CAVE-IN OF THE BON AIR SHAFT

At Leadville, Colorado—How It Happened and How the Men Were Rescued After Fourteen Days' Imprisonment.

Through the courtesy of Mr. Harry Lee, Commissioner of Mines for Colorado we are enabled to give the following account of the cave-in of the Bon Air shaft which is located at Leadville, Col., and of the rescue of the men imprisoned. This account is part of the report to the Commissioner of Mines made by C. N. Crowder, inspector.

The Bon Air shaft is located on Carbonate hill, Leadville, Col., just east and back of the old St. Louis Smelting Company's plant and was originally known as the Bohn shaft. It is operated by the Home Mining Co., a company organized at Leadville for the purpose of unwatering and working the down-town mining properties, and at the present time is under the management of Mr. Albert Sherwin.

The shaft is four hundred and seventy-five feet deep, 5 ft. × 15 ft. in the clear and is timbered with 10″ × 10″ timbers, 4 feet 10-inch square sets down to the Blake station and from the Blake station down to the Smith & Vaile station, square sets 3 feet and 10 inches, and from the Smith & Vaile station to the bottom of the shaft, with 2″ × 12″ cribbing nailed together. On the 430-foot, or Dean station, a level is driven which connects the Bon Air and Star shafts, the distance being about one thousand, one hundred and twenty-five feet.

The shaft is divided into three compartments, No. 1 being the center compartment, No. 2 the east, and No. 3 the west compartment. Nos. 1 and 2 are used as steam-pipe and bucket compartments and No. 3 for ladderway and water column.

At 11 o'clock P. M., March 8th, Chas. Ruess, pumpman on the Bon Air, went down to the pump below the 430-foot level. About 12:30 A. M., March 9th, rocks began falling down the shaft, striking two water cocks on the pumps and breaking them off. Ruess immediately went to work to repair the damage, when other rocks commenced to fall. He rang at once for his helper, Albert Frey, who was at the surface, and who thought Ruess was preparing to lower the pumps and wanted him to bring down stulls. Frey placed the stulls in the bucket and was lowered to the Dean station at the 430-foot level. The pumps did not work satisfactorily, and Ruess ordered Frey to the surface to telephone H. M. Sheppard, night foreman for the company, who was at the Penrose shaft.

Mr. Sheppard came and was lowered with Frey down the east, or No. 2 compartment, about forty feet, where they noticed that some of the lagging was broken and a slush of water and boulders was coming through the break in the shaft. They immediately repaired the break and were then lowered to the pumps. About 2 o'clock A. M., after having worked with the break on the pumps for some time, they climbed up to the Dean station to cool off, as it was very warm working around the steam pipes. While seated there some rocks came down the middle compartment.

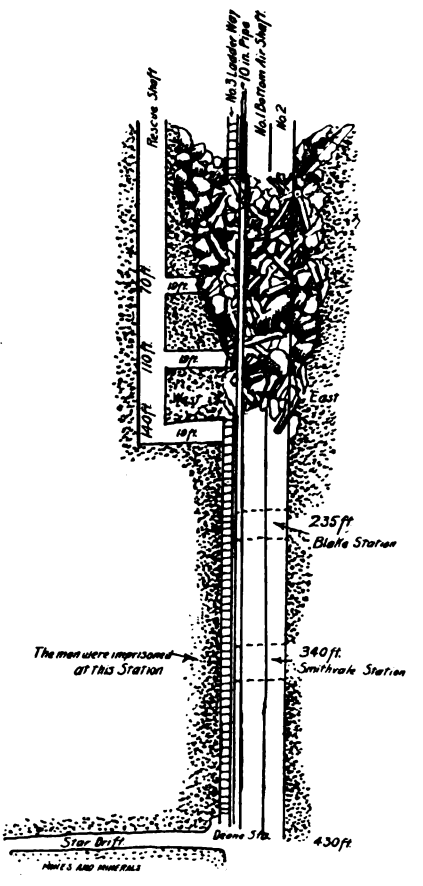
Mr. Sheppard went to the surface and found Supt. James Nimon, who accompanied him down the east compartment to where they had repaired the first break. They found everything just as they had left it. They were then hoisted to the surface and Supt. Nimon went down the west compartment about forty-five feet, where he found two or three laggings out. They put a plat under the break and went to the Penrose after a timber crew to repair it. When they arrived at the Penrose they found that the engineer had telephoned that the shaft had caved in. The management was notified at once and work was immediately commenced to stop the cave from going any further by dumping nearly one thousand bales of hay and straw into the opening and although another cave came lower down about 10 o'clock A. M., the cave was thus practically blocked.

