

FINAL REPORT
of
GAS EXPLOSION
in
ROCK SALT CORPORATION SHAFT
located at
ITHACA NEW YORK
July 10, 1917

INVESTIGATION BY:+

D. J. Parker, Mine Safety Engineer.
E. H. Denny, Assistant Mining Engineer.
W. B. Plank, Assistant Mining Engineer.

Report by W. B. Plank.

Urbana, Illinois,
August 24, 1918.

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REPORT OF GAS EXPLOSION IN
ROCK SALT CORPORATION SHAFT
ITHACA, NEW YORK
JULY 10, 1917

REPORT

BY

W.B. PLANK.

INTRODUCTION

On July 10, 1917 at about 12:20 A.M. a gas explosion occurred in the shaft of the Rock Salt Corporation, near Ithaca, New York, resulting in the death of one man and the serious injury of another, who died from his injuries about one month later. The injured man was rescued from the bottom of the shaft, then 835' deep, by Bureau of Mines men, about 24 hours after the explosion occurred. At the time of the explosion the shaft was under process of sinking to develop a bed of rock salt 60 ft. thick, occurring 1500 ft. below the surface.

GENERAL INFORMATION.

Location:-

The Rock Salt Corporation shaft is located in Tompkins County, New York along the east bank of Lake Cayuga, about 3/4 miles south of Ludlowville, and about 10 miles north of Ithaca. A branch of the Lehigh Valley Railroad runs very close to the shaft.

Ownership and Operators:-

The officials of the Rock Salt Corporation are as follows:

John Clute--President.
M.E.Calkins--General Manager and Supt.
James Quayle--Mine Captain.
J.B.Calkins--Assistant General Manager.

The post office of the Company and the mine is Ithaca, New York.

Adjacent Operations:-

At Ludlowville, about 3/4 of a mile north of this shaft, a number of salt wells have been in operation for some years.

The salt is extracted from these wells as brine.

The history of the development of the salt industry in this region is given by Phalen as follows:-

"In 1891 a well was sunk to the salt bed at Ludlowville, Tompkins County, and a second well was put down in 1892. In 1895 another well was drilled at Ithaca, north of a well put down in 1885. A shaft is reported to have been begun on the shore of Lake Cayuga south of Ludlowville in 1916". (Phalen W.C., Technology of Salt Making in the United States; U.S. Bureau of Mines Bulletin 146, 1917, p.7).

NATURAL CONDITIONS.

Geology:-

The salt occurs in the Salina formation which extends from the Niagara River across Central New York to a little south of Oneida Lake. Its greatest width about 20 miles is at the foot of Cayuga and Seneca Lakes.

Drill hole records show that at the shaft location the salt bed is 1500 ft. deep, and is about 60 feet thick. The upper half of the bed is said to be very pure rock salt.

The strata gone thru down to the 835 ft. level consisted chiefly of grey shale, but at the time of the explosion a darker

shale appeared from which gas issued in rather large quantities. An analysis of this dark shale is given in the appendix.

Development:-

The shaft when completed will be 1500 feet deep and have a clearance of 21' 2" X 9'. At the time of the explosion sinking had progressed to the 835' level. Small drifts or landings are made at the 400, 600 and 800 ft. levels, 20', 30' and 20' long respectively. These landings are used as safety places for the men while blasting and also for material depots.

Men employed:-

In the sinking operations 43 men were employed in the shaft and 40 on the surface. The work was done in three shifts of 8 hours each.

Explosives:-

About 40 lbs. of 40% low freezing Du Pont gelatine dynamite was used per day in blasting the rock in sinking. Both #8 instan-

taneous and #6 delay detonators were used and fired by electricity by 3 shotfires after the miners were out of the shaft. The maximum diameter of the drill holes is 1 1/4" , and the maximum charge was 8 sticks.

Several months previous to the explosion four men were seriously injured by a premature blast in the shaft caused by using a testing galvanometer in which the regular electric cell had been replaced by two stronger flash light cells.

Method of sinking:-

Compressed air drills are used for drilling the holes for sinking. One compressor supplies the air for these drills at 100 # pressure.

The arrangement of the drill holes is shown on Plan B-375 in the appendix. #1 hole is put down in the center of the shaft usually about 16 ft. deep.

Holes 2 to 11 inclusive, are drilled at an angle of 5° from the vertical and towards the center of the shaft. The purpose of these holes is to make the first excavation in the center of the shaft, and for that reason are called "sink holes". They

are drilled about 8 ft. deep. Holes 12-13-14 are called "bench holes" and are from 5' to 8' deep. Holes 15 and 16 are put down along the edge of the shaft to square up the sides and are called "trimming holes".

