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URANIUM EXPLORATION

I was very pleased when Mr. Burwell asked that someone from the Colorado Exploration Branch of the Atomic Energy Commission give a short talk on some topic of interest to the mining industry. It gives me the opportunity to tell you what our organization is doing in the field of uranium exploration. I am sure there are others better qualified than I to discuss the geology and mineralogy of uranium ores, so I shall not attempt a scientific subject.

Our office is located in Grand Junction, and our job is to find and evaluate our uranium reserves on the Colorado Plateau. Fortunately, we are not expected to do this all alone. The U. S. Geological Survey is also conducting a search for uranium, and our two organizations work closely together in a coordinated plan. Private industry is a very important part of this wide-spread exploration program.

In my opinion, one of the outstanding accomplishments during recent years is the realization that our search for uranium should not be limited by previously conceived ideas of where the boundaries of uranium mineralization are located. I think most of us who are active in the field will freely admit that we don't know where the limits of the uranium field are. It wasn't many years ago, however, that the best-informed carnotite experts believed that any serious search for vanadium-uranium ores should be concentrated in the Uravan-Naturita district or a few other small areas. Perhaps a brief history of the industry will illustrate the amazing growth of the uranium-vanadium field. Maybe we can blame our failure to recognize the true picture on such unscientific factors as price, demand, and economics.

The first shipment of carnotite ore is reported to have been made in 1898, after the claim from which it was mined, located in the Roc Creek district, had been discovered and re-discovered several times because of the presence of a yellow mineral which could not be identified.

The first experimental milling was done at the Cashin mine, upon ores from Roc Creek and from the old Yellow Bird on La Sal Creek. In 1901, these early experimenters built the first mill in the McIntyre district. This work continued for a few years, with the primary object the recovery of uranium, and with the discovery of vanadium of secondary importance. Between 1904 and 1910, there was little or no activity; but in 1910, foreign markets for uranium created a demand for carnotite ores, and extensive uranium deposits in the Long Park District were discovered and activity switched to the Uravan area.

Pioneers of present methods of mining carnotite entered the field in 1910. Activity increased each year until 1914, when the beginning of the war cut off the foreign markets. Up to this time, most carnotite ores had been sold to foreign buyers. After a brief slump, domestic demand for the ore increased, until in 1919, the quantity of ore mined exceeded that of any previous year. The first markets created were primarily for the uranium and radium content, but this second period of activity was based upon the market for vanadium for use in vanadium steel.

Early mining centered around the Long Park area, and soon discoveries were made on Club Mesa and in several other districts mostly lying between Outlaw Mesa to the north and the Slick Rock district to the south. The
market for vanadium stimulated new interest which resulted in discoveries of the roscoelite type ores at Placerville and Rifle. These ores are vanadium ores, and contain very little uranium.

As early as 1912, some interest was shown in outlying districts such as Temple Mountain and Thompkins. Old reports indicate that the presence of uranium and vanadium ores was known, but very little actual production was recorded for these areas until recent years.

In such cases where new discoveries were made or new districts developed, two basic economic principals were responsible: (1) a market, a place for the miner to sell his ore within hauling distance of his mine, and (2) a price at which the miner could sell his ore at a profit. A third factor was also present—but at that time it was not a problem—: before ore can be mined, it must be found. All early discoveries were made by the good old-fashioned prospector with a hand pick. There were literally thousands of miles of rims in the Colorado Plateau. Enough walking and digging would almost always result in the discovery of an outcrop of ore. The actual cost of finding ore did not have to be considered in the over-all cost of production.

At the end of World War I, the market for carnotite ores fell off, until by 1923, mining and milling were at a complete standstill. About 1935, an improved market stimulated interest in vanadium, and a new mill was built in Uravan. The Naturita mill was rebuilt in 1939 and production got well under way in the Uravan-Naturita district. The market grew strong enough that some districts outside of the old Uravan-Naturita region were for the first time carefully prospected; and mills at Monticello and Durango were constructed about 1940, which were dependent upon these outside ores. Other smaller mills were also built in Blanding, Gateway, and other places.

