

Report on  
Castle Gate No. 2 Mine Explosion

Castle Gate, Utah

March 8, 1924

by

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## INTRODUCTION

On March 8, 1924, shortly after eight o'clock in the morning, an explosion occurred in Castle Gate No. 2 mine of the Utah Fuel Company at Castle Gate, Utah, resulting in the death of 191 men, the total number in the mine. This explosion was followed by a second explosion which occurred about one and a half minutes later. A third explosion was reported by many; however, the writers are without proof of this explosion. Those who saw the third explosion, which was about twenty minutes after the first, say only a puff of smoke issued from the mine. It is thought that this puff was probably due to a cave. There was a cave of considerable size in the water road air course and in the back entry of the 4th Right Dip Entry. The pillars had been pulled above the 1st Right Raise Entry and a cave of considerable extent could have occurred here.

The first explosion forced out of the mine escapeway timbers from along the escapeway and a piece of sheet iron which was located near the entrance of the escapeway and shot it for a distance of 1,500 feet. The force

"Jan. 4, 1924 - Gas in No. 2 Room on 6th Left, gas extending back from face 70 feet. This gas was removed about 10 A.M. and made safe. Signed Ed Cox - Fire Boss."

"Jan. 8, 1924 - Gas found in No. 2 Room on 6th Left caused by a larger feeder. Signed E B C. Gas found on Jan. 8 was all cleared Jan. 10, 1924. Signed E B C."

"Jan. 22, 1924 - Gas found room 8th Right extending 90 feet back from the face caused by brattice down and feeders at the face. Signed E B C. The exception on the 22nd was cleared and ready for miners to work in. Signed E B Cox."

"Jan. 28, 1924 - Gas was found in No. 2 Room 6th left extending 80 feet from face. Signed Ed E. Cox. This exception was removed by ventilation and made safe. E B C."

"Feb. 16, 1924 - Gas was found in No. 2 and 2A on 7th Left extending 80 feet from face by large feeder at the face. Signed E B C."

The rooms in which this gas had been reported were about 20 feet wide, 8 to 10 feet high where the top coal had been left up and from 15 to 18 feet high where the top coal had been taken down. In most of these rooms the top coal had been taken down to a comparatively close distance to the face; thus leaving a large area for the accumulation of gas. Since all the reports showing gas, report the gas extending 70 to 90 feet back from the face, the volume even on a single report was comparatively large.

The explosion occurred shortly after eight o'clock in the morning and it is doubtful if the miners had sprinkled down in a thorough manner before starting to load their first car. It is the general practice to load the cars as soon as they are obtained and to sprinkle the workings while waiting for cars. It seems safe to assume that in general the fine dust made during the blasting after the previous shift had not been wet down. Also, many of the miners were loading coal and this put a certain amount of coal dust into suspension. Therefore, it is fairly safe to assume as far as coal

of the explosion at the fan entry and the main portal was not as great as at the escapeway. The explosion doors at the fan were blown open and the reversing door was forced about halfway up to the reversing position where it stuck due to the springing of the fan housing; otherwise the fan was not damaged. A few sets of timbers at the entrance of the main portal were blown out and the portal was filled about three-fourths full of dirt for a distance of about 30 feet.

Soon after the explosion the fan was started and ran until about 2:00 P.M. before it was noted that the reversing door was out of place. The fan was then closed down and not started again until about 6:00 P.M. About three o'clock in the afternoon an air measurement on the escapeway or first left entry showed 37,000 cubic feet of air was traveling in along this entry and this was one reason for believing the fan was normal. It was not until after the air started to leak out in this entry that it was suspected the fan was not in proper condition.

