The Carlton Tunnel - "it never was a bore! "

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Perhaps this paper should have been entitled, "The Carlton Tunnel - it never was a tunnel. " By definition, a tunnel should have two portals, and the Carlton had only one so it should have more properly been called the Carlton Adit.[1] Local terminology, however, often supersedes the book! The Carlton, driven for drainage, in the Cripple Creek mining district of Colorado was collared in 1939 and completed in 1941.

The Cripple Creek mining district lies nearly 100 miles south of Denver and due west of Colorado Springs on the west flank of Pikes Peak at an elevation of about 10,000 feet. The district has produced nearly 22 million ounces of gold since 1891 and is currently recovering close to 1/4 million ounces annually.

The district, originally described as a volcano by Thomas Rickard,[2] is more correctly described, geologically speaking, as a diatreme.[3] To get even more technical, the district has been described as the neck of a granite bottle with the brecciated and mineralized rock inside the impervious granite bottle acting like a sponge which was saturated from millions of years of rainfall and snowmelt.[4]

After the Cripple Creek Mining District was officially formed in 1891, miners sank into the diatreme encountering no water, so they figured it was a "dry camp"[5] (Cripple Creek & Victor bars excepted!). However, continued sinking encountered an overabundance of water. Bailing by bucket was not very efficient and pumps were not that effective at the turn of the century. Cornish pumps were huge, cumbersome and in their waning years of use. Steam pumps were expensive to operate and required a large capital outlay although a few larger mines like the Portland did employ them.

The solution was to drive drain tunnels, a procedure that goes back in time at least to their use at Rammelsburg, Germany in the 10th century.[6] The Cripple Creek deposit was admirably suited to this procedure as its high elevation with the lower valleys to the west made it practical to drive into the mining area from the valleys. This has been likened to drilling a hole through the neck of the impervious granite bottle and into the sponge or mineralized core. Water could then flow by gravity out into the valley.

Four tunnels had been previously driven at successively lower elevations expressly for drainage — the Ophelia or Moffat, the Standard, the El Paso and the Roosevelt (named for Teddy, not Franklin). The Roosevelt was the most successful, and by the 1920s, the tunnel had drained the water table to about 8,000 feet in the southern or most productive part of the district. The four-and-a-half mile tunnel took eleven years to complete but was reputed to have prolonged the life of the district by at least 20 years. Funding for construction was obtained by charging each property owner to drive under his property for drainage. Collecting the money was responsible in some part for the 11 year time frame. The original tunnel contractors, Lund and Stream, made such slow progress, that the Carlton Brothers (very successful mine owners and businessmen in the district) took on the job. They increased the rate of advance by sinking an intermediate shaft 7,935 feet from the portal that advanced in both directions from the shaft as well as from the original heading. They also utilized existing shafts along the tunnel route as they came to them to hoist the blasted rock and avoid the

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long haul to the portal of the tunnel.[7]

In 1930, district workers were mining below the Roosevelt Tunnel level and were forced to pump water up to that elevation, raising their costs. The increase in the price of gold in 1934 provided a big stimulus to the district and this generated a great deal of interest in a deeper drain tunnel. Many studies were carried out by various entities to justify this construction.

The Southern Colorado Power Company, however, advocated a far different approach. President W. N. Clark of the power company commissioned Byllesby Engineering & Management Corporation to conduct studies to show that it was more feasible to continue to pump rather than to drop down another 1,000 feet, and drive over six miles through ground with unknown problems to get to the heart of the district, namely the Portland Mine, then the deepest mine in the district. The pumps, of course, were to be powered by electricity supplied by the Southern Colorado Power Company.[8]

Another proposal was to drive the tunnel from Colorado Springs on the east side of Pikes Peak, westward into the district. The main gold processing mills were located there and some mine officials felt that the tunnel would provide an all-weather route and cheaper ore-hauling rates than the existing railroad could or would. Mill operators would then use the water in their processing, and the residents of Colorado Springs would also benefit by using the water as well. A tunnel under the flanks of Pikes Peak would have been over 13 miles long and the miners would have encountered some known major faults with possible extensive ground support problems. The final nail in the coffin of that proposal, however, was that four cubic feet of water per second issuing from the Roosevelt Tunnel, that would be captured by the new tunnel, had already been decreed for irrigation purposes for the farmers along the Arkansas River.[9]

President Merrill E. Shoup of the Golden Cycle Gold Mining Company, the prime movers behind the tunnel project, selected a site at Marigold, an old stage stop, on the route to Cripple Creek from Canon City.[10] The site, advocated by A.H. Beebe, General Superintendent for Golden Cycle, was in the Cripple Creek/Oil Creek drainage at an elevation of roughly 7,000 ft. An application for construction funding through federal sources was submitted but when this was turned down, the Golden Cycle Company decided to fund the tunnel themselves at an estimated cost of $2 million.[11] By this time, the need for the tunnel was critical if the district was to continue producing gold. The major mines were operating below the Roosevelt Tunnel level and the consequent pumping cost added substantially to production costs with gold pegged at $35 an ounce.

Golden Cycle engineers set up an extensive triangulation net to provide survey control to hit the target of the Portland Mine area from a valley location over six air miles away and 3,500 ft. lower in elevation than the collar of the Portland No. 2 shaft.

The people in the area realized how crucial the tunnel was to the future of the district and rallied behind the plan. Teller County officials worked with Golden Cycle to improve the tight, twisting road down to the portal to expedite travel for men and supplies. "Long John" Austin, a noted tunnel man, was employed to ramrod the driving under the direction of Alfred H. Bebee, vice president of Golden Cycle. The company hired the best of the district miners to drive this tunnel expected to be the economic lifeline for the district. Local mining companies stopped pumping water and began mining remnants of ore above the Roosevelt level in anticipation of the day that the new tunnel would drain the ore below.[12]

Fortunately, the miners found the hard granite, through which most of the more than six miles of tunnel were driven was very competent and, therefore, very little timber was required to support the rock in the tunnel except for about 300 feet at the portal.[13] Each mile of tunnel was completed more quickly than the last, a tribute to management's detailed planning and the quality of the mine crews. The use of a bonus system of four dollars a foot for advances of more than 900 feet per month was also a motivator for the crews.[14] Another contributing factor was the switch from conventional forged drill steel to detachable bits which cut the manpower, time and costs required for handling, transportation and sharpening of the heavy lengths of conventional