At noon, March 9th, gangs of six men each were placed on six-hour shifts and were taken down the Star shaft to the 475-foot level to clean and open up the level which was connected with the Bon Air and at 3 o'clock a rescue shaft, 3½ ft. × 7 ft. in the clear, and timbered with 2″ × 12″ timbers, was started nineteen feet west of the Bon Air shaft. Double shifts (four men) of eight hours each were set to work on the rescue shaft. Another crew was placed on the Bon Air to save the gallows frame and the shaft timbers which were left intact.

Communication was held with the imprisoned men through the water column and it was learned that they were uninjured.

It was impossible to know the condition of the cave, and the imprisoned men, deeming it unsafe at the Dean station, climbed to the Smith & Vaile station in the dark, and, being tired out, went to sleep. For twelve hours nothing was heard from them and after repeated attempts had been made to communicate with them, it was suggested that dynamite be lowered down the 6-inch pipe to the Dean station and exploded, but the pipe was found to be broken about 40 feet from the surface. Another attempt was made through the 10-inch water column which was successful. The powder was lowered to a point about 12 feet above the Dean station and exploded, blowing off about 3 feet of pipe. An electric light was then lowered through the opening.

The explosion awakened the imprisoned men and they climbed down the west compartment to the opening and communicated with the men on the surface. An elbow was found on the 10-inch pipe at the intersection of the Blake station and tools were lowered through the pipe to the men, who removed the cap on the elbow so that they might communicate with friends on the surface, without going down to the opening made by the explosion of powder. Food, torches, bedding, and dry clothing were lowered to them for the next 13 days, which time they were imprisoned in the mine. The miners on the Star drift were working under many difficulties, as the mine had been filled with water so long that the drift was blocked with porphyry that had caved from the sides. The drift had been originally driven from the 430-foot level of the Bon Air to the Star and had a grade of 3 per cent., making it very difficult to run a car upgrade through water and mud 6 to 18 inches deep. A transfer of the dirt had to be made near the Star shaft and sent to the surface. The air was very bad at all times, although an air-pipe line was placed in the drift connected with a hand blower at the shaft. It was almost impossible to keep a light near the breast.



SECTION OF BON AIR SHAFT, SHOWING METHOD OF RESCUE.

The drift was driven partially through dolomite lime, which it was thought would be clear of dirt, but when intersected it was found that the water had washed the sand down through the water courses and had almost completely blocked it. After clearing up the drift for a distance of six hundred and ninety feet, and timbering some very dangerous places, it was abandoned March 23, after the men had been rescued through the rescue shaft.

At 9 o'clock P. M., March 17th, after talking with the imprisoned men through the pipe about the conditions of the cave below, the working stopped on caved shaft of the Bon Air, as it was deemed unsafe for both the imprisoned men and men working in the caved shaft.

By March 15th, the rescue shaft had been sunk to a depth of seventy feet, and as it was thought the cave had not extended any deeper, a drift was driven to intersect the caved shaft at that point, but it was found that the shaft was completely blocked and sinking was again resumed. A small steam hoist and temporary gallows frame were placed on the shaft March 16th, as it was found impossible to make any headway with a windlass.

March 18th, after having sunk one hundred and ten feet, or forty feet farther, it was thought by the management that by driving another drift it might be successful, but when the shaft was intersected a second time at the northwest corner, it was found as completely blocked as before.

