URANIUM OCCURRENCES IN THE GOLDEN GATE CANYON AND RALSTON CREEK AREAS, JEFFERSON COUNTY, COLORADO

By J. W. Adams, A. J. Gude 3rd, and E. P. Beroni

Trace Elements Memorandum Report 154

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J. W. Adams, A. J. Gude 3rd, and E. P. Beroni

January 1953

Trace Elements Memorandum Report 154

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URANIUM OCCURRENCES IN THE GOLDEN GATE CANYON AND RALSTON CREEK AREAS, JEFFERSON COUNTY, COLORADO

by

J. W. Adams, A. J. Gude 3rd, and E. P. Beroni

ABSTRACT

Pitchblende, associated with base-metal sulfides, has been found at eight localities in the northern part of Jefferson County, Colo., in shear zones that cut pre-Cambrian metamorphic and igneous rocks, chiefly hornblende gneiss, biotite schist, and granite pegmatite. The known deposits are in the vicinity of Ralston Creek and Golden Gate Canyon in the foothills of the Colorado Front Range and about 15 miles east of the pitchblende-producing area of the Central City district. Two of the pitchblende occurrences were found by a local prospector in 1949; the six other deposits were found by Geological Survey personnel in 1951 and 1952.

The pitchblende deposits, with one exception, are in major shear zones that contain vein-like bodies of carbonate-rich breccia. The breccia bodies range from 1 to 5 feet in thickness and are related probably to the Laramide faults, or "breccia reefs" of similar trend, mapped by Lovering and Goddard (1950). The breccias are composed of fragments of bleached and iron-stained wall rock, usually hornblende gneiss, that have been veined and cemented by carbonate minerals, quartz, and orthoclase (?). Pitchblende and associated ore minerals, chiefly copper sulfides, occur in and along the margins of the breccias, and apparently were introduced at a late stage of the carbonate deposition. At one deposit, the Buckman, the pitchblende is in narrow shear zones not known to be related to any large breccia bodies.
Secondary uranium minerals are subordinate except at the Schwartz mine where torbernite is common. Some alteration of pitchblende to non-opaque materials, believed to be hydrated oxides, has been noted in ore from two of the deposits.
INTRODUCTION

The recent discovery of eight uranium-bearing vein deposits in pre-Cambrian rocks of northern Jefferson County, Colo., indicates a new district favorable for uranium prospecting. The known deposits are in two small areas in the foothills of the Colorado Front Range, less than 20 miles from Denver (fig. 1) and about 15 miles east of the pitchblende-producing area of the Central City district.

The initial discovery of the uranium-bearing vein deposits in Jefferson County was probably made in the spring of 1949 when samples of pitchblende and torbernite ores from the northern, or Ralston Creek, area were brought to the attention of the Atomic Energy Commission by Fred Schwartz of Golden. In 1951, the first of the several occurrences in the Golden Gate Canyon area was found by members of the U. S. Geological Survey, followed by recent additional discoveries in both areas, also by the Survey; this work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission. In all of the deposits, the uranium is associated with copper, and most of the occurrences had been prospected for metals at least as early as 1894.

Preliminary studies show striking parallelisms in the geology and mineralogy of the several occurrences that are suggestive of a common period of deposition and closely similar environmental conditions. In general pitchblende occurs along the walls of fault zones that contain vein fillings of carbonate-potash feldspar rock, presumably of hydrothermal origin, and genetically related to the ore. The wall rock is usually hornblende gneiss that has been bleached severely adjacent to the veins, and wholly or partly replaced as breccia fragments in the vein itself. Copper minerals are invariably present in the veins, and include chalcopyrite,
FIGURE 1—INDEX MAP OF CENTRAL COLORADO SHOWING LOCATION OF GOLDEN GATE CANYON AND RALSTON CREEK AREAS.
covellite, bornite, chalcocite, malachite, and azurite. Pyrite is less abundant than chalcopyrite; galena has been noted at only two localities. Carbonates are generally abundant. Ankerite is the dominant gangue mineral of the carbonate-potash feldspar vein material and is earlier than calcite which probably is largely post-pitchblende.

The fault zones in which the pitchblende deposits are found have a similar trend and possibly are related to the extensive Laramide faults, or "breccia reefs" mapped by Lovering and Goddard (1950). At least one such breccia reef is present in the Ralston Creek area within 250 feet of, and roughly parallel to a pitchblende-bearing vein. The individual reefs have not as yet been correlated with those mapped a few miles to the north (Lovering and Goddard, 1950). The relationship between breccia reefs and the uranium-bearing veins possibly is analogous to that of the reefs and certain ore deposits in nearby Boulder County, where the reefs are thought to have served as deep channels for the ore deposited in adjacent fissures (Lovering and Goddard, 1950, p. 239).

The known uranium deposits will be discussed as those of the Golden Gate Canyon area (fig. 2) and the Ralston Creek area (fig. 5).