The Mine Inspection Department of the Industrial Accident Commission was notified of the explosion about 9:00 A.M. by the general offices of the Utah Fuel Company at Salt Lake City and the Bureau of Mine Safety Car 1, which was located at Butte, Montana, and Car 2, which was located at Dawson, New Mexico, were moved by special train to Castle Gate, Utah. Car 1 arrived at Castle Gate at 4:30 A.M. Sunday and Car 2 arrived at 2:30 P.M. Sunday afternoon, March 6th. A special train carrying the officials of the Utah Fuel Company, other prominent mining officials and representatives of the State Mine Inspection Department and the Bureau of Mines left Salt Lake City at 11:45 A.M. and arrived at Castle Gate at 3:00 P.M. The officials of many mining companies located near by, together with the general superintendents and practically all



dust is concerned that the mine was in its poorest condition to resist an explosion at the time it occurred.

#### GENERAL INFORMATION

##### Location, Operable, etc.:

The Castle Gate No. 2 Mine is one of a group of mines being operated by the Utah Fuel Company. It is located at Castle Gate, Carbon County, Utah, and is served by the main line of the Denver & Rio Grande Western Railroad.

Mr. F. W. Cameron, Judge Building, Salt Lake City, Utah, is Vice-president and General Manager.

Mr. William Littlejohn, Castle Gate, Utah, is General Superintendent.

The Utah Fuel Company operates in addition to Castle Gate No. 2 Mine, Castle Gate No. 1 Mine at Castle Gate, Utah, Utah Mine at Clear Creek, Utah, Clear Creek Mine at Clear Creek, Utah, Winter Quarters Mine at Winter Quarters, Utah, and the Sunnyside Mine at Sunnyside, Utah.

The production of Castle Gate No. 2 Mine at the time of the explosion was about 1,400 tons per day.

##### Coal Occurrence:

The coal at Castle Gate No. 2 Mine is being produced from what is known as the "D" seam, - New Verbe formation and Cretaceous age (U.S.G.S. Bulletin No. 318). The seam varies in thickness from 30 to 36 feet and dips about 6 or 7 degrees to the North. The coal is massive and of good quality being moderately low in moisture and ash. It has a bright luster and streaks

the local officials of the various mines of the Fish Fuel Company were at the mine when the special train from Salt Lake City arrived at Castle Gate and had the recovery work well under way.

On March 1, 1926, due to the shortage of carload for coal the Fish Fuel Company closed their Castle Gate No. 1 mine and transferred most of the married men and old employees of the company to the Castle Gate No. 2 mine.

The explosion of Castle Gate No. 2 mine was extremely violent. This is shown by the fact that the flames and violence reached all parts of the mine and at no time did any of the men have any possible chance to barricade themselves.

Three sprinklers had been continuously employed at this mine besides the miners sprinkling their own working faces. This mine had been fairly well sprinkled so far as all the active workings were concerned. Supporting evidence of this is that after the explosion at almost any place in the active workings one could scratch below the top layer of dust and coal which had been deposited by the explosion and could find the underlying dust and fine coal so damp that it would ball in the hand. It is probable that some of the air courses and old workings were drier than they should have been. There was a pipe line and sprinkling hose in all working places and pipe line with hose line in all places that were not working. However, in the old workings the same amount of moisture could not be found in the floor that was found in active places and in many old workings upon digging to the floor it was found that they were positively dry showing that they had not been sprinkled for some time or that the sprinkling was not properly done.

A comparatively small amount of gas had been reported in this mine and below are the first boss' exceptions to the mine being clear of gas.

long surface exposure without slacking, making it particularly desirable for storage purposes. Due to its physical and chemical properties, the coal in this district is rated as high grade bituminous, excellently adapted to domestic and steaming purposes.

#### MINING SYSTEMS

##### Mining Systems:

The Castle Gate No. 2 Mine of the Utah Fuel Company, is opened by means of a tripple entry system driven from the surface in what is known as the "B" seam. This tripple entry is driven off the true strike of the vein sufficiently to give a suitable grade in favor of the loaded trips. The center entry of the system is used as a main haulage way, while the north or lower entry serves as a main return air course. The south entry is not in use at the present time.

##### History:

The first work carried on from these entries consisted of a development to the rise in the "B" seam. This territory was opened by a double entry from which cross entries were turned off, right and left until the work approached to workings of the Panther Canyon mine of the United States Fuel Company. This development in the "B" seam was abandoned some years ago due to low coal and restriction of available territory.