The shots are loaded and fired by the shotfirer usually at lunch time when the miners are out of the shaft. Loose sand is used for stemming material and the holes are not tamped.

During June 1917, the shaft was sunk a distance of 109' which was a record accomplishment up to that time.

Occurrence of gas:-

It was said that small pockets of gas were met with in the shaft at intervals during the sinking process before the explosion, but they were usually very small and became exhausted in a short time without giving any trouble. Some slight commercial use has been made of the gas met with in wells put down thru this same formation at Watkins, New York.

A cross-section north and south thru the Rock Salt shaft shows that it is located on the side of an anticline where gas may be expected. At Ithaca, 6 miles south of the shaft the

salt stratum lies 2100 ft. below the level of Lake Cayuga, and at Ludlowville $3/4$ mile north of the shaft the wells are 1250 ft. deep to the salt stratum, while at the shaft the salt lies 1500' deep.

During the afternoon shift of July 9, about 10 hours previous to the explosion a considerable quantity of gas was met with while drilling the holes at the 835' level and it was the ignition of this gas that caused the explosion of this report. The details of this occurrence of gas will be given later under the discussion of gas conditions.

A sample of this gas taken from hole #2 on July 9 was analyzed by Professor Dennis, Head of the Department of Chemistry, Cornell University. It was said that the results of this analysis showed that the gas was very pure methane with traces of the higher hydrocarbons.

Hoisting and Pumping:-

The hoisting during the sinking operations was by means of a bucket operated by a second motion steam engine. The bucket

was equipped with a wooden cross-head which worked on guides and was designed to keep the bucket from swinging in the shaft. The cross-head in its downward path traveled only to the end of the guides, about 50 ft. above the bottom of the shaft, where it was caught by temporary blocks or pins. The rope passed on thru the cross-head when the bucket was lowered to the bottom of the shaft to be loaded.

No safety devices were provided on the cross-head which would prevent it from sticking in the shaft when on a downward trip while the rope and bucket continued on down. The subsequent loosening of the cross-head and crashing down on the bucket might have resulted in the injury to the men at the bottom of the shaft. The writer is informed that such an accident has occurred since this investigation, but fortunately no one was injured. A safety device has since been provided so that the bucket is prevented from going further if the cross-head sticks while on a downward trip in the shaft. The shaft was also provided with a separate bucket hoist adjoining the airway used as an emergency hoist for men. This was seldom used, as the men were usually hoisted and lowered in the main hoisting bucket.

At the north end of the shaft steel stairs were provided as an emergency exit for the men in the shaft.

The bucket landing on the surface was 20 ft. above the ground level. The rock was dumped into a chute and loaded into small cars and hauled to the spoil bank between the shaft and Lake Cayuga.

(See Plan E-94 and B 375 for plan and details of the shaft)

When completed the shaft will be equipped with double balanced skips operated by a 500 H.P. electric motor. It is expected to produce 1500 tons of rock salt per day.

No pumps were required as the shaft was practically dry. Only a little water issued from the strata near the surface and this was bailed out when necessary.

Lighting:-

The miners working in the shaft all used open carbide lights. The landing on the surface was lighted at night by electric incandescent bulbs.

On July 9, the day previous to the explosion, after the gas

was met with at the 835 ft. level, it was not possible to use open lights in the shaft, so the work of drilling the holes was continued by the use of hand electric flash lamps similar to the Ever Ready flash lamp, and hand lamps fitted with an ordinary single dry cell. Also the electric bell signal wires which extended from the surface to the bottom of the shaft were utilized on the night of July 9 to carry current from the surface to incandescent bulbs at the shaft bottom. These electric lights were not safe for use in gas. The use, especially of the incandescent bulbs was extremely hazardous under the circumstances.

No fireboss was employed and no safety lamps of any kind were available at the shaft prior to the explosion.

Ventilation:-

The shaft was equipped with an air compartment extending from the surface to about 50 ft. from the bottom and separated from the rest of the shaft by plank partitions. This compartment also carried the electric signal wires and the compressed air pipes.

Ventilation was natural, the airway being the upcast. This arrangement was satisfactory until the shaft became too deep, when in order to obtain better ventilation a section of 20 inch steel spiral pipe 25 ft. long was erected at the top of the shaft so as to extend the up cast about 25 ft. vertically above the mouth of the intake. The upper end of this pipe extended up thru the temporary head frame timbers and was about 5 ft. vertically above the bucket landing. Sufficient pipe had been procured to extend this to the bottom of the shaft but it was not installed at the time of the explosion. (See Plan B 375)

STORY OF THE EXPLOSION:-

Local conditions:-

On July 9, at about 2 P.M. about 10 hours preceding the explosion, gas under considerable pressure was met with while drilling hole 2. (See Plan B 375) The gas was struck at a depth of 5 feet and it issued with such force that the drill and water were forced

out of the hole. It is said the water was forced about 8 ft. into the air when the gas was first struck.