GOLDEN GATE CANYON AREA

The five known deposits in the Golden Gate Canyon area (fig. 2) are aligned along a narrow belt, trending N. 75°-80° E., that is a mile in length. The trend of this belt is essentially parallel to the trend of the well-developed foliation of the pre-Cambrian metamorphic rocks of the area. The individual deposits, however, with the possible exception of the Buckman, are related to northerly-trending breccia zones and are found at the intersection of these faults with the N. 75°-80° E.-trending belt.
EXPLANATION

O2
Uranium occurrence
1. Union Pacific
2. Buckman
3. Ladwig No.1
4. Ladwig No.2
5. Ladwig No.3
6. State highway

FIG. 2—INDEX MAP SHOWING KNOWN URANIUM OCCURRENCES
IN GOLDEN GATE CANYON AREA, JEFFERSON COUNTY, COLORADO

BASE TAKEN FROM RALSTON BUTTES, COLORADO, QUADRANGLE, EDITION OF 1948.
These factors suggest that a favorable rock unit or feeder channel along foliation planes in part controlled the localization of the ore. Where the breccia zones have been traced to the north or south of the favorable belt they show only weak abnormal radioactivity, but to date radiometric examination of the structures has not extended farther than a few hundred feet from the known radioactive deposits. Analyses of samples from this area are shown in table 1.

Union Pacific prospect

The uranium occurrence at the Union Pacific prospect (fig. 2), which was the first to be discovered in the area, is an land owned by John Pearce and Thomas Pearce of Golden, Colo.. Mineral rights to the property are held by the Union Pacific Railroad Company. The deposit was at one time prospected, presumably for copper, by an inclined shaft, 57 feet deep, from which a short drift extends a few feet into the right wall at the 30-foot level. The shaft was dewatered in December 1951 by the Union Pacific Railroad Company for examination by their geologic department. At that time, samples were collected and the walls of the shaft were mapped by personnel of the Geological Survey. The shaft is at present flooded to the collar.

Pitchblende and copper minerals occur along the hanging wall of a 10- to 15-foot fault zone that strikes N. 15° - 20° W. and dips about 35° NE. The strike of the zone is approximately at right angles to the foliation of the enclosing hornblende gneiss and biotite schist of the Idaho Springs formation. The fault, of undetermined displacement, consists of hanging and footwall zones with subparallel shears, and a central unit of cemented breccia composed essentially of small bleached fragments of wall rocks in
Table 1.—Analyses of samples from Golden Gate Canyon and Ralston Creek area, Jefferson County, Colorado.

| Locality          | Denver sample number | Field number | Type            | Material                        | Equivalent uranium (percent) | Uranium (percent) | Copper (percent) | Lead (percent) | Zinc (percent) | Fe (percent) | Mn (percent) | Au (oz./ton) | Ag (oz./ton) | Remarks                                                                 |
|-------------------|----------------------|--------------|-----------------|---------------------------------|------------------------------|----------------------|----------------|---------------|---------------|---------------|------------|-------------|--------------|-------------|--------------------------------------------------------------------------|
| Union Pacific.    | 50999                | EA-1         | Grab.           | Carbonate-breccia with pitchblende. | 0.130                        | 0.110                |                |               |               |               |            |             |              |             | Sample from dump.                                                        |
|                   | 56100                | UP-1         | 3.0 ft channel. | Mineralized carbonate-breccia shear. | 0.006                        | 0.004                |                |               |               |               |            |             |              |             | Sample from underground workings.                                        |
|                   | 56101                | UP-2         | 3.0 ft channel. | do.                             | 0.006                        | 0.003                |                |               |               |               |            |             |              |             | do.                                                       |
|                   | 56102                | UP-3         | 4.0 ft channel. | do.                             | 0.006                        | 0.004                |                |               |               |               |            |             |              |             | do.                                                       |
|                   | 56103                | UP-4         | 4.0 ft channel. | do.                             | 0.005                        | 0.003                |                |               |               |               |            |             |              |             | do.                                                       |
|                   | 56104                | UP-5         | 4.4 ft channel. | do.                             | 0.009                        | 0.006                |                |               |               |               |            |             |              |             | do.                                                       |
|                   | 56105                | UP-6         | 4.2 ft channel. | do.                             | 0.014                        | 0.006                | 0.16           | 0.03          |               |               |            |             |              |             | Trace. 0.20                                            |
|                   | 56106                | UP-7         | 4.0 ft channel. | do.                             | 0.094                        | 0.086                | 0.49           | 0.33          |               |               |            |             |              |             | do.                                                       |
|                   | 56107                | UP-8         | 4.0 ft channel. | do.                             | 0.230                        | 0.260                | 0.33           | None. 0.50    |               |               |            |             |              |             | do.                                                       |
|                   | 56108                | UP-9         | 3.0 ft channel. | do.                             | 0.007                        | 0.003                | 0.25           | 0.95          |               |               |            |             |              |             | do. Trace. do.                                                     |
|                   | 56109                | UP-10        | 1.0 ft channel. | do.                             | 0.007                        | 0.003                | 0.25           | 0.95          |               |               |            |             |              |             | do.                                                       |
|                   | 56110                | UP-11        | 2.3 ft channel. | do.                             | 0.006                        | 0.003                |                |               |               |               |            |             |              |             | do.                                                       |
|                   | 56111                | UP-12        | 2.6 ft channel. | do.                             | 0.006                        | 0.004                |                |               |               |               |            |             |              |             | do.                                                       |
|                   | 56112                | UP-13        | 4.3 ft channel. | do.                             | 0.006                        | 0.012                |                |               |               |               |            |             |              |             | do.                                                       |
|                   | 56113                | UP-14        | 4.9 ft channel. | do.                             | 0.014                        | 0.012                |                |               |               |               |            |             |              |             | do.                                                       |
|                   | 56114                | UP-15        | 0.3 ft channel. | do.                             | 5.60                         | 5.60                 | 0.29           | 0.08          | 0.45          |               |            |             |              |             | Trace. 0.72                                              |
|                   | 56782                | UP-16        | 0.9 ft channel. | do.                             | 0.015                        | 0.006                | 0.20           | 0.25          |               |               |            |             |              |             | do.                                                       |
|                   | 56783                | UP-17        | 4.0 ft channel. | do.                             | 0.008                        | 0.003                | 0.16           | 0.25          |               |               |            |             |              |             | do.                                                       |
|                   | 56784                | UP-18        | 1.0 ft channel. | do.                             | 0.009                        | 0.003                |                |               |               |               |            |             |              |             | Sample taken from road cut N. 63 W. of portal.                        |
| Bucanan property. | 62892                | GG-3         | 0.5 ft channel. | Pitchblende in gouge.           | 0.230                        | 0.260                |                |               |               |               |            |             |              |             | Sample from adit.                                                     |
|                   | 62893                | GG-4         | 0.4 ft channel. | Altered gneiss.                | 0.010                        | 0.003                |                |               |               |               |            |             |              |             | do.                                                       |
|                   | D-69910              | B-1          | Grab.           | Pitchblende in altered gneiss.  | 1.20                         | 1.23                 |                |               |               |               |            |             |              |             | Sample from road cut.                                                |
|                   | D-71567              | EB-4         | 0.5 ft channel. | Pitchblende in altered gneiss.  | 1.50                         | 0.860                | 0.08           | 4.04          |               |               |            |             |              |             | Sample from adit.                                                     |
|                   | D-71568              | EB-5         | 0.5 ft channel. | Pitchblende in altered gneiss.  | 0.350                        | 0.230                | 0.10           | 8.19          |               |               |            |             |              |             | Sample from adit.                                                     |
|                   | D-71590              | EB-6         | 1.0 ft channel. | Pitchblende in altered gneiss. | 0.027                        | 0.062                | 0.06           | 6.29          |               |               |            |             |              |             | Sample includes wall rock adjoining pitchblende shear.               |
|                   | D-71591              | EB-7         | 4.0 ft channel. | Schist and pegmatite.          | 0.004                        | 0.16                 |                |               | 5.22          |               |            |             |              |             | do. Trace. Sample from adit.                                        |
|                   | D-71592              | EB-8         | 0.5 channel.    | Altered pegmatite.             | 0.032                        | 0.012                | 0.01           | 3.01          |               |               |            |             |              |             | do. do. do.                                                          |
| Ladwig No. 1.     | 6-9432               | L-1          | Grab.           | Pitchblende in altered gneiss.  | 0.980                        | 1.96                 |                |               |               |               |            |             |              |             | Sample taken 1 foot below mill stop.                                 |
|                   | 6-9433               | L-2          | do.             | Carbonate-breccia.             | 0.006                        | 0.007                |                |               |               |               |            |             |              |             | Sample from a lower dump.                                            |
| Ladwig No. 2      | 6-9885               | L2-1         | do.             | Carbonate-breccia with pitchblende and copper. | 0.250                        | 0.300                |                |               |               |               |            |             |              |             | Sample from dump.                                                     |
Table 1.—Analyses of samples from Golden Gate Canyon and Ralston Creek area, Jefferson County, Colorado—Continued.