In 1914 it was decided to prosecute the development in the upper or "B" seam. Accordingly a double entry rock tunnel was turned approximately at 50 degrees to the "B" seam main haulage. After cutting the "B" seam, these entries were turned again to the original strike grade and driven to the point



at which the slope and rise entries were turned off.

#### Plan of Workings:

In general, the system of development employed at Castle Gate No. 2 Mine consists essentially in driving a double entry on the dip of seams, from which cross entries are turned off right and left at distances ranging from 400 to 500 feet. As a rule, left entry haulage curves are turned off the main slope just below the back entry crosscut of the corresponding right entry.

From the cross entries, a room, called No. 1 room, is turned up the dip parallel to the main slope. A barrier pillar 200 feet wide is left between this room and the adjacent slope. On the left side of the dip and the right side of the raise, the second room is turned off the main entry at a distance of 100 feet from No. 1 room and at an angle of 45 degrees with the main entry. The triangular block of coal thus left is split by rooms parallel to Room No. 1 and turned off Room No. 2, called Rooms 1 off 2 and 2 off 2. The successive rooms in by are turned at 45 degrees with a 50 foot room pillar separating them. Crosscuts are driven between rooms at distances ranging from 50 to 100 feet. When rooms are driven to destination, the faces are connected by a top or barrier crosscut driven parallel to the cross entries. Cross entries are driven sufficiently off the strike of the seam to give a grade in favor of the loaded cars. The pillar between main and back entries is maintained at approximately 70 feet, and is split at intervals with ventilation crosscuts and haulage cleats. The pillar between main and back slope entries is maintained at 100 feet.

This general scheme of development is carried out on both right and

### Ventilation:

Ventilation is effected by means of a "Jeffrey" 6 x 12 fan rated at 300,000 cubic feet per minute at 6-inch water gage, and operating exhausting. The fan drift is located on a 45 degree offset from the main return air course. In addition, the fan proper is located on a short 90 degree offset from the fan drift. The explosion door is located at the end and on direct line with the fan drift and is so constructed that it will be blown out by any explosive force traveling out through the return air course. The fan drift and a portion of the air course are lined with concrete for a distance of about 400 feet. In the mine, circulation is maintained by concrete stoppings and overcasts. In places generating methane, line brattices are constructed from the last crosscut to face. In general, each working panel operates on a separate split of air, the only exception being noted in the ventilation of abandoned panels where two or three districts may be ventilated with a single split.

In general, the ventilating system may be described as follows: There are two intakes: the motor haulage or main entry and the let left escape-way. The total return is conducted to the fan through the back entry of the haulage road. The intake is split on the main slope, part of the air being drawn to the rise entries and the balance to the dips. In ventilating a given panel, the air intakes on the main entry, circulates through the rooms, returns through the last crosscut between main and back entries out over the back entry and to the back slope return by way of the panel overcasts. See map of ventilation system.

### Lighting:

Lighting on the main motor road circuits is operated on 110 volt

left sides of the slope, with the exception that rooms on the right side of the dip and left side of the raise are turned toward the slope at an angle of 45 degrees instead of at the same angle away from the slope, as on the opposite side. This plan was adopted after it was determined that trouble was encountered from roof falls on the east side of the slope where rooms were driven at 90 degrees to the rooms on the west side.

#### Methods of Mining:

All coal is undercut by electrically driven mining machines of the shortwall type, operating on 500 volts direct current. Rooms are cut 20 feet and entries 10 feet wide. After a room is reeled, the top coal is taken down with the mivance.