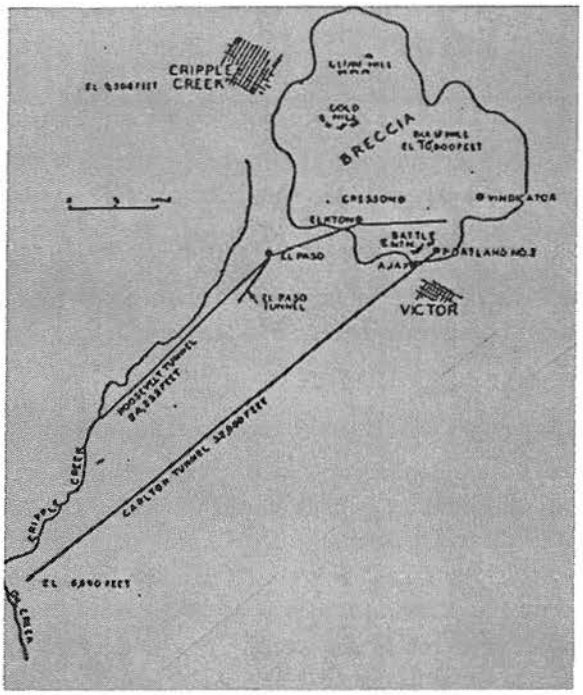

Figure 1. Plan View – Tunnel Location. *Compressed Air,* June 1940.

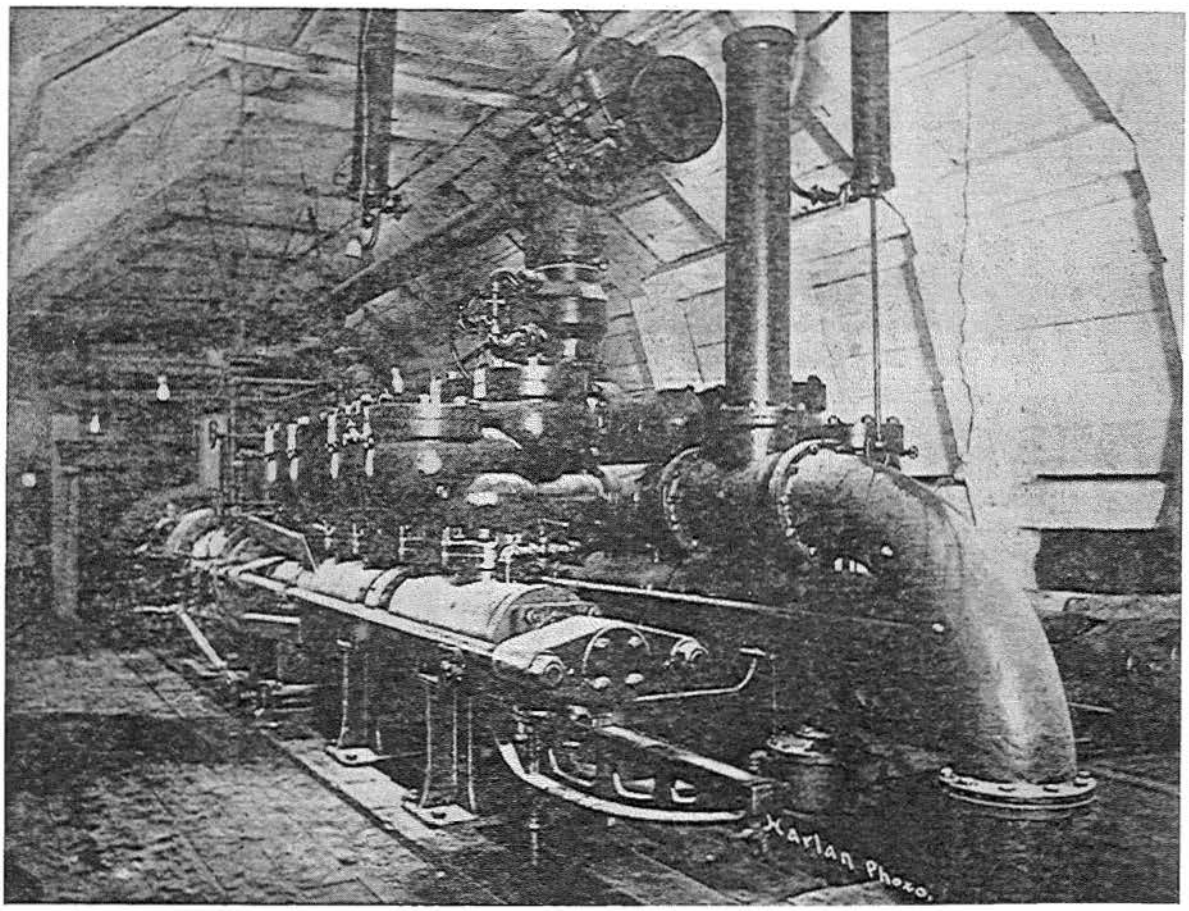

Figure 2. Steam Pumps – Portland No. 2, 900 Level.
Portland Gold Mining Company Annual Report.