Louis Peragastine, the shift boss, went to the surface and reported the occurrence of gas to James Quayle, the mine captain. In the meantime the gas issuing from hole 2 was ignited by a miners light. The only disturbance was a slight puff and then the flame was extinguished. This, however, also extinguished the lamps of all the miners, 13 in number, who were working in the shaft at the time.

All the men then climbed up the compressed air pipe to the first shaft timbers about 18 ft. above the bottom and from there by a ladder to the 600 foot level. They rang a distress signal to the surface which was responded to by J.B.Calkins, Louis Peragastine and Merit Brotherton who went down the shaft in the bucket carrying electric flash lights. Some of the men started to climb out of the shaft in the meantime and six were brought from the 600 ft. level and seven from the 400 foot level.

No one was then allowed to enter the shaft until 3 P.M. when the new shift came to work. Two or three men from the new

shift then entered the shaft carrying hand electric flash lights and drilled holes 3, 4, 5 and 6 and started hole 1, striking gas only in holes 4 and 6. When these holes were completed the gas had almost stopped issuing from hole 2.

At 6:30 P.M. the Company officials had procured from Ithaca eight (8) hand electric battery lamps referred to previously under "Lighting". Also about this time a string of incandescent electric bulbs (110 V A.C.) were connected to the bell wires previously referred to, and hung near the shaft bottom to provide more illumination. Then at 7 P.M. the whole crew of 9 men went down the shaft with these lamps and from then until 12 P.M. drilled holes 1,7,8,9,10,11, 12, 13,14,15 and 16. Gas was struck in holes 9,10,11,12,14,15 and 16. Hole 11 was the strongest blower which continued to blow for sometime. At noon of July 11, at the time of the investigation this hole was still blowing with a loud noise that could be heard 50 ft. above the bottom of the shaft.

At midnight the battery electric lights began to play out so the shift boss sent all the men out of the shaft except two.

Also at this time the electric current supplying the incandescent bulbs went off due to a fire along the transmission line a half mile away.

All the men came out of the shaft except Brotherton and Freeburg who remained in the shaft in order to extend the electric light wires nearer the bottom while the electric current was turned off.

When the electric current, which also supplied the lights on the surface, went off it was necessary to provide some other means of illuminating the landings on the surface, so for this purpose some open flame oil lanterns were hung on the timbers at the bucket landing. (See Plan B-375)

It is said that the air compressor which was supplying air for the drills was shut down at this time, but it was started up immediately after the explosion and run continuously for several days thereafter.

THE EXPLOSION, AND RESCUE AND RECOVERY WORK:-

About 12:20 A.M. July 10, J.J.Quayle, Jr. who was acting as tap man at the time, noted a blue flame shooting from the top of the 20" spiral pipe extending up in the headframe for ventilating purposes. He was standing at the ground landing at the time and ran up the stairs to the bucket landing in order to extinguish the flame. He was in the act of putting his coat over the end of this pipe to beat out the flame when the explosion occurred. He was thrown around somewhat and scratched by flying debris but was otherwise uninjured.

People nearby noted three distinct explosions accompanied by sheets of flame from the top of the shaft. It is said that large volumes of light colored smoke issued from the shaft after the explosion.

At 4:15 A.M. July 10, Mr.Parker, Mine Safety Engineer at Pittsburgh received a telegram from the Rock Salt Company asking for aid from the Bureau, and later communication was had with the Company by telephone, when it was learned that two men were entombed in the shaft as a result of the explosion.

Rescue Car 6 which was at Winburne, Pa., was ordered to proceed to the scene of the disaster at once and Messrs. Parker, E. H. Denny and the writer left Pittsburgh for Ithaca at 10 A. M. via Pittsburgh and Lake Erie R. R. The Lehigh Valley R. R. held their train at Buffalo, N. Y., for 18 minutes, for the Bureau party. The party arrived at Ithaca at 8:30 P. M. and were at once taken by auto to the shaft, 10 miles distant, arriving there at 9:30 P. M. Owing to poor train connections, Car 6 could not reach Ithaca until after the completion of the rescue work so it was ordered to return to Winburne. Although then about 20 hours after the explosion, nothing had been done towards the recovery of the men in the shaft or toward examination or exploration of the shaft. The statement was made by the officials that they had telephoned to the Bureau of Mines at Pittsburgh during the day and had been advised not to proceed with the recovery work until the Bureau men arrived. Later inquiry there and at Pittsburgh developed the fact that the Superintendent of the Pittsburgh Station had given this advice concerning the inadvisability of allowing a fireman from Syracuse, New York, equipped with a helmet type of breathing apparatus, to enter the shaft alone.