#### Shot Firing Practice:

Shooting "off the solid" is prohibited in all parts of the mine and only permissible powder is used for shooting purposes. Electric detonators are employed and all shots are fired from the surface after all men are out of the mine. Miners carry their own powder into the mine and store it in wooden boxes provided by the company for this purpose. They also drill and load their own holes. Toward the end of the shift, the electric detonators are distributed by the shotfirers, the miners placing the primers and connecting the leads to the shooting lines. Holes which are on the solid, or which are not properly placed, are turned down by the shotfirers at this time. In addition, working places must be thoroughly sprinkled before shots are fired. There are two double pole, single throw switches located between the feed lines and the shooting wires. One switch is exposed and the other is enclosed in a locked

currents from transformers located on the surface. Where only 500 volts direct current is available, two 250 volt lamps are connected in series across the feeder circuits.

At the time of the explosion, this mine was operating on an open light basis. In other words, carbide lamps were used exclusively for illumination. Electric cap lamps of a pattern tested and approved by the U. S. Bureau of Mines had been ordered some time before and were delivered to the company about six weeks before the explosion but due to all the charging equipment having not been received had not been put into service. These electric lamps are now in service and will be used hereafter in this mine.

Flame safety lamps of the type commonly known as the "Toby Wolf" with single gauge are used by fire horses for gas testing purposes. A quantity of large "Wolfe key" and "magnetic lock" lamps were noticed about the property at the time of the disaster but it is believed that they were not in common use.

#### Dust:

The coal at this property is brittle and has a tendency to make a large amount of fines. Tests run on this coal at the Experimental Mine of the U. S. Bureau of Mines show that it produces the most inflammable and explosive coal dust known in this country. These facts, coupled with the experience gained at Seafield in 1900, early impressed Utah coal operators with the necessity of affording an efficient method of rendering this coal dust inert. Little, if any, information was available as to rock dusting at that time, whereas sprinkling had been used with considerable success in various parts of this country. A very elaborate system of sprinkling was installed in all mines of the Utah Fuel Company and it may well be said that

all

box. These switches are thrown in by the shotfirer, on his final round of inspection before going to the surface. After all inside switches are closed, the power house is advised and the main feeder switch thrown in. The shooting switch located at some convenient point is then closed and the shots fired.

#### Shot Inspection:

After shots are fired, the inspectors make a second run through their districts, examining each place and noting the presence of missed shots and fires.

#### Haulage:

The coal is loaded at the face into wooden cars of the loose end gate type. Gathering of loaded cars and distribution of empties on the entries is done by horses and mules. After a loaded trip is gathered at the entry parting, a red light signal is used to advise the slope rope rider of the fact. Trips are hoisted on the slope by means of an electric single reduction drum hoist located at the top of the main rise entry. Loaded trips from the slope are dropped onto the main inside parting from which point they are hauled to the tipple by electric trolley locomotives operating on 500 volts direct current.

#### Timbering:

In view of the fact that a coal roof is maintained in nearly all portions of the mine, very little timber is used. Some timbering is present at the haulage portal and also at various points along the motor road.

this company spared no expense in the installation and operation of their sprinkling system. This company has diligently attempted to make the miners wet down the working faces each morning before starting to load coal, but to strictly enforce this rule is almost impossible as the miners will load coal if a car is available and do the sprinkling afterwards while waiting for cars. Also, the company had three men regularly engaged as sprinklers whose duty it was to sprinkle all other parts of the mine which were not sprinkled by the miners. In the recovery work, the body of a sprinkler was found in one of the rooms off the 2d left dip entry with his hose connected. He was undoubtedly sprinkling in this district which, because of its close proximity to one of the main intake air courses, would be more likely to be drier than the good workings on the right side of the dip. At the time the mine was inspected on February 13th, a sprinkler was noted to be working in rooms off the left raise workings.

In brief, the system consists of a storage tank, of about 30,000 gallon capacity, located at an elevation of 400 feet above the mine opening and 137 feet above the highest workings in the mine which is kept filled with water pumped from the power house. Neglecting friction this gives a pressure of 59 pounds at the highest point in the mine and it is safe to say that with friction the pressure at the nozzle would be at least 40 pounds which is capable to reach the roof and highest point of ribs. In the dip entries the pressure will be about 300 pounds at the lowest points and at the 5th left where the explosion originated, 200 pounds. All pipe lines are laid in the return air courses where the temperature is always at least 60° F. and never gets to a freezing point.