| Locality       | Denver sample number | Field number | Type                          | Material                                      | Equivalent uranium (percent) | Uranium (percent) | Copper (percent) | Lead (percent) | Zinc (percent) | Fe (percent) | Cu (percent) | Pb (percent) | Zi (percent) | Mn (percent) | Au (percent) | Ag (percent) | Remarks                                                                 |
|----------------|----------------------|--------------|-------------------------------|-----------------------------------------------|-------------------------------|-------------------|-----------------|---------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|----------------|
| North Star mine | D-6926               | NS-3         | 1.0 ft channel.               | Mineralized carbonate-breccia shear.          | 0.370                         | 0.510             | 5.90            |               |               |              |              |              |              |              |              | Sample from underground workings.                               |
|                | D-6926               | NS-5         | 1.0 ft channel.               | Mineralized carbonate-breccia shear.          | 0.140                         | 0.110             | 3.08            |               |               |              |              |              |              |              |               | Sample from underground workings.                               |
|                | D-71501              | NS-6         | 0.5 ft channel.               | do.                                           | 0.062                         | 0.027             | 5.74            |               |               |              |              |              |              |              |               | Do.                                                     |
|                | D-73343              | NS-7         | 0.5 ft channel.               | do.                                           | 0.023                         | 0.010             | 1.44            |               |               | Trace.       | 1.12         |              |              |              |               | Do.                                                     |
|                | D-73344              | NS-8         | 0.5 ft channel.               | do.                                           | 0.005                         | 0.002             | 0.29            |               |               | do. Trace.   |              |              |              |              |               | Do.                                                     |
|                | D-73345              | NS-9         | 0.5 ft channel.               | do.                                           | 0.007                         | 0.002             | 0.02            |               |               | None.        | None.        |              |              |              |               | Do.                                                     |
|                | D-73346              | NS-10        | 0.5 ft channel.               | do.                                           | 0.011                         | 0.005             | 0.08            |               |               | do. do.      |              |              |              |              |               | Do.                                                     |
|                | D-73347              | NS-11        | 0.5 ft channel.               | do.                                           | 0.010                         | 0.006             | 0.12            |               |               | Trace.       | 6.42         |              |              |              |               | Do.                                                     |
| Nigger shaft   | D-7546               | AJG-9        | 4 ft channel.                 | Carbonate-breccia.                           | 0.010                         | 0.004             |                 |               |               |              |              |              |              |              | Sample from underground workings; contains 22.9 percent CoO.  |
|                | D-7564               | AJG-10       | 0.2 ft channel.               | Carbonate vein with pitchblende.             | 0.320                         | 0.220             |                 |               |               |              |              |              |              |              | Sample from underground workings.                               |
|                | D-7564               | AJG-11       | 0.2 ft channel.               | do.                                           | 0.280                         | 0.310             |                 |               |               |              |              |              |              |              | Sample from underground workings.                               |
| Schwartz mine  | D-7449               | NS-9         | 4 ft channel.                 | Altered gneiss.                              | 0.021                         | 0.011             |                 |               |               |              |              |              |              |              | Sample taken in adit.                                      |
|                | D-7449               | NS-10        | 2 ft channel.                 | Carbonate-breccia with torbernite and pitchblende | 0.880                         | 1.07              |                 |               |               |              |              |              |              |              | Sample taken in adit.                                      |
|                | D-7450               | NS-11        | 3 ft channel.                 | do.                                           | 0.380                         | 0.360             | 0.21            |               |               | 0.40 Trace.  | 1.34         |              |              |              | Sample taken in adit.                                      |
|                | D-7450               | NS-12        | 4 ft channel.                 | Torbernite in massive quartz.                | 0.110                         | 0.083             |                 |               |               |              |              |              |              |              | Sample taken in adit.                                      |
|                | D-7450               | NS-13        | 4 ft channel.                 | Altered silicified gneiss.                    | 0.099                         | 0.010             | 0.15            |                 |               | 0.07 Trace.  |              |              |              |              | Sample taken in adit.                                      |
|                | D-7453               | NS-17        | Grab.                         | Carbonate-breccia with torbernite.            | 0.094                         | 0.081             |                 |               |               |              |              |              |              |              | Sample taken in adit.                                      |
|                | D-7454               | NS-18        | do.                           | do.                                           | 0.340                         | 0.170             |                 |               |               | 0.15 Trace.  |              |              |              |              | Sample taken in adit.                                      |
|                | D-7454               | NS-20        | do.                           | Carbonate-breccia with pitchblende and torbernite | 0.260                         | 0.330             |                 |               |               |              |              |              |              |              | Sample taken in adit.                                      |
|                | D-7457               | NS-21        | 0.5 ft channel.               | Carbonate-breccia with pitchblende and sulfides. | 1.40                          | 1.94              |                 |               |               | 0.24 Trace.  |              |              |              |              | Sample taken in adit.                                      |
|                | D-7600               | NS-22        | 2 ft channel.                 | Carbonate-breccia with torbernite.            | 0.084                         | 0.058             |                 |               |               |              |              |              |              |              | Sample from prospect pit 35 ft above portal of adit.         |
|                | D-7600               | NS-23        | Grab.                         | do.                                           | 0.59                          | 0.790             |                 |               |               |              |              |              |              |              | Sample from prospect pit 35 ft above portal of adit.         |
|                | D-7601               | NS-24        | 1.5 ft channel.               | do.                                           | 0.13                          | 0.059             |                 |               |               |              |              |              |              |              | Sample from prospect pit 35 ft above portal of adit.         |
a fine-grained groundmass of ankerite and a mineral tentatively identified as orthoclase. Ankerite is also present as minute rhombohedrons lining voids in the groundmass. The carbonate-breccia is a dense, light gray rock which oxidizes readily to an earthy limonite gossan. Oxidation is also marked in the sheared and bleached hornblende gneiss exposed in the cut adjacent to the shaft. The fault zone is concealed except within the limits of the open cut (fig. 2), but it can be traced for about 100 feet to the northwest by a gap in the outcrop pattern of the country rocks.