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of

It was thought by some of the officials the Company that a fire was still burning in the shaft because a white haze was issuing from the shaft which was supposed by some, to be wood smoke. An examination of the air uptaking in the shaft, by means of a safety lamp and by smell indicated that there was no fire in the shaft and no gas could be detected at the surface. The hoisting bucket was then lowered to the bottom of the shaft and brought up after about 10 minutes. There was no evidence of heat about the bucket. Then at 10:20 P. M. a black cat was tied and lowered to the bottom of the shaft in the bucket and kept there for 10 minutes. When brought up the cat was found alive and clinging to the edge of the bucket and apparently no-wise affected. At 11:10 P. M. two flame safety lamps were lowered hanging to the bale of the bucket, and allowed to remain at the bottom of the shaft for several minutes. When raised, one was still burning, the other had fallen to the bottom of the bucket and was extinguished, but the glass was unbroken.

These two tests before entering the shaft showed that the air in the shaft was respirable and that the percentage of methane was not high enough to extinguish a safety lamp.

It was then decided to explore the shaft without the use of breathing apparatus. First about 1000 feet of #12 insulated copper wire was lowered in the shaft for use as a signal cord and life line by those who were to explore the shaft. The end of the cord was held by a man on the surface so that he could readily feel the signals.

This plan worked very satisfactorily, there being no confusion due to mistaken signals during the recovery work.

At 11:15 P. M. Messrs. Parker, Denny and John Sincor, a company employee, were lowered in the main hoisting bucket slowly to the 400 ft. level. The writer remained at the surface landing to look after the signals and the lowering operations. At 11:30 P. M. the bucket and men were hoisted to the surface after reaching the 400 ft. level and the party reported that the atmosphere was respirable at that point, the shaft guides were not disturbed, but the partition between the air and hoisting compartments was badly shattered in places.

At 11:40 P. M. the same party was lowered slowly to the bottom, stopping at frequent intervals to push boards and other debris away from the path of the bucket, being careful always that nothing was thrown down the shaft but was carefully laid on the shaft buntons. At about the 500 ft. level it was necessary to straighten out several kinks in the signal cord and to pull up about 600 ft. of same which had entered the wrong compartment. When within about 30 ft. of the bottom, a man was heard coughing and when the bucket reached the bottom Merit Brotherton was found alive in the northeast corner of the shaft, but under and caught by the foot in a mass of fallen boards and timbers. When called to by Sincor, he recognized his voice. He was able to talk intelligently, although he did not realize what had happened nor how long he had been in the shaft.

It was found impossible to release Brotherton from the timbers so Messrs. Parker and Sincox were hoisted to the surface about 12:30 A. M., July 11, to procure saws and axes, Mr. Denny remaining in the shaft with the injured man. The saws and axes were procured and taken down by Messrs. Parker and Sincox and at 1 P. M. the party were hoisted to the surface with Brotherton. He was at once taken to the emergency first aid room nearby where he was given a stimulant and his clothes were removed. It was found that no bones were broken, but he sustained a deep cut on the head and numerous body bruises, and he had received severe burns about the face and hands. His body was drenched from the spray of water falling in the shaft. This had no doubt alleviated somewhat the pain of the burns during his 24 hour imprisonment in the shaft following the explosion.

Brotherton was placed in a doctor's care in about 30 minutes after his rescue and at once taken to the hospital, where he recovered entirely from the burns but died about a month later from an internal injury.

While Brotherton was being rescued, it was discovered that Nelson Freeburg was dead and almost entirely covered by debris at the shaft bottom, his head only being visible. Reluctance was shown by the local men toward recovering this body without the assistance of the bureau men, so at 1:30 A. M. Mr. Denny and 4 local men went down

the shaft and returned to the surface at 2:10 A. M. with the body. It was found that Freeburg had been dead for hours, his face, hands and chest being badly burned and part of his clothes were torn off. He was probably killed instantly by the explosion.

This accounted for the two men who were in the shaft at the time of the explosion, so the bureau party returned to Ithaca about 4 A. M., July 11.

INVESTIGATION BY BUREAU OF MINES ENGINEERS

Personnel:-

The investigation for the Bureau of Mines was made July 11 by Messrs. Parker, Denny and the writer. Mr. W. W. Jones, State Mine Inspector, who had arrived at the mine July 10, also made his investigation at the same time.