From the storage tank, headers are run to the various distributing points within the mine. As a usual practice, 1-1/4 inch lines are laid in all

cross entries. From these laterals  $\frac{3}{4}$  inch lines are laid to every working face. On laterals or cross entry lines, bibbs are left at 100 foot intervals for sprinkling the entries. Where back entries are dry,  $\frac{3}{4}$  inch branch lines are laid to such entries through the crossover stoppings. Lengths of hose are supplied at each working place and miners are required to keep their places well sprinkled. There is no doubt that the sprinkling work and the system itself is as effective as natural conditions will permit.

Under "Mining Methods", it will be noted that mention was made of the fact that rooms are driven 15 to 20 feet high. In many places, especially on the slopes and catty sides of cross entries equal heights are maintained. These conditions present difficulties which it is practically impossible to care for with known methods of sprinkling. It is reasonable to suppose that sprinkling is effective on rib surfaces up to 10 feet in height, while it is equally reasonable to suppose that above that height, accumulations of fine rib dust cannot be effectively removed by this means. In addition, it is on these surfaces, in entries and rooms having large cross sections with low air velocities that the finest and most dangerous dust is found.

Due to the dry, friable character of the coal, considerable dust is produced in the operations of machine cutting, shooting and loading. Cars are "topped" about 12 inches above the car bodies, causing considerable spillage along entries, slopes and motor haulage ways. This road coal is quickly pulverized by the passage of trips, men and animals, the fine dust being thrown into the air currents to be later deposited on rib ledges, and timber. Existing speeds of around 500 feet per minute on the main slope against a ventilating current velocity of 600 to 700 feet per minute, giving a relative velocity of about 1,400 to 1,500 feet per minute, causes considerable amounts of fine

ferred to the lot left escapeway which presented no obstructions to travel, and air measurements showed an intake of around 80,000 cubic feet per minute. Temporary stoppings were erected in several room necks on the lot left main entry and a large regulator placed across the main entry at the last crosscut for the purpose of deflecting a large portion of the air through the lot left back entry and thence to the 24 and 25 left dip entries by way of the break-thrus in the barrier pillars. (See map of temporary ventilation.) Temporary stoppings were also placed in the crosscuts between the main and back dip entries and also at the entrance to all dip entries on the right dip side. The air current thus produced on the main dip slope was then deflected into the main entries of the left dip panels as exploration and recovery work was carried forward.

Soon after the ventilation had been partially restored, it was found that several mine fires existed in various parts of the mine. One of the first fires encountered was located in Room 2 off the 24 left dip. This fire covered practically the full width of the room for a distance of 20 feet, the greater part of this area showing a smoldering action with some flames near the upper edge. This fire was extinguished by a bucket crew, and was carefully watched by a fire patrol for possible re-ignition.

Evidence of additional fires was noted by the smoke issuing from the fan. The presence of fires in undetermined positions, coupled with the possibilities of methane accumulations in some of the dip entries and a temporary ventilation system, presented a very dangerous condition, calling for extreme care in order to prevent a second disaster.

With these conditions in mind, a conference of company, State and Federal officials was called for the purpose of formulating a definite plan



dust to be swept from the trips and thrown into the air currents, later to be deposited on ribs, roof and floors.

#### Safety Measures and Equipment:

The company maintains a rescue station equipped with five sets of haul apparatus with the necessary supplies and repairs. A sufficient number of trained apparatus men are available at all times. In addition, the mines at Castle Gate are fortunate in being located at a short distance from the Spring Canyon Mine Rescue Station at Standardville. Apparatus teams are also quickly available from the company's camps at Sunnyside, Inter Quarters, Clear Creek and the Utah mines. The mines of the U. S. Fuel Company are also equipped with rescue apparatus, and maintain efficient corps of men for immediate call. These facts are mentioned under this head merely to show the equipment available in addition to that maintained by the company.

An underground first-aid station is located at the motor parking and is fully equipped with stretchers, blankets and a plentiful supply of first-aid materials.