Radiometric examination of the underground workings showed anomalous radioactivity along the southeast wall of the shaft from the collar to a few feet below the stub drift. On the southeast wall of the cut (pl. 1, A) a radioactive gossan from one-half to a foot thick directly underlies the hanging-wall shear zone, and many of the fracture surfaces in the shear zone itself show strong radioactivity. A weak anomaly was found in soil near a shallow trench about 75 feet northwest of the shaft (fig. 3).

Pitchblende, which is the only uranium mineral that has been observed in the deposit, is associated with chalcopyrite, tetrahedrite, bornite, chalcocite, covellite, and pyrite in a zone from one-half to a foot thick that is along the contact between the carbonate-breccia and the hanging-wall shear. The ore minerals are largely concentrated in the altered and sheared hornblende gneiss, but are also present in the upper few inches of the underlying breccia. Pitchblende is the most abundant ore mineral and occurs chiefly as lustrous, black films along minor shear planes that are roughly parallel to the major structure of the fault. Less conspicuous pitchblende, accompanied by the sulfides, is disseminated through most of the rock in the ore zone; at least some of this pitchblende is a late mineral in carbonate-lined veinlets.
Plate 1 A. - South wall of open cut at the Union Pacific prospect, showing shear zone and surface exposure of vein; a) hornblende gneiss, b) altered hornblende gneiss, c) oxidized vein, d) breccia zone. Stick in lower right hand corner is approximately 1 foot long.

Plate 1 B. - Photomicrograph of polished section of ore from the Nigger shaft (Hoffmeister prospect), showing pitchblende (p) coating ankerite (a) in calcite (c) quartz (q) ankerite (a) vein. Reflected light, X 34.
Most of the pitchblende seen in the deposit was found on the walls of the stub drift, and a rapid decrease in uranium content was shown in samples taken across the shaft walls at points above and below the drift. It is possible that the radioactive gossan in the southeast wall of the surface cut is an oxidized and leached part of the pitchblende-bearing body exposed underground and that both represent the north edge of a lenticular ore shoot whose direction of plunge is a few degrees south of the direction of the shaft. A further localization of ore on the crest of rolls in the breccia zone is suggested by the relationships observed underground.