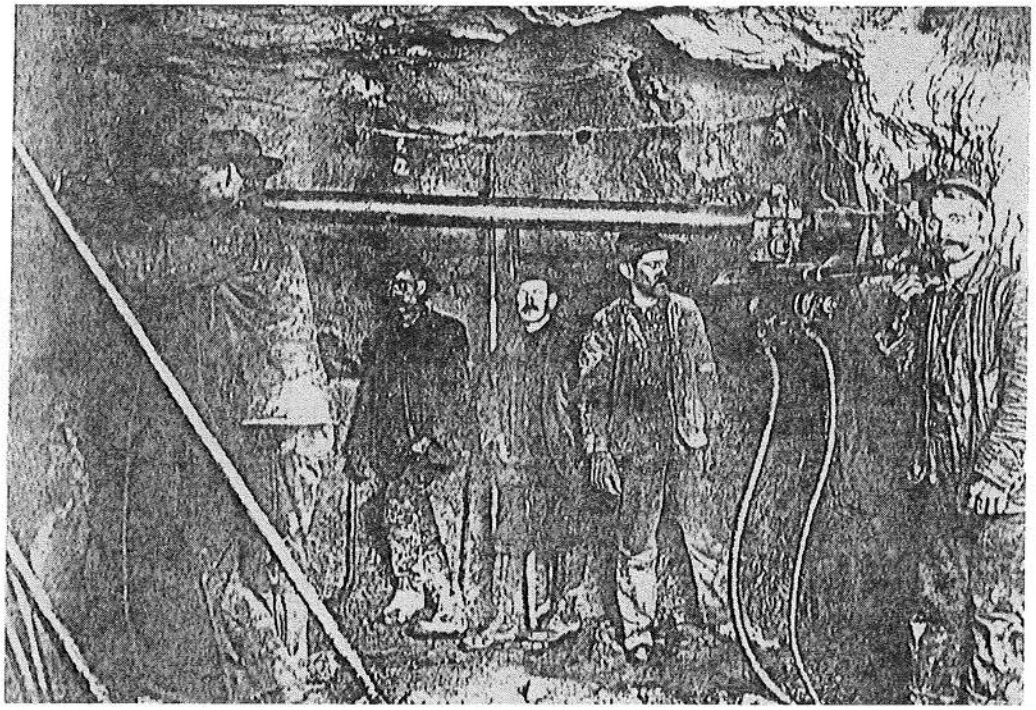

Figure 3. Roosevelt Tunnel Drill Setup – 1908.
Pikes Peak Gold, Barbarosa Press, 1964.

Figure 4. Man-train Enroute to Face.
Joe Vanderwalker Photograph.

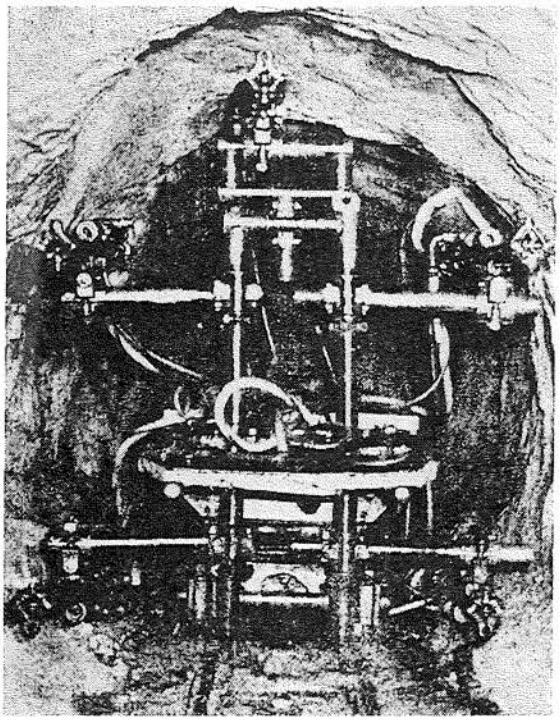

Figure 5. Five-drill Jumbo.
Compressed Air, June 1940.

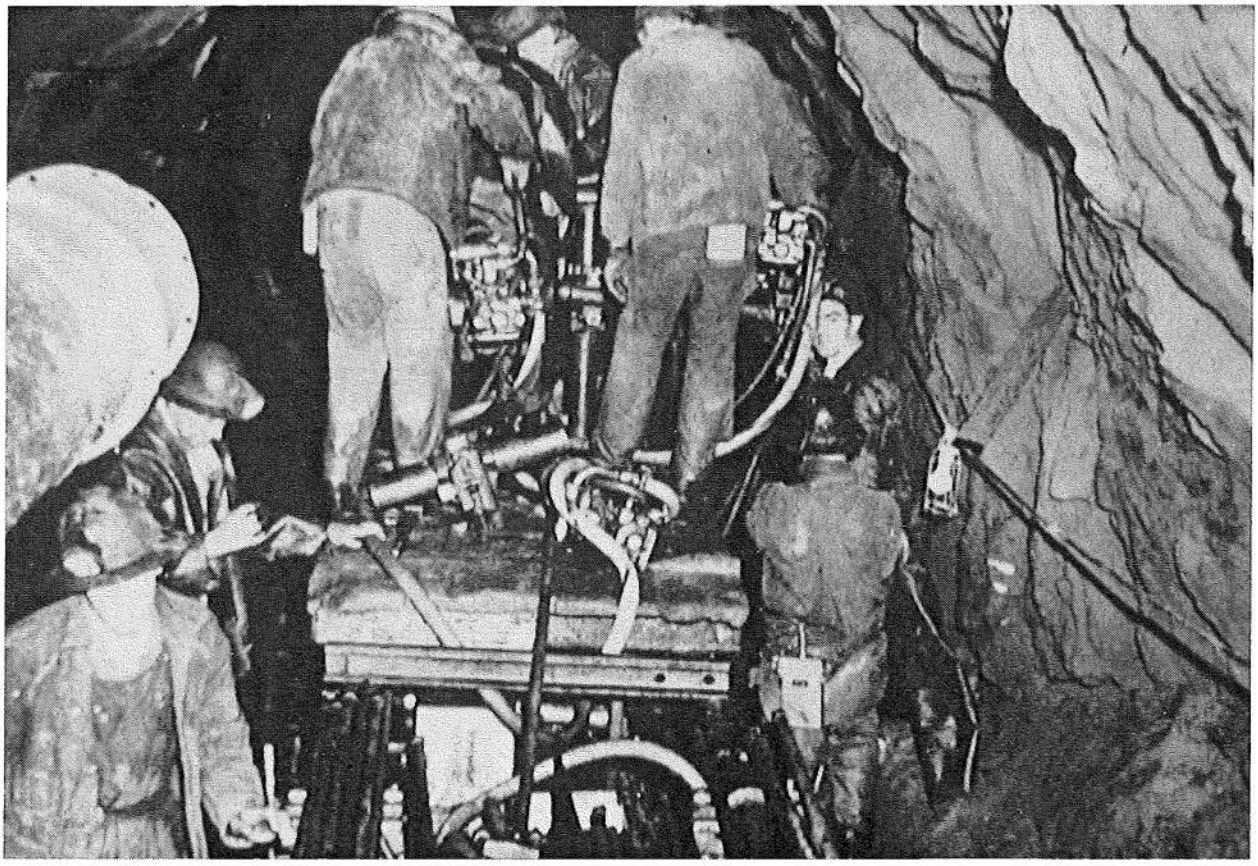

Figure 6. Drilling at Face.
Cripple Creek and Victor Gold Mining Company Archives