#### STORY OF THE EXPLOSION

The explosion at the Castle Gate No. 2 Mine occurred shortly after 8:00 A.M. on the morning of March 8, 1924, there being a normal shift of 171 men in the mine at the time. According to statements made by company officials, and others who were on the surface at the time, there were two distinct explosions. Statements were also made by various individuals to the effect that a third explosion occurred but to date no positive evidence is available on this point.

of attack. As a result it was decided that the recovery work should be carried forward on the left dip entries toward the slope bottom, fresh air being carried ahead as each entry was explored. In addition, it was ordered that any major changes in the ventilation be made at night with only the necessary men on shift. After the left dip entry had been explored and the recovery work on that side completed, the work was to be carried up the right side. With the completion of the dips, the raise entries were to be explored.

From the time of the explosion, much discussion was heard regarding the fate of the men working in the extreme upper portion of the mine, namely in the rooms being driven to the burned coal areas off the 5th left raise. Going on the theory that the explosion had its inception in the dip workings, it was argued that the force and flame would be largely dissipated in the large open areas of the raise entries and that the men in this district would have a good chance of being alive. In order to determine if conditions in the raise were such as to warrant hopes of finding living men, it was decided that an apparatus exploration be made up the main slope to the raise. The apparatus crew making this trip consisted of Messrs. B. W. Byer, Chief Mine Inspector of the State of Utah, and District Engineer of the U. S. Bureau of Mines, D. Harrington, Supervising Mining Engineer of the U. S. Bureau of Mines, H. E. Dunn, Mining Engineer in charge of Car 2, U. S. Bureau of Mines, Fred Westlake, Mining Engineer, U. S. Bureau of Mines, and W. F. Sullivan, Foreman Miner, Car 2, U. S. Bureau of Mines. The observations made on this exploration trip showed conclusively that the violence in the raise was at least as great as any noted in the dip and that no hope could be held for any of the miners working in this district. This fact made it possible to follow

The Mine Inspection Department of the Utah State Industrial Commission was notified of the disaster at about 9:00 A.M. by the general office of the Utah Fuel Company. U. S. Bureau of Mines Car No. 6, located at Butte, Montana, proceeded immediately by special train, arriving at Castle Gate at about 4:30 A.M., March 5th. The Denver office of the U. S. Bureau of Mines was notified of the disaster by the Associated Press at about 1:00 P.M., March 5th. Bureau of Mines Car No. 2, located at Cooson, New Mexico, received word of the disaster at 1:37 P.M., and left immediately for Castle Gate by special train, arriving there at 3:00 P.M., March 5th.

Shortly after the explosion occurred, rescue teams were rushed to Castle Gate from surrounding mines. Short explorations were made in the main haulage road by men wearing oxygen breathing apparatus, but no bodies were found. Repairs were started on the caved haulage road portal, it being necessary to do this work with apparatus men on account of the gas issuing at this point. During one of these preliminary exploration trips, Geo. Wilson, captain of the Standardville No. 1 rescue team, was killed by inhalation of carbon monoxide due to the removal of his nose clip in the presence of after-damp.

In the meanwhile the necessary repairs had been made to the fan which had been little, if any, damaged by the explosion. The explosion door, directly in line with the main fan drift, was blown out and one of the reversing doors partially displaced. This damage was quickly repaired and work was started on the restoration of ventilation. The first line of attack was through the main motor road but was abandoned later due to the difficulty of removing obstructions in the way of timber, wrecked cars and other debris in the vicinity of the main portal. Rescuing operations were then trans-

the plans for recovery without deviation.

The organization effected for carrying out the plans for exploration and recovery work were as follows:-

Apparatus Crews: The mines operating in the vicinity of Seattle Gate are exceptionally well equipped with oxygen breathing apparatus. Surrounding companies contributed their own apparatus and repairs as well as trained crews of rescue men. In all, 51 sets of apparatus with the necessary supplies were available within a short time after the explosion.