No one seemed to know the measurements from the collar of the shaft to the various stations, the estimates to the Smith & Vaile station, where the imprisoned men were, being 330, 342, 360, and 380 feet, and not until a civil engineer was employed, March 20th, and the measurement taken through the 10-inch pipe, was it found to be 340 feet.

March 22 the rescue shaft had been sunk one hundred and forty feet, and at 7 o'clock A. M. an incline drift was again started

toward the shaft and this time successfully. In driving under the cave, this drift being nineteen feet, a bulkhead was at once placed under the cave, across the shaft, in the west compartment, and clearing the rocks and rubbish from the ladders and timbers, the rescuers descended to the Smith & Vaile station, where they found Reuss and Frey, and all at once ascended the ladders to the drift whence they were hoisted to the surface, just 14 days from the time Reuss went on shift.

CAUSE OF ACCIDENT.

Information was received from various persons to the effect that when the shaft was partially retimbered in the year 1886, up to within seventy feet of the top, large openings were left behind the timbers without being properly blocked; the surface water running through the wash caused the dirt and boulders to become loosened in the open spaces, causing a great pressure against the timbers, which they could not withstand. Not until 12:30 o'clock, A. M. of March the 9th, was it noticed that any surface water was running into the shaft, and from information received up to the time of the cave, the shaft was in excellent condition. From statements made by all the men employed on the mine, they do not believe the shaft unsafe.

About twenty feet of the caved shaft has been retimbered with 12″ × 12″ cribbing, securely fastened with hangers and properly blocked behind the timbers. At the bottom of the cave, a strong bulk head has been built, and with careful management, the shaft can be retimbered through the cave without much danger to the lives of those employed in the work.

THE TREATMENT OF SQUEEZES OR CREEPS.

What They Are, What Causes Them and the Means for Preventing or Stopping Them.

Written for MINES AND MINERALS.

A squeeze occurs when the weight of the cover forces or squeezes a pillar of coal into a soft floor or roof. A creep occurs when the weight of the cover squeezes a *series* of pillars in succession into a soft floor or roof; for example, when the squeezing of

THE PROGRESS OF A CREEP.

one pillar causes the floor to lift and undermine the adjacent pillars, which in their turn sink into the floor and undermine others continuously, the squeezing is said to "creep" or advance until it is arrested by pillars that are too strong to yield.

To prevent the extension of a creep, something has to be done to remove the cause, and there are only two methods put in practice for doing this; in the first one, the excessive pressure on the pillars is relieved by the use of timber supports, and in the second one the pressure of the roof is relieved by removing the pillars to allow the covering rocks to fall. There are four distinct causes of pillar creeping or squeezing: (*a*) Making the coal pillars under a soft roof or on a soft floor too small. (*b*) Extracting the pillars without system and localizing instead of distributing the roof pressure. (*c*) Robbing the pillars in a lower seam long after they have been extracted in an upper one. (*d*) Working narrow strips of coal and leaving pillars between the gobs of two adjacent mines.