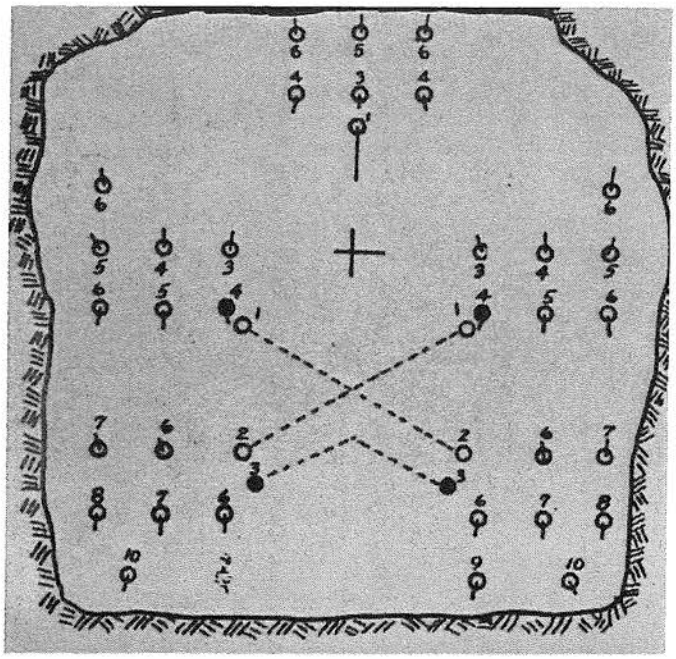

Figure 7. Typical Drill Pattern at Face.
Compressed Air, June 1940.

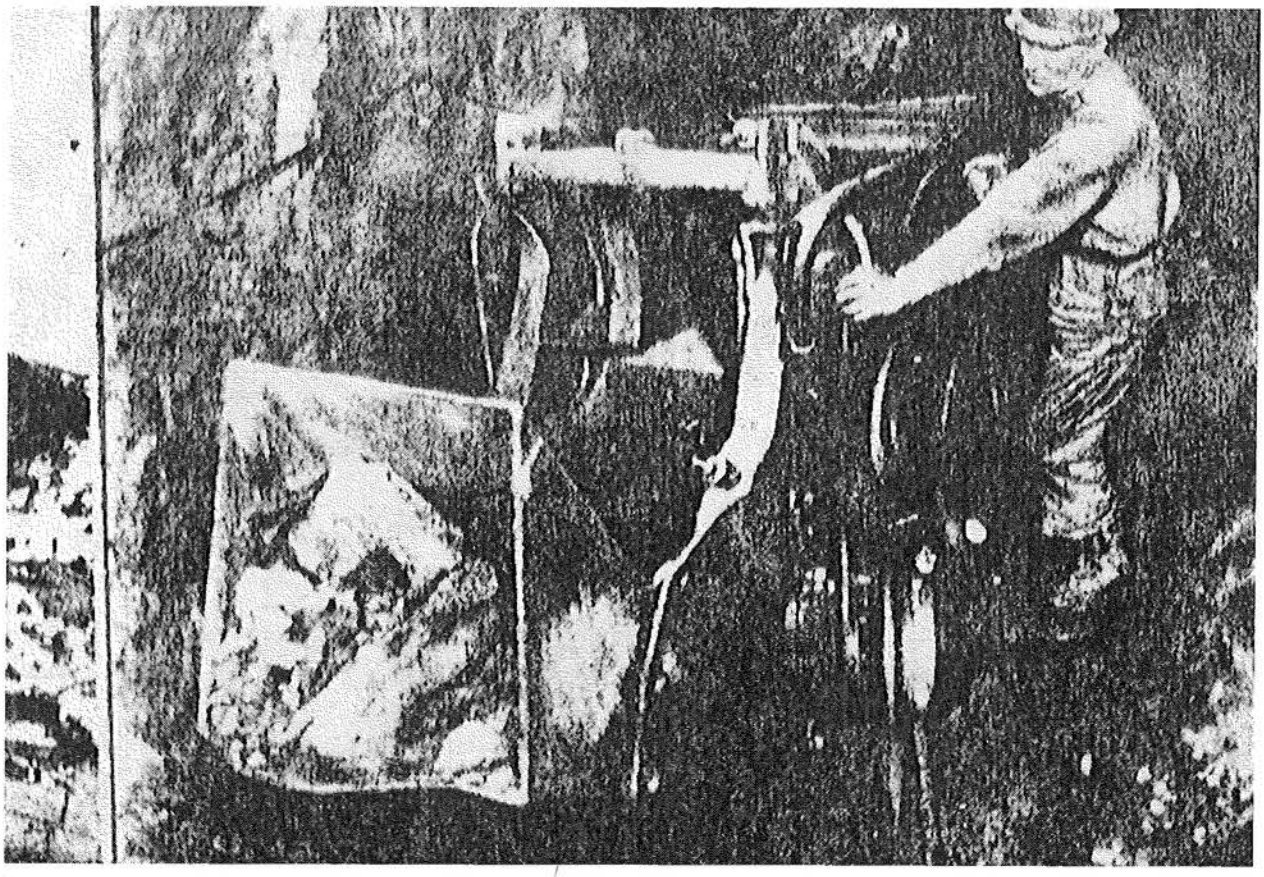

Figure 8. Mucking Face Round.
The Mines Magazine, May 1940.

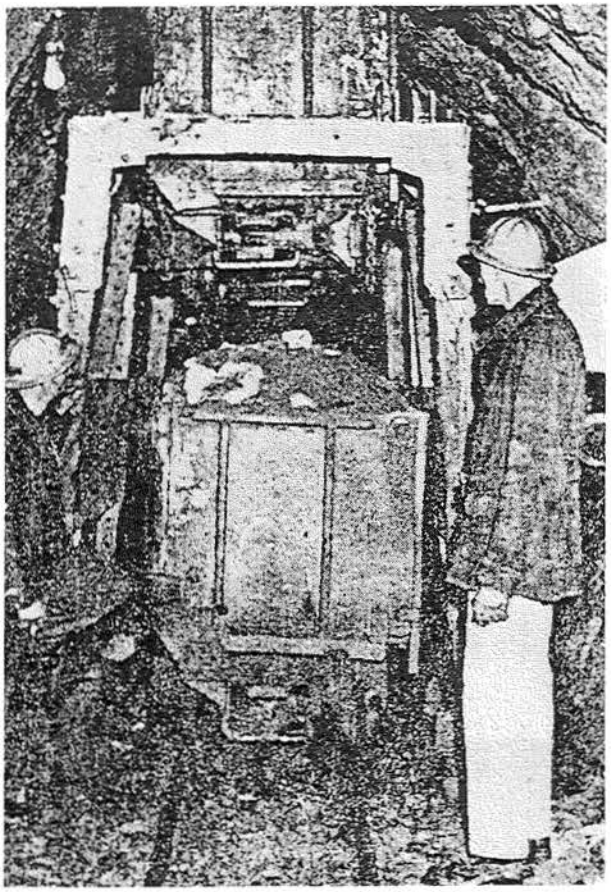

Figure 9. Checking Operation of Car-transfer.
The Mines Magazine, May 1940.