Supervision: General supervision of recovery work was detailed to three superintendents for each eight hour shift, - one in charge of the apparatus crews at the wash-house, one at the 1st left cabin, and one underground. Later, when work was conducted simultaneously in raise and dip districts, two superintendents were on duty underground.

The rescue work was divided into three shifts with eight apparatus crews on duty for each eight hour period. In actual work, two crews worked together, one crew exploring and recovering bodies, while the second crew acted as a reserve at the fresh air base. As soon as the first crew had completed its time limit in the apparatus, a third crew was called in for reserve duty. In this manner, crews working under oxygen were at all times backed up by a reserve team. Constant use was made of the life line, in spite of the fact that no considerable amount of smoke was present, and every possible effort was exerted to prevent accidents to crews working under oxygen. Telephone communication was maintained at all times between the fresh air bases and the surface. Upon the recovery of a body by an apparatus crew, the data relating to the exact location of the body as well as any other pertinent facts regarding the condition at the point of recovery were tel-

placed immediately to the outside. In addition, a slip of paper containing patients information was pinned to the body, thus giving a double check.

From the fresh air zone, the bodies were carried to the surface on stretchers by fresh air men. A receiving room was established on the surface near the lat left roadway. Here the bodies were searched for life checks and other means of identification and all available records taken. From the receiving station, bodies were transferred by auto bearers to the morgue.

Life of Apparatus: Soon after the apparatus work started, the importance of thorough examination and recharging of the machines was realized. An outdoor apparatus base was established in the wash-house near the main haulage portal. Work benches were erected and facilities installed for the repair and recharging of the apparatus. The work of inspection, testing, repairing and recharging was put in direct charge of C. E. Bureau of three apparatus men whose training made them particularly fitted for this duty. All machines coming off duty were repaired when necessary, recharged and subjected to exhaustive tests before being placed on the table ready for use. Some difficulties were encountered, but this was to be expected, especially in view of the fact that many of the replacement apparatus men had had little or no experience in this work. In the whole, the results were extremely satisfactory and too much cannot be said in praise of the men who worked in the apparatus as well as of those who took the responsibility of its care and operation.

Doctors' Organization: Medical aid was quickly supplied from the district and consisted of physicians and surgeons from Castle Gate and other Utah Fuel camps as well as medical men of surrounding towns. Dr. A. L. Murray, Surgeon of the C. E. Bureau of Mines was active in effecting the doctors' organization.

Five doctors were detailed to the receiving station. These doctors

by the following:

William Littlejohn,	General Superintendent,	Utah Fuel Company
R. H. Lagrew,	"	United States Fuel Company
D. Harrington,	Mining Supervisor,	U. S. Bureau of Mines
H. I. Sims,	Mining Engineer,	U. S. Bureau of Mines
Fred Smith,	"	U. S. Bureau of Mines
D. S. Lyster,	District Engineer,	U. S. Bureau of Mines, and Chief Mine Inspector, State of Utah.

The sampling was done by the following:

W. F. Sullivan,	Foreman Miner,	U. S. Bureau of Mines Car 2
F. E. Keegan,	First Aid Miner,	U. S. Bureau of Mines Car 2
W. W. Keeler,	"	U. S. Bureau of Mines Car 2
J. B. Davis,	Foreman Miner,	U. S. Bureau of Mines Car 2

Due to two explosions, the second which undoubtedly originated in the upper left side of the mine and was the most violent, it is impossible to trace the exact course traveled by either explosion. In many parts of the mine absolute evidence of the force having traveled in one direction can be found and within 100 feet of this point there is likewise as convincing evidence that the force traveled in the opposite direction.

That the initial explosion was not caused by a runaway trip is borne out by the fact that all three rope trips were still on the rope after the explosion. The motor trip was on the motor parting, evidently waiting for another rope trip before going to the surface.

#### Source of the Explosion:

In No. 2 room, 6th Left Dip Entry, there appears to be enough evidence to believe the explosion started at this point. Top coal had been

examined the bodies as they were brought to the surface, made notes on material available for identification purposes, and dispatched them to the morgue.

