gas had passed through the fan, something occurred to ignite the mixture and this was sufficient to start the dust explosion, which wrecked the mine.

There are several possibilities to consider in connection with the actual ignition point. There is little if any evidence of flame, or coking or charring of the dust at the fan or on the woodwork near it, in fact the action on the material in the crosscuts was not violent until several cross cuts in-by the fan had been passed. That it is possible that the fan could ignite the mixture and still not have the woodwork of the fan support show any evidence of flame the writer is convinced from a recent mine accident where an ignition of gas in which several men were more or less severely burned left no trace of the fact that flame had passed over the places where the men were burned. In this recent instance the flame travelled down the entry a hundred feet or more as was conclusively proved by the men who were burned; but the most careful investigation made with electric flash-lights failed to reveal any coking of dust or charring of small splinters on the timbers, anywhere along this hundred feet.

Hence the writer believes in this case, the main body of gas could have been ignited by a "streamer" of gas extending from it to the fan motor. It is equally possible, and perhaps more probable, that the gas was ignited by a short circuit on the wires which brought the current along the airway between the No. 2 slope and the fan. However there can probably never be any certainty about the exact manner of ignition; this is offered only as a possibility and further discussion would be a useless waste of time.

The disturbance along the 10th West level out-by from the fan (between the fan and No. 1 slope) was very slight indeed, there were a few small roof falls, the trolley wire was down in a place or two, and the stoppings out but otherwise things were in fair shape. Just inbye from the fan the disturbance <sup>was</sup> ~~has been~~ violent in the extreme, as already described. The only part of the mine which shows unmistakable evidence of flame is that part in the vicinity of this fan. In view of the evidence given above that the explosion did originate in the vicinity of this fan, and in the total absence of evidence that it could have started elsewhere, the writer feels that there can be no reasonable doubt that this fan or the electrical equipment in connection therewith, should properly be blamed for causing the explosion. Hence it is urgently recommended that in future, any system of ventilation which necessitates placing electrically driven "booster-fans" on return air currents, shall be unconditionally condemned, and that any mines using this system at present shall be immediately so arranged that such assistance to the outside fans shall not be necessary.

Course of Explosion:

As nearly as it can be traced the explosion travelled from



the 10 W. Fan along the 10th W. Level and aircourse to the face, at the same time spreading upward along the No. 2 slope and through the rooms off the 10th W. level between the fan and the No. 2 slope, to the 8th W. and along the 8th W. toward the No. 1 slope. Somewhere between the slopes the greater part of the explosive wave seems to have worked down onto the 9th W. level and to have travelled along it and to have emerged from it onto the No. 1 slope, as is shown by the fact that all timbers on this slope are knocked down the slope, immediately below the 9th, and up the slope immediately above it. From this point it is not very clear just what did happen, but apparently the explosive wave divided, part of it going up the slope to the 8th East and along it to the shaft and outside, the other part seems to have crossed the slope to the aircourse, travelled down the aircourse (spreading out to the faces of each of the East levels) to the sump where it crossed and came back up the slope, spreading out along the 14th, 13th, 12th and 11th W. levels. Out-by the 10 W. fan where the rooms had been holed through from the 11th W. to the 10th W. aircourse, the blast was apparently from the 10 W. aircourse toward the 11th W. level.

General Discussion:

There are nearly always some points in connection with a mine explosion, that cannot be explained; in this case there are numerous ones that the writer has not even attempted to account for, even for his own satisfaction; possibly some of these latter could have been cleared up if it had been possible to spend more time on the examination. However, some noteworthy points are already clear to the writer, and will be explained. For instance, objects on the