Violence:-

The explosion extended throughout the entire shaft as was evidenced by the destruction of the wood partition between the air and hoisting compartments. Some of the boards of this partition extended into the air compartment and some into the hoisting compartment. The only damage on the surface was to the coverings over the shaft which were torn loose. The steps at the north end of the shaft were damaged somewhat by falling debris. The compressed air pipe, 4" in diameter, was broken at the 700 ft. level.

Brottherton stated that he and Freeburg had been working on a platform about 35 feet above the bottom of the shaft when the explosion

occurred. They were extending the electric light wires to the bottom of the shaft. He remembered hearing three distinct detonations or explosions which threw them to the bottom of the shaft amidst a shower of debris from above.

Evidences of Flame:-

There were no evidences at the time of the investigation of heat in the shaft other than the burns on the bodies of the two men recovered from the bottom of the shaft. This was probably due to the fact that the shaft timbers had been saturated with the water that fell down the shaft from near the surface. However, at the bucket landing in the headframe were found evidences of flame in charred roofing paper and a charred hemp rope just above the end of the 20 inch ventilating pipe. This had most likely been caused by the initial ignition of the gas at the end of this pipe (See plan B 375).

Gas Conditions:-

Samples of the air in the shaft were taken on July 11, by means of magnesia bottles. Two samples (9166-9167), taken in the shaft at the 400 ft. level, analyzed 1.98% and 1.99% methane, respectively. At the time these samples were taken, air was leaking from the 4" compressed air pipe at the 700 ft. level which supplied the only ventilation.

The two samples (9168-9169) taken at the 800 ft. level, analyzed 3.64% and 3.49% methane, respectively. A strong gas feeder was heard at the bottom of the shaft under the debris which was no doubt from one of the drill holes drilled on the night of the explosion.

A slight cap was obtained with a flame safety lamp at the 400 ft. level and a 1 inch cap was obtained at the 800 ft. level at the time the samples were taken. (See appendix for complete analyses.)

The results of the air analyses show that considerable methane was being given off in the shaft, which, if allowed to accumulate by the interruption of ventilation, would prove dangerous.

CONCLUSIONS REGARDING ORIGIN.

A study of the foregoing facts leads to the conclusion that the explosion, which resulted in the death of one man and fatal injury of another, was caused by the ignition of the gas that was issuing from the drill holes at the bottom of the shaft, the ignition occurring at a point outside the shaft.

It is quite unlikely that the ignition was caused by electricity in the shaft, because the electric current was off at the time. The two men who remained in the shaft, however, were using hand electric lamps which were not explosion proof, but from the evidence given by the survivor these lamps had not caused the explosion.

From the evidence given by J. J. Quayle, Jr., the top man, that he saw a flame shooting from the end of the ventilating stack, it is proven that the gas was ignited at or near the end of this stack.

It was stated that when the electricity was turned off about midnight on July 10, the air compressor was shut down until after the

explosion. This no doubt permitted a sufficient concentration of methane in the air issuing from the ventilating stack to cause its ignition by the lanterns hanging in the headframe, one of which was only 7 ft. away from the end of the stack.

The percentage of methane in the air issuing from the stack, was no doubt so high that at first it burned from the end of the stack until some fluctuation in the ventilation, such as might have been caused by a gust of wind or the act of Quayle in attempting to beat out the flame with his coat, caused the flame to travel down the stack, resulting in the explosion which traversed the entire shaft.

LESSONS AND RECOMMENDATIONS

1:- All open lights, fires, boilers, etc., should be kept away from near the top of the shaft to guard against a repetition of this accident.

2:- Approved electric cap lamps only should be used by the miners in the shaft and the use of matches be strictly prohibited.

3:- An experienced fireboss, experienced in detecting and handling explosive gas, should be employed to make frequent examinations for the presence of methane.

4:- The shaft should be ventilated by an exhaust fan at the top of the airway, making the hoisting compartment the downcast. The ventilating fan should be run continuously and provided with an emergency engine, so that if one breaks down the other can be used.

The writer has learned that the Company has complied with all these recommendations which were given verbally at the time of the investigation.

Acknowledgement is gratefully made of the courtesies and assistance extended by the Company officials to the Bureau of Mines party during the recovery work and the investigation following the explosion.

Respectfully submitted,

W. B. Plank

Approved:

J. M. Paul

Chief Coal Mining Engineer.

APPENDIX

ANALYSIS OF SAMPLE OF SOFT SHALE TAKEN FROM THE 900 FT.

LEVEL OF THE ROCK SALT CORPORATION,

ITHACA, NEW YORK.

Lab. No. 29265 Sampled by John T. Lynn 9-16-17.