At least two doctors were detailed at the lower station who made the necessary medical examination of men wearing the breathing apparatus, and supervised the disinfection of mouth pieces. In addition, men in recovery work were required to wash in antiseptic solution, cuts and bruises were dressed and the men's general health attended to.

The camp physician was placed in charge of the morgue, his acquaintance with the men and their families making his services at this point especially valuable. One doctor was detailed to the company hospital, it being his duty to administer to any cases sent there in addition to caring for the general health of the camp.

Welfare Work: Two canteens were established near the mine, one at the first left opening and the other at the lower check cabin. Hot coffee, sandwiches, cigars, cigarettes, and chewing tobacco were available to the men at all hours. Baskets of food and large cans of hot coffee were continually being carried by fresh air men to the men employed underground. Complete outfits of working clothes were supplied to those men engaged in recovery work, and complete changes supplied to those whose clothes came in contact with the bodies. The Salvation Army and local posts of the American Legion were active in administering to bereaved families.

Fire Work: As the air currents were carried ahead, and entries explored, it became necessary to patrol these districts for the presence of fire and possible accumulations of explosive gas. Crews, consisting of two experienced fire bosses, equipped with flame safety lamps and canary birds, were detailed to this work. Each crew was given a definite district and reports as to

shot down in this room the night before the explosion. The body of the Fire Boss was found with his flame safety lamp disassembled on the inside of this pile of top coal. The bodies of two miners were found on the outside of the pile close to a car of coal which had evidently been loaded that morning. The ribs and coal roof were badly burned and the coal distilled to a considerable extent on the outside of the coal pile. The remains of a line brattice up Room No. 2 was badly burned but showed no signs of violence. It appears that the fire boss found gas near the roof in this room on his first examination and went back with the miners to remove it. He had evidently got on top of the pile of coal which had been shot down the night before and raised his lamp to ascertain the exact amount of gas when his lamp became extinguished. He then got down from the pile of top coal, opened his lamp and was in the act of relighting it when he or one of the miners ignited the gas. The gas could have been stirred up by the fire boss while he was testing. The body of one of the miners was found partially covered with a fall of coal. This fall was evidently just before or at the time of the explosion and this could have pulled the gas down to a point where it could have been ignited by the open lights being used by the miners.

Three loaded cars were found on the entry between Rooms 2 and 3 and were badly burned. These cars evidently had been standing just outside the latches of Room No. 2 when the explosion occurred and had been pushed to the position formed by the second explosion. The sprags in the wheels of these cars showed they had been pushed in by on the entry.

The explosion of gas aided by the coal dust that had not yet been completely sprinkled down from the blasting of the previous night together with a certain amount of dust that was in the air from the loading of the cars



conditions in that district were made at the end of each eight hour shift. These patrols performed a very important work as it was largely due to their inspections that fires and gas accumulations were located and reported. In addition, the patrols located several bodies which had escaped the attention of men wearing apparatus.

In summarizing the results of the work, it may be stated that approximately 90 per cent of the bodies were recovered by men wearing oxygen breathing apparatus. With the exception of the fatal trip made by the Standardville No. 1 team shortly after the explosion, no serious difficulties were encountered. Considering the number of men employed in this work, and the amount of apparatus used, we believe that a very enviable record had been established for work of this class.

#### THE INVESTIGATION

The first day there was much speculation as to the cause of the explosion. It was conceded that the explosion was one of dust and the cause of ignition was thought to have been caused either by a runaway or wrecked trip throwing quantities of fine dust into suspension, which became ignited by an open light or electric arc, or through the explosion of a small pocket of gas which in turn threw into suspension and ignited coal dust.

During the course of the rescue work the body of one of the fire losses was found near the face of No. 2 room 6th left entry on the inside of a pile of top coal, which had been shot down the evening before, with his safety lamp disassembled. In No. 2 room 7th left, the fire losses' danger board marked "Danger - Keep Out" was found face down in the center of the track opposite the crosscut about 15 feet from the face.

On March 17, 16, 19 and 20th an inspection of the mine was made