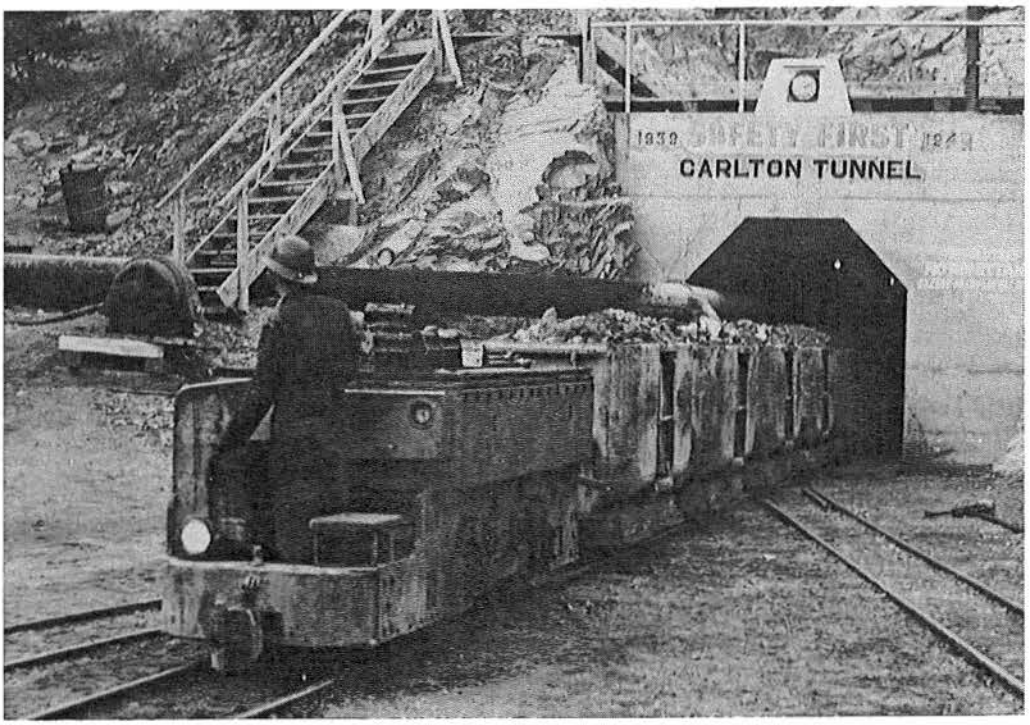

Figure 10. Muck-train Enroute to Dump.
Joe Vanderwalker Photograph.

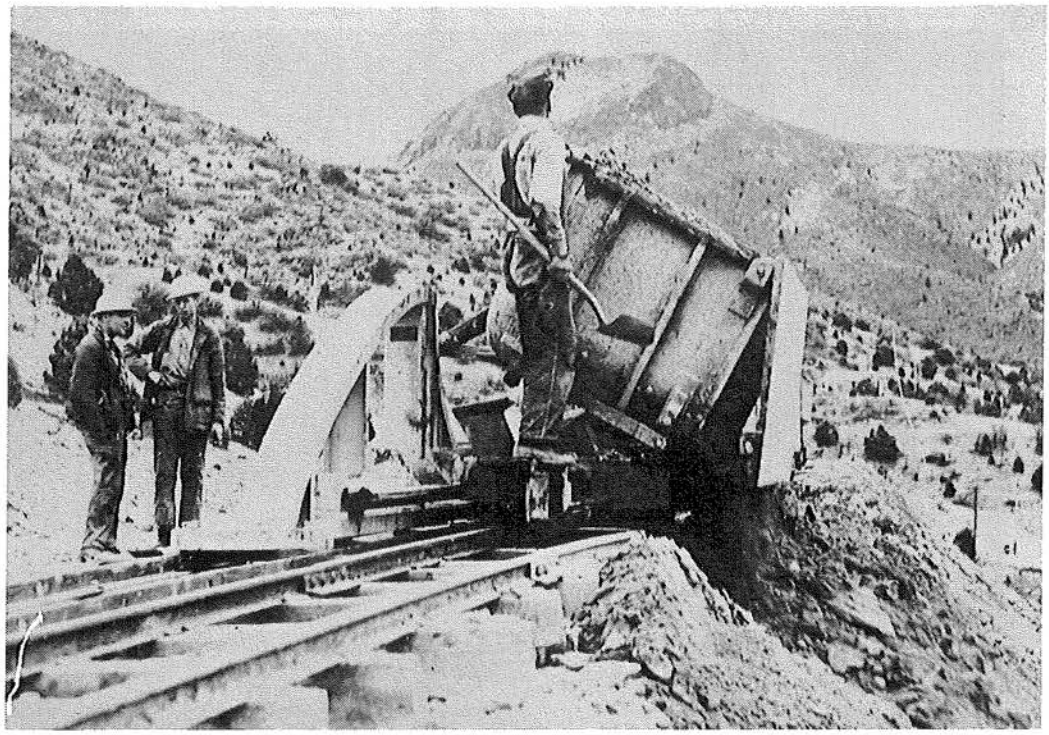

Figure 11. Granby Mine Car at Camel-back Dump.
Joe Vanderwalker Photograph.