Air-Dry Loss .5%	Air Dried	As Received	Moisture Free
	<u>INCOMBUSTIBLE MATERIAL</u>		
Moisture at 105°C.95	1.42
Water of Composition	3.10.....	3.09	3.15.....
Carbon Dioxide	3.42.....	3.40	3.45.....
Ash.....	29.54	29.21	21.51
<u>Total Incombustible</u>	<u>98.11</u>	<u>98.12</u>	<u>98.09</u>
	<u>COMBUSTIBLE MATERIAL</u>		
Hydrogen Organic.....	.30.....	.30.....	.30.....
Carbon Organic.....	<u>2.72</u>	<u>2.72</u>	<u>2.76</u>
<u>Total Combustible</u>	<u>3.02</u>	<u>3.02</u>	<u>3.06</u>
Total	101.14	101.14	101.15

Date October 22, 1917.

(Signed) W. A. Selvig,
Asst. Chemist.

DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Test No.

COAL-ANALYSIS REPORT

Lab. No. 29265

Sample of Shale

Can No. Box

Operator Rock Salt Corp.

Mine

State New York

County

Bed

Town Ithaca

Location in mine Soft Shale showing fossils taken from 900 ft. vertical shaft

Method of sampling

Gross weight, lbs.

Gms.
Net weight, lbs. 1847.0

Date of sampling 9/18/17

Date of Lab. sampling 9/28/17

Date of analysis 10/12/17

For B. of M. section 252

Collector John T. Lynn

	AIR-DRY LOSS <u>.5</u>	COAL (Air dried)	COAL (As received)	COAL (Moisture free)	COAL (Moisture and ash free)
Proximate Analysis	INCOMBUSTIBLE MATERIAL				
	Moisture <u>AT 105° C.</u>	<u>.95</u>	<u>1.42</u>		
	Water of Composition				
	Volatilized carbon dioxide	<u>3.10</u>	<u>3.09</u>	<u>3.13</u>	
	Total carbon	<u>3.42</u>	<u>3.40</u>	<u>3.45</u>	
	Ash	<u>90.64</u>	<u>90.21</u>	<u>91.51</u>	
Total Incombustible		<u>98.11</u>	<u>98.12</u>	<u>98.09</u>	
Ultimate Analysis	COMBUSTIBLE MATERIAL				
	Hydrogen <u>Organic</u>	<u>.30</u>	<u>.30</u>	<u>.30</u>	
	Carbon <u>Organic</u>	<u>2.73</u>	<u>2.72</u>	<u>2.76</u>	
	Nitrogen				
	Oxygen				
	Sulphur				
Total Combustible					
Ash	<u>3.03</u>	<u>3.02</u>	<u>3.06</u>		
TOTAL		<u>101.14</u>	<u>101.14</u>	<u>101.15</u>	
Calorific value determined	Calories				
	British thermal units				
Calorific value calculated from ultimate analysis	Calories				
	British thermal units				

Date, 10/22/17

(Signed) W. A. Selvig, Asst., Chemist.

FILE - Rock Salt Corp.

DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

CHEMICAL LABORATORY REPORT

MINE AIR SAMPLE

Received, July 13, 1917 (Laboratory Record)

Bottle No. 3 and 4 Laboratory No. 9168 - 69

Shaft now 835' deep with gas blowers in bottom. Will be 1500' deep to 60'

Mine, salt bed, Operator, Rock Salt Corporation

State, New York County, Tompkins

Township, Lansing Sec. _____ T. _____ R. _____

Town (Distance and direction from) 5 1/2 miles N. of Ithaca, N. Y.

Name of coal bed, _____ ft. _____ in. _____

Room, _____ Entry, _____

Location in same, where sample is taken, In shaft at 800' level

Are there gas feeders near where sample is taken? _____ Strong or weak? _____

Are gas feeders from roof, coal, or floor? _____

Method of sampling, Magnesia bottle Taken 7-11-17 12:25 P. M.

Velocity, _____ Area, 9' x 12' Quantity, _____

Barometer: Inside, _____ Outside, _____

Corrected to sea level: Inside, _____ Outside, _____

Bulbs: Wet, 62 Dry, 63 Humidity, _____

Collector, Plank, Parker, Denny Mailed, 7/13/17

Remarks (Note whether sample represents average mine air in locality or localized body of gas): _____

Lab. No.	<u>9168</u>	<u>9169</u>	
Bottle No.	<u>3</u>	<u>4</u>	
CO ₂	<u>.17</u>	<u>.14</u>	H ₂
O ₂	<u>20.06</u>	<u>20.08</u>	H ₂ S
CO			C ₂ H ₄
CH ₄	<u>3.64</u>	<u>3.49</u>	
N ₂	<u>76.15</u>	<u>76.29</u>	

Date, July 20, 1917

(Signed) A. C. Fieldner

Chemist
ds

W.P.P.
7/11/17

DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

CHEMICAL LABORATORY REPORT

MINE AIR SAMPLE

Received, July 13, 1917 (Laboratory Record)

Bottle No. 1 and 2 Laboratory No. 9166 - 67

Mine, Shut now down 835' and gas blowers at bottom. (Will sink to 1500' depth for salt bed.) Operator, Rock Salt Corporation

State, West Virginia County, Waynes

Township, Lansing Sec. _____ T. _____ R. _____

Town (Distance and direction from) 6-1/2 miles N. of Hurricane, W. Va.