Analysis of samples shows uranium to be the dominant valuable element in the deposit. Copper minerals are abundant in selected samples, but the copper content of the ore zone is low. Zinc was detected in analysed samples, but no zinc minerals have as yet been recognized. Gold, silver, lead, nickel, and cobalt are present in trace amounts only.

The paragenesis of the minerals from this and the several other deposits in the area has not been studies sufficiently to be discussed at length in this paper, but it seems probable that the pitchblende was formed after the brecciation of the wall rocks and during the last stage of carbonate deposition.

**Buckman property**

Pitchblende has been found in an abandoned adit about 15 feet east of the Golden Gate Canyon road (fig. 2, locality 2) on land owned by Nora R. Buckman of Golden, Colo. The adit was driven for 86 feet in a northeasterly direction roughly parallel to the foliation of steeply-dipping pre-Cambrian biotite schist and gneiss, and presumably prospected
sulfide-bearing quartz stringers. A water-filled winze, 25 feet deep, had been sunk near the heading.

The biotite schist and gneiss exposed in the adit is cut by granite pegmatite dikes and discontinuous quartz bodies that contain local concentrations of pyrrhotite and chalcopyrite. The quartz bodies, which may represent segments of a single quartz vein, are cut by the pegmatites and are assumed to be pre-Cambrian in age.

Pitchblende occurs at two places along the south wall of the adit (fig. 4). Near the portal, it forms masses as much as one-half inch thick in a shattered iron-stained quartz vein. In thin section, the pitchblende shows colloform rim structures around angular quartz fragments. Unidentified yellow-green secondary uranium minerals coat some of the pitchblende. Although the relations are somewhat obscure, the shattered quartz in which the pitchblende is found appears to lie along a prominent shear that strikes N. 15° E., and dips 40° SE., but no anomalous radioactivity has been found in the shear away from the quartz body.

About 45 feet further along the adit, pitchblende is found in an oxidized shear striking N. 45° E., and dipping 71° SE. Although this shear cuts a quartz vein, the only pitchblende seen occurred a few inches outside of the quartz in the adjacent sheared and silicified gneiss. Anomalous radioactivity was not detected along the shear except in the few inches of exposure in which the pitchblende was found.

In spite of the localization of the pitchblende in and directly adjacent to the quartz veins, it is doubtful that they are genetically related, and a post-quartz vein origin appears more probable.

The pyrrhotite and chalcopyrite sparsely disseminated in and along the margins of the quartz veins probably are essentially contemporaneous with the quartz.
FIGURE 4.—GEOLOGIC MAP OF ADIT, BUCKMAN PROPERTY, JEFFERSON COUNTY, COLORADO

Geology by J.W. Adams, August 1952.
About 300 feet northwest of the adit, a pitchblende-bearing vein is exposed in a roadcut at the east edge of the highway. The vein is 1 to 3 inches thick, strikes approximately north and is essentially vertical. Although the radioactive part of the vein is less than two feet in length, it is remarkably rich, containing 1/8- to 1/4-inch surfaces of hard botryoidal pitchblende that coat a carbonate mineral tentatively identified as calcite. Minor chalcopyrite is also present in the vein. The vein cuts hornblende gneiss at approximately right angles to the foliation and has almost completely bleached the gneiss for an inch or more along the contacts. Beyond the pitchblende-bearing area, only a barren fracture marks the course of the vein.

Because of its proximity to the adit occurrence, the vein is included in the description of the Buckman property, but its location, so far as can be determined, is so close to the north edge of the property that its ownership is uncertain.

Ladwig No. 1

Strong anomalous radioactivity was detected at the Ladwig No. 1 property (fig. 1) by a U. S. Geological Survey-designed gamma scintillation detector. The radioactivity, which is traceable over an area of about 50 square feet, was found to be caused by uranium minerals in rocks concealed under 1 to 3 inches of soil. Torbernite, which coats foliation planes of altered schist, was noted in the few samples that could be collected. A few small fragments, found in the soil, appear to be carbonate breccia and contain minute grains of pitchblende and an altered yellow uranium mineral that resembles uranophane. Secondary copper minerals are also present. A nearby exposure of hornblende schist strikes N. 72° W., and dips 75° - 80° N.
This occurrence is approximately 330 feet N. 50° W., of a water-filled prospect shaft showing copper minerals on the dump. The shaft was sunk in schist cut by a 1- to 2-foot wide carbonate breccia that strikes north and dips about 70° E. Much of the material on the dump is quartz associated with pyrite, limonite, and more rarely bornite, covellite, and copper carbonates. No anomalous radioactivity was detected. The breccia-vein exposed in the shaft crops out on the hillside about 200 feet to the north, and is apparently unrelated to the breccia-vein at the uranium deposit.

Mineral rights to this and the two following localities are held by Lyman C. Ladwig of Golden, Colo.