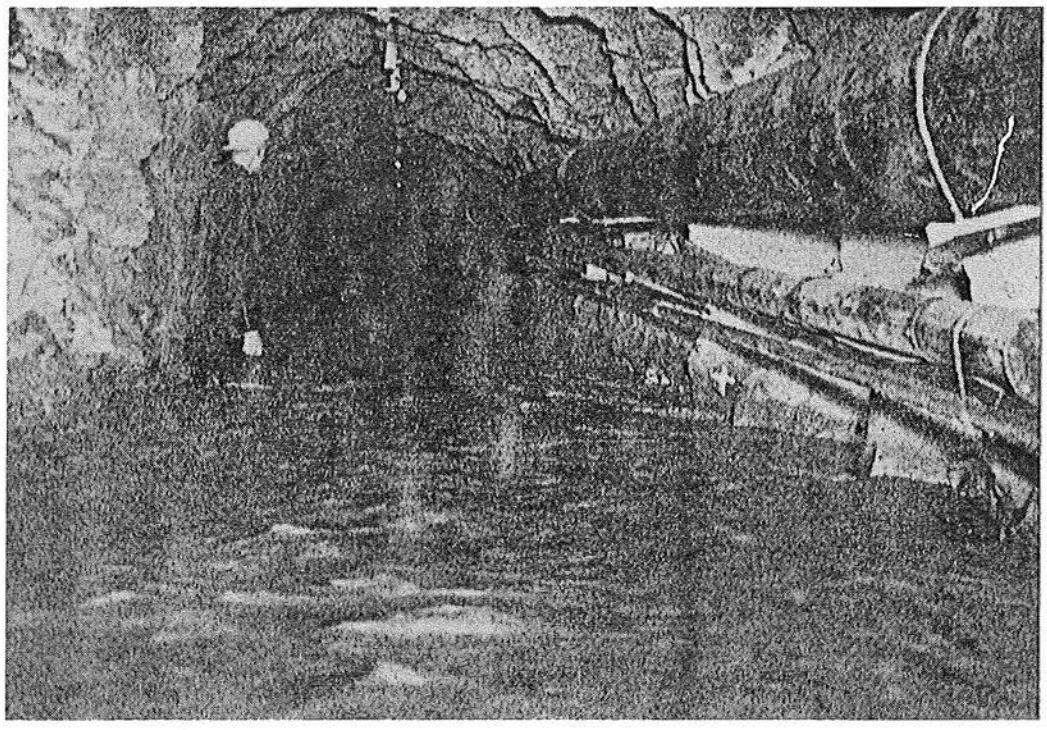

Figure 12. Long John Austin and Water from the New Market Fault.
Cripple Creek and Victor Gold Mining Company Archives.

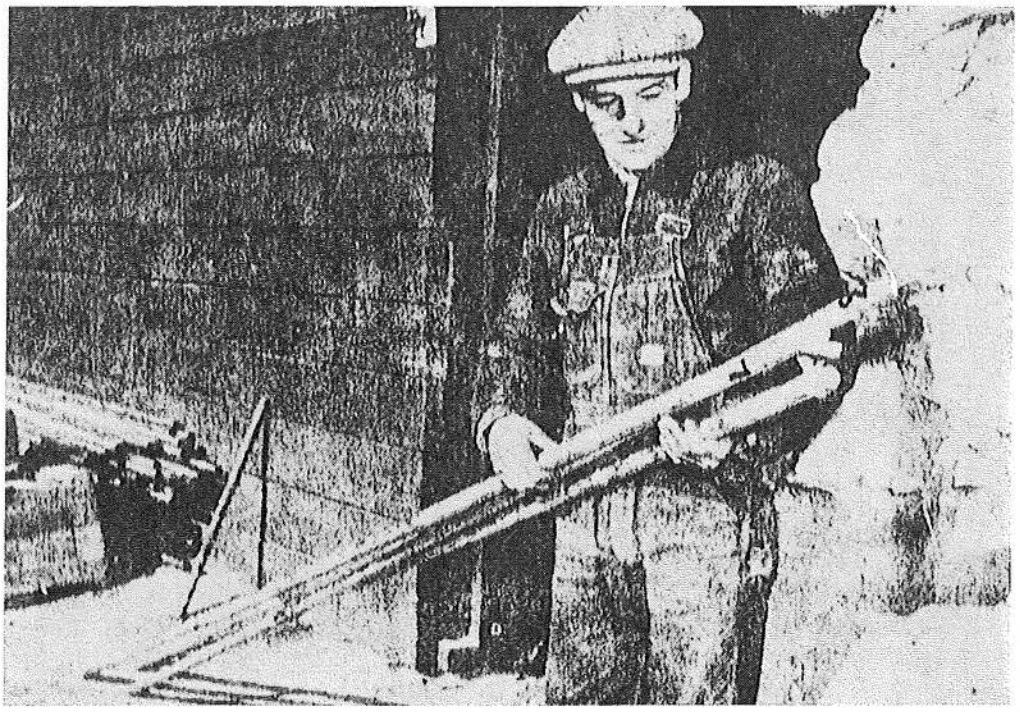

Figure 13. Blasting Tubes for Wet Conditions.
Compressed Air, April 1941.

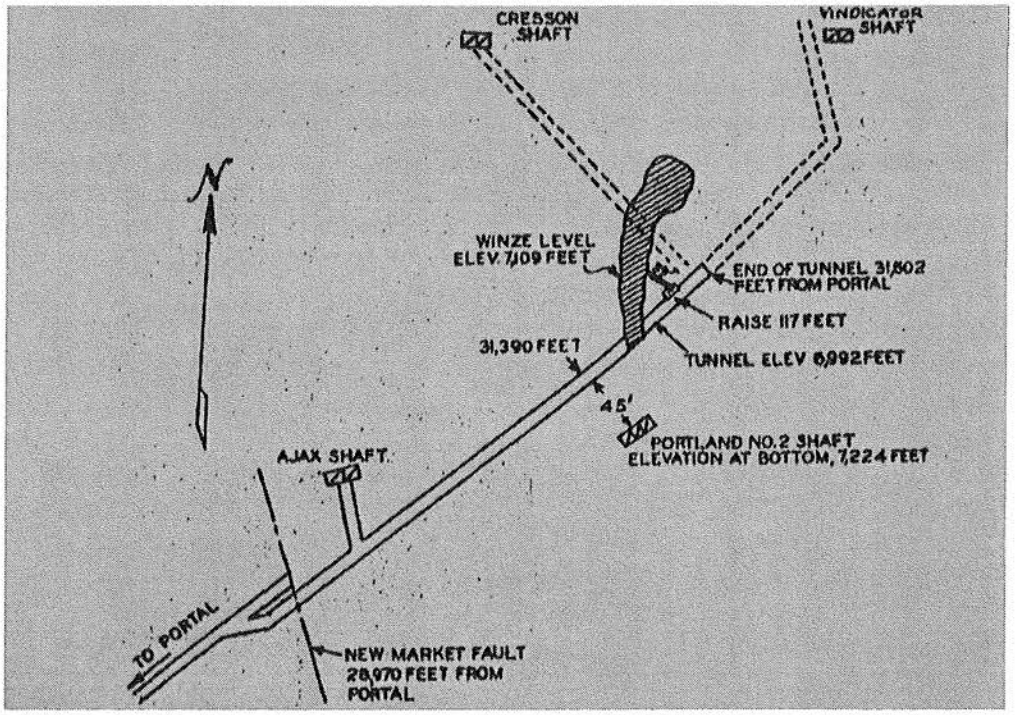

Figure 14. Plan View – Breakthrough to Portland Stope.
Adapted from *Compressed Air*, November 1941.