Name of coal bed, _____ ft. _____ in.

Room, _____ Entry, _____

Location in same, where sample is taken, In shaft at 400' level

Are there gas feeders near where sample is taken? _____ Strong or weak? _____

Are gas feeders from roof, coal, or floor? _____

Method of sampling, Woods' bottle June 7, 1917 10:25 P. M.

Velocity, _____ Area, 9' x 22' Quantity, _____

Barometer: Inside, _____ Outside, _____

Corrected to sea level: Inside, _____ Outside, _____

Bulbs: Wet, _____ Dry, _____ Humidity, _____ %

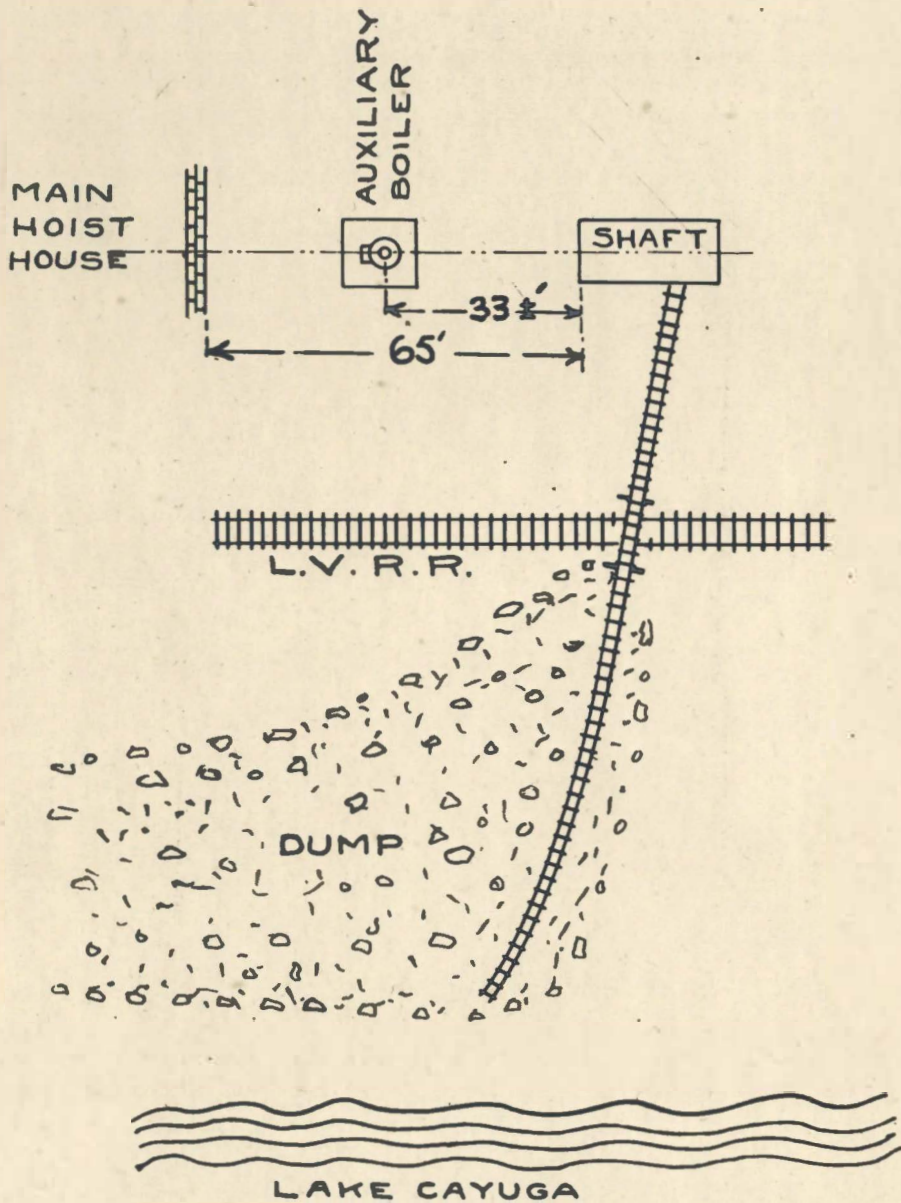
Collector, W. G. Fisher Mailed, July 13, 1917

Remarks (Note whether sample represents average mine air in locality or localized body of gas):
No cap detected at this point with Wolff round wick lamp. Samples taken from sinking bucket in hoisting compartment.