Ladwig No. 2

At the Ladwig No. 2 property (fig. 1), uranium minerals have been found on the dump of an abandoned prospect shaft and in a small trench 100 feet to the east. The shaft, which is now 12 feet deep but may have been considerably deeper, was sunk on a 1- to 2-foot wide radioactive carbonate breccia zone that strikes north and dips steeply to the east. The breccia zone cuts hornblende schist that is extensively sheared and bleached for several feet on the hanging-wall side of the contact. No uranium minerals were found in place, but specimens collected from the dump of the shaft contain pitchblende and torbernite in limonite-stained breccia host rock. Additional radioactive samples, probably derived from another breccia zone, were found in the debris from the lower of two shallow cuts about 100 feet east of the shaft. Copper minerals, notably carbonates, are conspicuous in the dump material where the uranium minerals are found.
The radioactive breccia zone is also exposed at the caved portal of an adit 125 feet south and about 70 feet below the collar of the shaft. Here the zone is 6 feet thick and contains altered but recognizable schist fragments that are several inches in diameter. No uranium or copper minerals were noted at the adit or in the shallow cut that exposes the breccia zone about 40 feet north of the shaft.

Ladwig No. 3

A single specimen of pitchblende and associated copper carbonates was found on the dump of the lower of two small prospect pits at the Ladwig No. 3 property (fig. 2). As at the previously described deposit, the pitchblende and more abundant copper minerals occur in or near a north-trending breccia zone. This occurrence is poorly exposed, and at present is chiefly of interest as another example of uranium mineralization along the "favorable zone" which roughly parallels the trend of the foliation of the metamorphic rocks of the area.

RALSTON CREEK AREA

Three pitchblende-bearing deposits are known in a small area in the vicinity of Ralston Creek (fig. 5), about 6 miles north-northwest of the prospects in Golden Gate Canyon. The deposits are similar to those in Golden Gate Canyon in that they are related to north or northwest-trending breccia zones; they do not, however, show a similar alinement in a northeasterly direction. The deposits are all relatively accessible. The North Star and Nigger Shaft deposits can be best reached from the north by way of a private road to the A. G. Brumm ranch from Coal Creek Canyon. From the end of the ranch road, it is possible to drive 4-wheel drive
EXPLANATION

1. Nigger Shaft
2. North Star Mine
3. Schwartz Mine

BASE TAKEN FROM RALSTON BUTTES, COLORADO, QUADRANGLE, EDITION OF 1948.

FIGURE 5—INDEX MAP SHOWING KNOWN URANIUM OCCURRENCES IN THE RALSTON CREEK AREA, JEFFERSON COUNTY, COLORADO
vehicles to within easy walking distance of the workings. The Schwartz mine, which is on the south side of Ralston Creek, can be approached by 4-wheel drive vehicles by using trails leading north from the Paul White ranch in the NE 1/4 of sec. 2, T. 3 S., R. 71 W. Roads to the ranch are shown on the Ralston Buttes Quadrangle (1:24,000). Analyses of samples from this area are shown in table 1.

North Star mine

Pitchblende was discovered at the abandoned North Star mine in April 1952 by geologists of the U. S. Geological Survey. The mine is on the ranch of August G. Brumm and is believed to be in the south half of section 23; mineral rights of which are held by the Union Pacific Railroad Company. According to Mr. Brumm, 4 tons of copper ore was taken from the mine in 1894, and another 12 tons was shipped in 1916.

The mine was worked by a short upper level (fig. 6) and a lower level connecting with a stope that at one time was open to the surface. The portal of the lower level is badly caved, and a backfilled area in the workings makes access to the stope quite difficult. Several other small prospect workings, apparently not on ore, are present in the general vicinity of the mine.

The rocks exposed in the area are pre-Cambrian hornblende gneiss, quartz-biotite schist, and granite pegmatite. The foliation of the metamorphic rocks strikes northeast and dips steeply southeast; the pegmatites show a similar northeast trend but are locally discordant. These rocks are cut by a carbonate-orthoclase (?) vein that strikes northwest and dips from 25 to 45° NE. Much of the vein exposed in the mine is altered to a limonitic gossan, but where fresh it shows streaks and patches
FIGURE 6 - MAP AND SECTION OF UNDERGROUND WORKINGS, NORTH STAR MINE, JEFFERSON COUNTY, COLORADO.
of incompletely incorporated wall rock fragments, and is undoubtedly a breccia-filling quite similar to those in the Golden Gate Canyon area.

Uranium and copper minerals occur throughout the vein as fracture fillings and as interstitial material surrounding breccia fragments. The ore minerals are not consistently present along the vein, and it is probable that the small tonnage of copper ore that was mined came from narrow lenses of which little evidence remains. The best copper and uranium ore now showing in the mine constitutes a zone 6 inches to a foot thick above the carbonate vein that is exposed at track level near the face of the lower adit. Some of the ore seen underground is comparable to the pitchblende-bearing rock found on the upper level dump. This ore is made up largely of reddish-brown rock fragments, generally less than an inch in diameter, cemented by primary and secondary copper and uranium minerals that include bornite, chalcocite, covellite, malachite, azurite, pitchblende, and several unidentified uranium minerals. Some of the breccia fragments appear to be hornblende gneiss and granite but the alteration, particularly the hematite (?) staining, makes identification of the original material difficult. This ore probably came from the small workings of the upper level where, according to Mr. Brumm, the richest copper ore was found. In addition to uranium and copper, the ore contains appreciable silver, but no silver minerals have as yet been recognized.

The pitchblende found at the North Star mine, as seen under the microscope, shows alteration from the opaque, isotropic mineral to a brown translucent to transparent material that is very weakly anisotropic and has a refractive index of approximately 1.87. The brown mineral has a radial structure reflecting the original rounded or even spherical
surfaces of the original pitchblende, and is locally abundant in some specimens of the ore. It is thought to be a hydrated uranium oxide, but its identity is still uncertain.