The terms too large or too small, when applied to pillars of coal, have not without qualification any definite meaning, for what is a thin pillar under a thick roof is a thick one under a thin roof. Pillars that are thin when standing on a soft floor would be considered thick when standing on a hard one, even although the thicknesses of the covering rocks in the two cases were equal. The hardness or softness of a seam of coal, the hardness or softness of the roof, the inclination of a seam, the free gas in a seam, all require providing for in fixing on the minimum sizes of the pillars that should be left to support the roof of a seam. In cases where all the pillars in a district are left without robbing, if the pillars are properly proportioned, they generally prove to be sufficiently strong to carry the roof, but if the pillars have been left too thin, as soon as one or two are extracted the adjacent ones prove insufficient for their increased load and yield by squeezing. In the same way when the floor rock is soft and yielding, the pillars may be squeezed into it, because the pressure of the roof exceeds the carrying strength of that portion of the floor rock whose area is equal to that of the base of a pillar. Extracting pillars without system often results in locating the weight of a great extent of roof on a small number of pillars that are insufficient to support, the load by which they are crushed or squeezed. Pillars may be made abnormally large and yet be squeezed and the district made to creep by what becomes a general squeeze if foresight directed by intelligence and observation is not exercised in the selection of the methods adopted for pillar extraction. Before extracting any pillar, due care should be taken to ascertain on what other pillars the weight that the pillar in question at present supports will fall. Not only are squeezes produced by random modes of pillar extraction, but much coal is lost or else is obtained with needless danger and expense. Extracting the pillars in an under seam after they have been extracted in an upper seam is sometimes attended with great trouble, and especially so where the intervening strata are soft, or are cut up very much with joints, for then the dead weight of the broken cover of the upper seam so breaks the cover of the under one that it is with difficulty, under the best of management, that the lower pillars can be taken out. Where the pillars of an under seam are extracted before those of an upper one, the pillars in the upper seam can often, with good management, be easily and cheaply worked out. In both cases, however, the nature and thickness of the intervening strata produce favorable and unfavorable conditions. The mining conditions are never favorable when a long patch of coal has to be extracted between the co-extensive gobs of two neighboring mines. If, as a mode of working, the room-and-pillar method is adopted, little, if any, of the pillars will be available, and as the weight of the cover would fall so heavily on stone pack walls as to hopelessly crush them, longwall working would not answer, seeing that the roads through the gob could not be kept open. The only method of working such a lease would be, if the grades would permit, longwall retreating, for then the roads would be secure with coal walls. Not only is a mine subject to the squeezing and loss of much of its pillar coal when it is situated between the coextensive gobs of two neighboring mines, but much coal may be lost in the same mine by leaving the pillars untouched in one panel until they are extracted in the panels adjacent to and on the opposite sides of the one in course of being worked. All the pillars in a panel may be subject to the creep by making it a kind of peninsula in a sea of gob. If, in a case like this, the pillars do not sink into the floor they will nevertheless be nipped or squeezed and so crushed that the coal will be reduced in market value and much of it lost by the breaking of the roof. Single pillars are lost in very much the same way that groups of pillars are, that is, by being made too small or by being isolated or left as outliers in a gob where the other pillars have been removed.

The figure is an illustration of the progress of a creep in eight stages which extend from *A* to *H*. At *A* the floor is just beginning to lift and at *H* the floor rock is seen to have not only blocked up the heading but to have squeezed and crushed the pillar coal.

The treatment of a creep should be determined on by the inspection of an accurate and complete map of the workings. Proceeding in this way it will be found that the region of a creep cannot in all cases be isolated by timbering and building strong stoppings in all the roads round about it, but rather, that the squeeze can be effectively stopped with little trouble and expense, by drawing out some of the timber and throwing the weight onto some small outlying patches of coal that can, with advantage, be sacrificed to save the roads and pillars of the district. In many cases a creep, with all its attendant destruction, can more quickly be arrested by helping it than by trying to prevent it. When once the roof becomes unsteady and the timbers are breaking and the floor is lifting, a force is operating that cannot be stopped by artificial means; it can, however, be directed by assisting it to find relief where the least damage will be done.

Colorado Coal Mining Law.

Mr. David Griffiths, Inspector of Coal Mines for Colorado, says in his last annual report: "Our present coal mining law is lax and incomplete, and much can be done by legislation that will benefit the general welfare of our coal miners. Since our present law governing coal mining was framed in 1883, the coal-producing capacity of the state has greatly increased, and we now have conditions to cope with not then existing. In my previous report I suggested that a board of commissioners be appointed composed of any desirable number of coal miners and an equal number to represent the operators. Said board to make a complete revision of the mining law and adopt every known precautionary measure in vogue here and elsewhere tending to provide for the health and safety of our coal miners. The coal mine inspector and a constitutional lawyer, who should be a member of one of our legislative bodies, would be of great aid to such a board. In this manner a law could be drafted that would be satisfactory to the operators, beneficial to the miners, and undoubtedly be approved and passed by our legislative bodies."