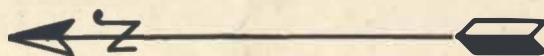
Lab. No.	9166	9167	
Bottle No.	<u>1</u>	<u>2</u>	
CO ₂	<u>0.15</u>	<u>0.11</u>	H ₂
O ₂	<u>22.75</u>	<u>22.82</u>	H ₂ S
CO			C ₂ H ₄
CH ₄	<u>1.98</u>	<u>1.99</u>	
N ₂	<u>77.54</u>	<u>77.53</u>	

Date, July 20, 1917 (Signed) W. G. Fisher

EMD

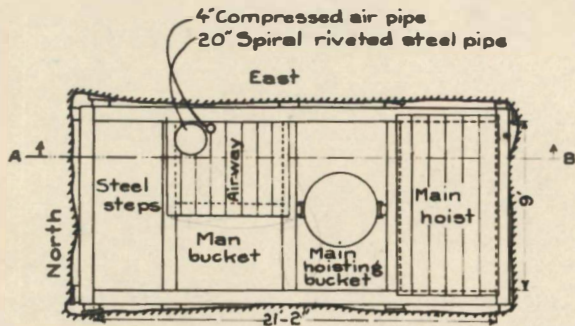


SCALE IN FEET (APPROXIMATE)
 0 20 40 60 80 100

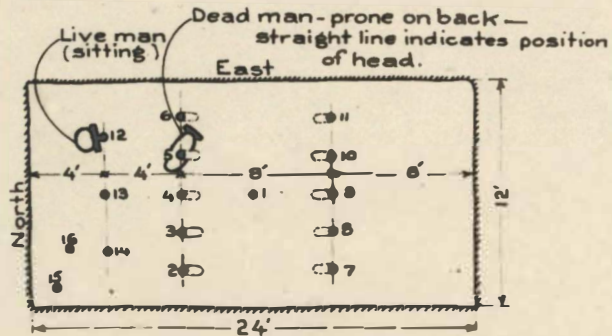


LOCATION OF SHAFT OF ROCK SALT CORPORATION AT ITHACA, N.Y

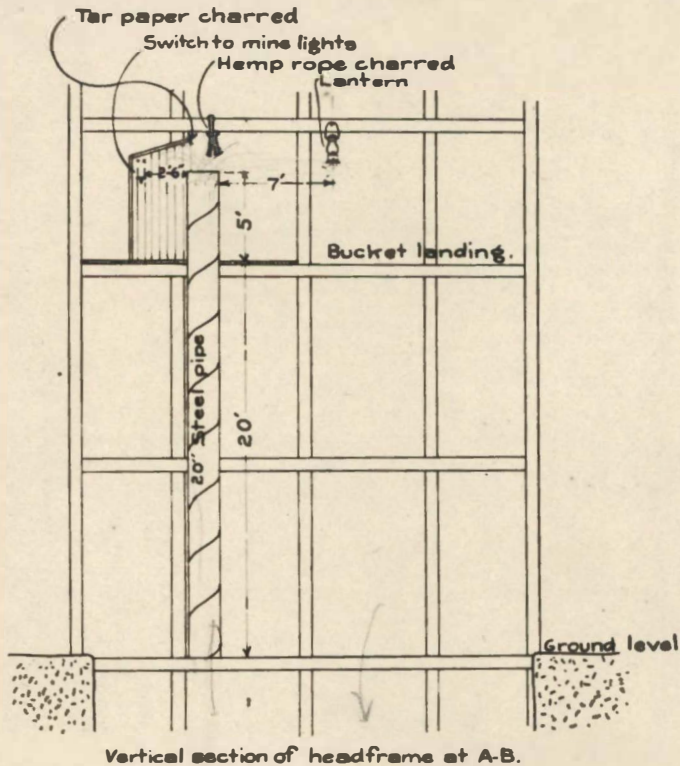
E-94



Section of shaft showing compartments



Plan of holes in bottom of shaft



Vertical section of headframes at A-B.

BUREAU OF MINES		PITTSBURGH, PA.
DATE	ROCK SALT CORPORATION	
7-12-17	ITHACA, N.Y.	
	EXPLOSION IN SHAFT JULY 10, 17	
DRAWN BY	<i>Edmond H. ...</i>	APPROVED
CHECKED BY	<i>J. J. ...</i>	<i>J. J. ...</i>
<i>Ransom ...</i>		B 375