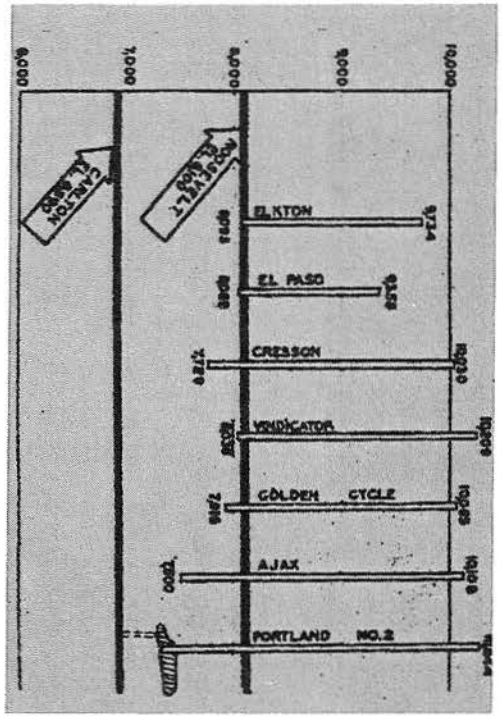

Figure 15. Vertical Section – Breakthrough to Portland Stope.
Adapted from *Compressed Air*, November 1941.

Figure 16. Bottom of Connection Raise – 1200 gpm.
Compressed Air, November 1941.

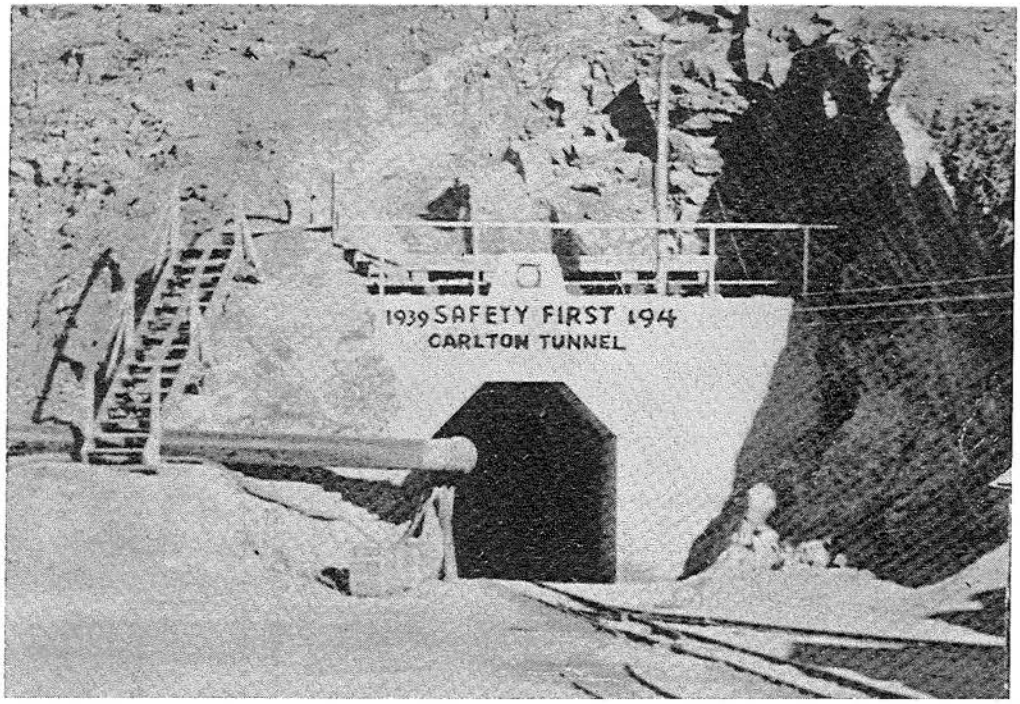

Figure 17. Portal at Breakthrough Blast Time.
Elks Bulletin, Cripple Creek Lodge 316, July, 1942.

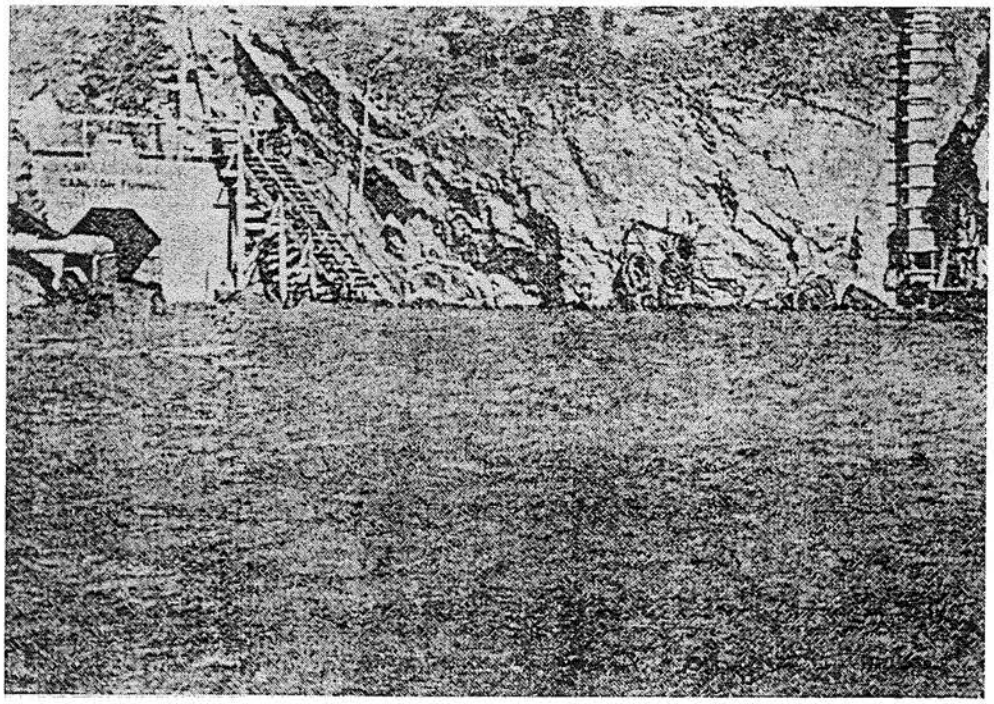

Figure 18. Portal 65 Minutes after Blast.
Elks Bulletin, Cripple Creek Lodge 316, July, 1942.