To judge from the position and attitude of the vein in the stope and at the same map level (fig. 6) in the lower adit, it is assumed that either there are two veins or that post-vein faulting has taken place. Geologic mapping of the underground workings, while not complete, indicates that the vein is probably faulted.

Anomalous radioactivity was found at a small prospect trench on the hillside about 600 feet southeast of the North Star workings. The few radioactive samples found on the dump contained secondary copper minerals.

Schwartz mine

The Schwartz mine (fig. 5) is on a steep, heavily wooded slope about three-quarters of a mile southwest of Ralston Butte and at an altitude of approximately 7,000 feet. Surface rights to the property are owned by Paul White of Golden, Colo. The Union Pacific Railroad Company has coal rights, which may possibly include other minerals, to sec. 25, on which the mine is located. The pitchblende-torbernite-autunite deposit at the mine currently is being prospected by Fred Schwartz, who discovered uranium minerals on the property early in 1949.

On June 30, 1950, the deposit was visited by T. P. Anderson, then of the Atomic Energy Commission. The results of his examination are given in unpublished Reconnaissance Report No. 35.

Early prospecting, presumably for copper, resulted in 3 shallow pits and a 25-foot adit, caved prior to 1949. Anomalous radioactivity and the presence of torbernite at the caved adit led Mr. Schwartz to excavate
the adit as an open cut, and later to drive a new adit for 60 feet beyond the south end of the cut (fig. 7). Pitchblende-torbernite-autunite-bearing ore was found near the present heading of the adit, along an approximately southeasterly trending fault that dips 35° SW., on the west wall, and 49° SW., on the east wall (fig. 7).

A strongly radioactive northerly trending carbonate breccia shear, containing visible torbernite along fracture surfaces, is adjacent to a massive quartz body about 3 feet thick exposed in a shallow pit 34 feet above and little southwest of the portal of the new adit. The radioactive carbonate breccia, also containing torbernite, is present in another excavation, higher on the slope, about 52 feet above the adit. Mild radioactivity was detected in carbonate breccia in an 18-foot vertical pit about 100 feet above and 150 feet south and a little east of the adit.

The rocks at the Schwartz property are hornblende-biotite gneiss and biotite schist of the pre-Cambrian Idaho Springs formation. The foliation of the gneiss and schist, as noted in the underground workings, strikes N. 50° E., and dips 77° W. Locally, the gneiss and schist have been cut by a shear zone that contains carbonate breccia and massive quartz. Gneiss and schist fragments, as much as 5 inches across, that megascopically show little or no alteration, have been noted in the breccia. More advanced alteration of breccia fragments has accompanied the carbonate mineralization at the other uranium occurrences described in this report.

Finely disseminated pitchblende is found only in the carbonate breccia and is associated with chalcopyrite, galena, and pyrite (?). Only sparse sulfides are present in the massive quartz.

The shear trends N. 10° - 15° E., is about 10 feet wide, and has been traced as far north as Ralston Creek (fig. 5), but its extent to the south
EXPLANATION

Quartz, carbonate breccia

Silicified gneiss, contains some massive quartz

Sheared and altered gneiss

Bleached gneiss

Mineralized areas

Contact showing dip
Dashed where inferred

Fault showing dip
Dashed where inferred

Strike and dip of foliation

Strike and dip of joints

Open cut

Dump

Geology by E. P. Beroni and A. W. Rose, August 1952

FIGURE 7. - GEOLOGIC SKETCH MAP OF THE SCHWARTZ MINE
JEFFERSON COUNTY, COLORADO
has not yet been determined. Radioactivity anomalies were noted at various places along the strike of the shear, especially in the vicinity of workings.

Iron and manganese oxides, torbernite, autunite, and malachite are found as fracture coatings within the shear zone. Minor torbernite, autunite, quartz, and calcite were found lining vugs in the carbonate rock.

**Nigger shaft (Hoffmeister prospect)**

Pitchblende was first recognized in the Ralston Creek area in 1949 at an abandoned copper prospect, locally known as the Nigger shaft. The discovery was made by Fred Schwartz of Golden, Colo., who submitted samples of the radioactive rocks to the Atomic Energy Commission. The prospect, worked between 1912 and 1914 by a Mr. Hoffmeister, consists of a 20-foot inclined shaft connected to a small stope (fig. 8). A short adit was driven from a point about 130 feet southeast of the shaft, presumably to intersect the vein below the shaft level.

The ownership of the deposit is unknown to the Survey because the workings are situated on or very close to the boundary line between sections 23 and 26. If the deposit is in section 23, the mineral rights are owned by the Union Pacific Railroad Company. Surface and mineral rights to the adjacent land in section 26 are owned by Oscar Dahlberg of Golden.

The rocks in the vicinity of the Nigger shaft are hornblende gneiss, biotite schist, granite pegmatite, and aplite, all of pre-Cambrian age. These rocks are cut by a northerly trending breccia reef which probably is an extension of one of the major Laramide fault zones mapped three-quarters
of a mile to the north by Lovering and Goddard (1950, pl. 2). The reef, bordered by sheared and altered rocks, crops out above 250 feet northeast of the shaft, and can be traced by float and outcrops for 1,000 feet or more to the northwest.