This expansion during the period about 1938 to 1940 is an important milestone in the story of uranium and vanadium, because it marks the first time that producers, miners, and prospectors gave serious consideration to the possibility of extending their search for ore far beyond the original limits of discovery. During this period, many of the outlying districts became known as potential producers, but actual development of ore deposits was very limited because the high cost of hauling to existing mills was prohibitive.

The strong market for vanadium continued until the end of the war, when Metals Reserve ceased its purchasing of ores. Vanadium and uranium mining and prospecting fell off to almost nothing, and most of the mills were shut down.

During this entire period between 1935 and 1945, mining and milling activity was based entirely upon the demand for vanadium, and the uranium content in the lower-grade ores was ignored because the mills were paying only for the vanadium. The first actual payment for uranium content in low-grade ores was in 1946, although the initial price offered was not sufficient to stimulate great interest among the producers.

Two factors were responsible for the increased activity in 1948; the guaranteed price policy announced by A.E.C., and the fact that exploratory diamond drilling by Government agencies began to yield new ore discoveries. Most rim outcrops, at least in the central part of the region, had been found
previously. Diamond drilling exploration discovered new uranium deposits in areas where ordinary prospecting methods could not be used. Operators say that these new discoveries, resulting from systematic, geologically guided drilling programs, are as important a factor in this increased activity as is the price factor. Uranium deposits which are discovered on Public Domain by Government drilling projects are leased to private operators for exploitation. Private mining companies feel that diamond drill exploration in new areas is too costly to be considered a function of their mining activities. Discovery of ore has become a factor of major importance; whereas, during the early period, it did not present a difficult problem.

As I have pointed out, until about 1939 and 1940, almost all of the prospecting energy expended was confined to the Uravan district, with very little activity in the outlying districts. In recent years, the picture has changed, and today it is changing more rapidly than ever. Vast new regions have been recently recognized as potentially productive areas, and those who are active in the uranium industry no longer confine their search to one or two geologic formations. New discoveries are constantly pushing out the boundaries of the uranium country, and new discoveries made by prospectors who "don't know any better" are opening our eyes to the fact that uranium mineralization is not confined to one or two stratigraphic horizons, but is widely distributed geologically as well as geographically. An ever-expanding search is being conducted by the Government and by private industry. New mills are being planned and built in areas where a few years ago there was no uranium activity.

We are also finding that our search must not be directed only toward carnitote ore. Completely new types of ore are being discovered and developed, which promise to play an important part in the uranium production picture. I refer to the copper-uranium ores of the White Canyon district; to the recent and much publicized deposit near Grants, New Mexico (carnitote and complex uranium-oxides in massive limestone); to Temple Mountain, where we find asphaltic ores; to the Marysvale deposit; and to others in widely scattered areas.

The Navajo Indian Reservation offers a wide, little known area, which the Atomic Energy Commission is actively exploring at the present time and in which we plan a great deal of additional investigation. We have just completed 50,000 feet of diamond drilling in the Lukachukai Mountains area. This district was almost completely unknown six months ago. Rim prospecting quickly discovered many good ore showings, once interest in the area was aroused. The drilling we have done has defined the approximate limit of some of these rim deposits and has also discovered ore bodies in the center of the mesas, which do not outcrop on the rims.