steel to less than half the previous figures.[15]

The equipment used in all aspects of the driving was a combination of innovative design by Austin and Guy Rorabaugh, master mechanic, and that typically used by the industry for similar work. Drill crews used a mine-manufactured jumbo mounted with five Ingersoll-Rand drills (DA 35) for drilling and blasting. A conventional Eimco 21 track-mounted, overshot mucking machine was used in the mucking cycle in combination with a unique overhead car transfer unit. Fifty-four cubic-foot side dump cars pulled by an 8-ton General Electric battery locomotive hauled the blasted rock outside. A fifth or side wheel, added to each car at the portal, permitted the car to automatically dump as it ran over the camel-back at the discharge point. The fifth wheel was removed from each car as they re-entered the tunnel to provide additional clearance between the car and the side of the tunnel.[16]

Miners struck the first major flow of water when the tunnel intercepted the New Market fault, 28,970 feet from the portal.[17] Very loose ground at the fault convinced Beebe and Austin to turn the heading slightly to the east as soon as the reported 16,000 gallons per minute of water had subsided. The crew then advanced through the fault with no increase in water and little problem with the ground. In very wet ground, explosives were loaded into a 30-gauge galvanized tube, sealed at one end and protected at the other by an expandable rubber plug which permitted the electric cap wires to protrude and hooked-up for detonation. The tube unit kept the explosives from washing out from the force of the water until detonation.[18] (This very effective method might give the Mine Safety & Health Administration a problem with the procedure today.) After successfully crossing the fault, the miners drove the tunnel to the contact between the granite and the breccia of the diatreme where only minor amounts of water drained from above. Drifting along the contact increased the drainage slightly but the water in the workings above dropped only about 12 inches per day[19] and after two long years, miners and owners wanted instant gratification.

First, miners drove a 117 ft. raise from the tunnel level up to the level of the winze stope of the Portland Mine. They then drove a crosscut 20-1/2 feet or about halfway from the raise to the stope wall. A pilot hole drilled ahead of the face penetrated the flooded stope at 18-1/2 feet, just as the survey had indicated. Removing the drill machine from the drill steel, freed the steel which flew back with such force that it punched a hole through a 2-inch thick lagging.[20] An estimated 1,200 gallons a minute poured out of that hole. Miners then drilled around twelve closely spaced holes inside a 24-inch by 24-inch square but 1-1/2 feet short of breaking through and loaded with explosive. All personnel assembled at the portal prior to detonation of the round.[21] Two feet of water covered the yard at the portal in just over an hour after detonation, with the volume estimated at 125,000 gallons per minute.[22] The Portland workings drained in about three days![23] The force of the water bent some of the tunnel rail into curves and one of the tunnel ventilation fans reportedly turned up missing.[24] Without the accuracy of the survey, it would not have been possible to hit this small a target over the long distance involved. The surveyor did not have the benefit of the electronic survey equipment we take for granted today.

The Carlton Tunnel set record after record for rate of advance for a tunnel from one portal. Local newspapers, the mining journals and even Time Magazine reported the latest progress figures.[25] The final totals for the 6.3 mile advance, driven in just two years and five days, required drilling and blasting 4,518 times for an average advance of 47.24 feet per day.[26] The Roosevelt Tunnel had the advantage of intermediate shafts to help expedite the work and still took 11 years to advance 4-1/2 miles.

Driving the Carlton Tunnel had been estimated to take four years and $2,000,000 but final costs were about $1.2 million. The crews began driving the tunnel in July 1939 and finished it in July 1941. This was truly a masterpiece in tunnel driving. It was also a masterpiece in mistiming, for soon after mining resumed, the federal government issued the L-208 order. Because of the need for miners in the strategic metals - copper, uranium and iron - the order temporarily ended all industrial gold mining for the duration of World War 11. This action virtually eliminated gold mining during the war in the Crip-

ple Creek Mining District. After the war, miners utilized the tunnel for access and ventilation until 1961. The idle Ajax shaft, presently the deepest in the district, is now flooded 250 feet below the Carlton Tunnel level[27] and would require pumping once again, to resume underground mining.

The Carlton Tunnel still drains a large part of the Cripple Creek Mining District today, although it sits idle. Current mining in the district is carried on in a surface operation far above the tunnel elevation. The average discharge from the tunnel for the last several years has been about 1,600 gallons per minute at a slightly alkaline pH of 7.6.[28] This flow is subject to, and meets, all of the rules and regulations of an EPA discharge permit for water quality. Should another drain tunnel 1,000 feet below the Carlton level ever be required, topography would dictate its length to be 13 miles. That tunnel would, most likely, be a *bore*.

NOTES

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5. Ibid.
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15. Vivian, C.H., The Carlton Tunnel Taps Watercourse, *Compressed Air*, v. 46, no. 4, April 1941.
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17. Vivian, A.H., Carlton Tunnel Taps Watercourse, *Compressed Air*, v. 46, no. 4, April 1941.
18. Ibid.
19. Vivian, C.H., Carlton Tunnel Drains Portland Mine, *Compressed Air*, v. 46, no. 11, November 1941.
20. Leber, R., Personal Communication.
21. Vivian, C.H., Carlton Tunnel Drains Portland Mine, *Compressed Air*, v. 46, no. 11, November 1941.
22. *Elks Bulletin*, Cripple Creek Lodge No. 316, July, 1942.
23. Vivian, C.H., Carlton Tunnel Drains Portland Mine, *Compressed Air*, v. 46, no. 11, November 1942.
24. Leber, R., Personal Communication.
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