The Grants district is worthy of special mention because its discovery again extends the known limits of sedimentary uranium deposits. The first reported discovery in this area was made by a Navajo Indian named Paddy Martinez, on his homestead at Haystack Mountain, north of Bluewater, New Mexico. He saw some ore samples at a trading post and recognized them as being similar to some rocks he had seen near his homestead. Since the original discovery, a great deal of publicity has resulted in a small uranium rush. Prospectors, Government geologists, and geologists from the Santa Fe Railroad and several mining companies are presently scouring the hills, and new discoveries are being reported daily.
Perhaps the most remarkable thing about these deposits is that they were not discovered earlier. The known mineralized area has been extended some 25 miles along the main Santa Fe Railroad line and along U. S. Highway 66. All of these areas are less than five miles from the highway, and, although they rest at the top of sandstone bluffs, they are easily accessible by existing local ranch roads. The area is easily prospected, and mining will be economical. It also appears that, contrary to first guesses, the ore is exceptionally amenable to beneficiation.

The Grants deposits have always been there. They are exposed in many places and once interest was aroused, many discoveries were made. We wonder if there are other Grants districts yet to be found.

The copper-uranium deposits are receiving special interest, and important new discoveries are being made. The Happy Jack mine was only a good-looking prospect—in fact, the only good-looking prospect—in the White Canyon district only a short time ago. It is a good-looking mine now, and over 150 claims have been staked in the White Canyon district within recent weeks.

Old geologic reports list copper deposits in sedimentary rocks in many localities throughout the region. The White Canyon copper-uranium deposits are listed among these reports. We know of other similar deposits which were discovered as copper mines and later found to contain uranium. Every one of these sedimentary copper deposits should be carefully inspected to see if another White Canyon is among them.

We believe we have recognized the fact that our search for uranium must not be confined within geographic or geologic boundaries, nor should our methods of prospecting be limited to rim-walking and diamond drilling. Airborne radioactivity detection equipment, mounted in helicopters and various types of light aircraft, is being used in efforts to develop a simple, fast way of covering this vast area. The principal objective of the application of airborne prospecting is to give us information which will permit us to concentrate our efforts on favorable areas, rather than to attempt to cover the entire region in detail. Preliminary results of this type of prospecting are encouraging.

Radiometric logging of diamond drill holes is a relatively new innovation in uranium prospecting. This logging is done with truck-mounted units which measure the radioactivity of the drill hole and record the readings. Information to supplement our geologic logs is obtained, as well as quantitative assays of ore in the holes. Research is continuing in an effort to develop these instruments to their greatest possible application. The current exploration plans of the Colorado Exploration Branch of the A.E.C. call for many thousand feet of wagon-drill holes, for which the total cost will be perhaps one-third the cost of core drilling, using radiometric logs to supplement the data obtained from cuttings.

Resistivity methods which attempt to delineate favorable areas are being thoroughly investigated by the Geological Survey in their exploratory program which they are conducting in behalf of A.E.C. The Atomic Energy Commission plans to explore the application of other geophysical methods of prospecting. Geochemical, geobotanical, geothermal, and other types of scientific approach are being investigated.
Uranium mining remains a small miner's field, but large companies have a very definite place in the industry. They build the mills and furnish technical, financial, and administrative ability, which are essential to a progressive industry. The interest of established mining industry in uranium mining and processing is evidenced by the fact that several large, outside companies have men in the field at the present time.

My only reason for reviewing the history of uranium and vanadium production is to illustrate the fact that the frontiers of the productive region have been pushed out far beyond what was long believed to be the limit of production. Now that we have had our eyes opened to the fact that new geographic and geologic horizons must be recognized, we are in a better position to tackle the job of finding new ore reserves. Recent developments have clearly demonstrated that we must carefully search all of the outlying districts, not only in the sedimentary rocks, but also in veins and other types of deposits. We must also develop and use every possible new method of prospecting in our search.

Prospectors, miners, and large and small mining companies are combining their efforts with those of the Atomic Energy Commission, and the search is spreading out over an ever-increasing area. Last year, several hundred thousand feet of drilling was done by the Atomic Energy Commission, the U. S. Geological Survey, and private industry. Next year, the combined effort will be greater than ever before.

Industry and Government are cooperating to do a job, and those of us who are part of the team would like to assure you that we are going to continue as a team until the job is done.