The pitchblende deposit at the Nigger shaft is in a shear zone that is roughly parallel to the breccia reef. The shear exposed in the workings strikes N. 3° E. and dips 50° - 60° SE., but the surface exposures and radiometric data indicate that the general trend of the shear is northwest. The shear zone is from 4 to 8 feet thick and consists of brecciated and sheared hornblende gneiss that is cut by an irregular body of carbonate-rich rock which contains the ore in the deposit. This rock, which averages about 2 feet in width, apparently represents that part of the shear zone that was invaded by the ore-bearing solutions. It is made up of bleached and altered gneiss fragments, intricately veined and cemented principally by carbonates; it constitutes a stockwork of dense, hard, light-brown rock that in surface exposures appears as a brick-red gossan.

The sheared gneiss along the hanging wall of the vein has been bleached by hydrothermal action for as much as 2 feet outward from the vein, but the footwall gneiss in the shear zone, aside from brecciation, appears to be relatively fresh.

The vein has been traced radiometrically for 100 feet to the northwest, but it is almost entirely concealed by soil. Two areas of high anomalous radioactivity were discovered (fig. 8), and pitchblende and copper minerals were recovered from the soil at the larger area, about 50 feet from the shaft.

Pitchblende occurs in the deposit chiefly as thin seams in carbonate veinlets along the margins of the stockwork. The seams, which range
from 0.05 to 0.5 mm in thickness, form rims around earlier crystals of carbonate and orthoclase (?) (pl. 1, B). Later carbonate and sulfides fill the center of the veinlets. The botryoidal upper surface of the seams suggests that they were developed by the coalescence of many individual hemispherical bodies such as occur singly or in groups where the seams are discontinuous.

Sulfide minerals, including covellite, chalcopyrite, bornite, chalcocite, pyrite, and galena, have been identified in polished sections of the ore. Except for pyrite and some chalcopyrite, they occur within the carbonate veinlets, and most of the sulfides appear to have been deposited later than the pitchblende. Detailed mineralographic studies have not been made, however, to determine the paragenetic sequence of the ore minerals.

Calcite, ankerite, and quartz are the dominant gangue minerals in the pitchblende-bearing veins. The sequence of their deposition has not been definitely established, but preliminary studies show that the iron-rich carbonate formed both before and after the deposition of the pitchblende. Calcite is interstitial to both ankerite and quartz and appears to be the last gangue mineral to be formed. All of the quartz, so far as known, is younger than the pitchblende.

Crystals of a nearly uniaxial mineral of negative sign and low birefringence occur along the edges of the pitchblende-bearing veinlets. These crystals, thought to be orthoclase, were deposited before the pitchblende. A dark-green mineral, tentatively identified as chlorite, forms radial aggregates in the post-pitchblende vein filling.

Most of the pitchblende in the veinlets is surrounded by an orange-brown layer, approximately 0.02 mm wide, that may be in direct contact
with the pitchblende or is developed entirely in the adjacent gangue minerals. The layer may end abruptly at an interface between two carbonate crystals or between a carbonate crystal and quartz. The material forming the layer has not been identified, but its distribution and color suggest that it is made up of finely dispersed iron oxides formed in ankerite as a product of radiation from the pitchblende. It has not been observed in quartz, and where present in one carbonate and not another it is assumed that the barren carbonate is calcite.

A mineral tentatively identified as a hydrated uranium oxide occurs sparsely in oxidized and leached breccia. It is light to dark brown, transparent, isotropic, and has a refractive index of approximately 1.75. Qualitative test shows that it contains uranium and lead. This mineral was probably derived from pitchblende exposed to supergene solutions by the partial removal of enclosing carbonates, and is analogous to the brown material found in more abundance at the North Star mine.

Several secondary copper minerals are present in the ore; they are not abundant and are chiefly confined to cavities in the veinlets.

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PART II

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PART II

ABSTRACT

Studies of the uranium deposits in the Golden Gate Canyon and Ralston Creek areas have so far been limited to brief reconnaissance examinations, and the geologic setting of the individual deposits is incompletely known. Most of the deposits are in strong, persistent structures—the carbonate-bearing breccia zones—but the uranium minerals, particularly in Golden Gate Canyon, appear to be restricted to isolated ore shoots or lenses in the otherwise barren structures. Because of the lack of information regarding the behavior of the ore, reserve estimates are given for only two properties, the Union Pacific prospect and the Nigger Shaft. Both reserve estimates are limited to the small tonnages of inferred ore now exposed in the workings. The potential of these and some of the other deposits, however, is large by virtue of the extent of the favorable carbonate breccia zones and warrants the complete exploration of those deposits that appear to offer the promising combinations of structure and ore.

The Union Pacific prospect is estimated to contain 85 tons of ore containing 0.38 percent uranium. The inferred reserves of the Nigger Shaft are approximately 600 tons containing 0.038 percent uranium.

Plans are outlined for limited exploration which will be covered in the fiscal year 1954 Work Plan and Operating Budget.
GOLDEN GATE CANYON AREA

Union Pacific prospect

Pitchblende-bearing ore at the Union Pacific prospect is exposed in an 8-foot stub drift cut in the southeast wall of the inclined shaft, and on the adjacent wall of the shaft itself. The highest-grade ore underlies the back of the workings and constitutes a zone from 0.3 to 0.5 feet thick that probably contains from 5 to 6 percent uranium. The ore is chiefly in sheared and altered metamorphic rocks directly above the carbonate breccia.

For the purpose of estimating reserves, the ore zone is considered to extend for 20 feet down the dip of the structure, from sample point UP-14 to sample point UP-7 (fig. 9). The width of the zone is assumed to be 16 feet, twice its exposed width, and a thickness of 3.4 feet is obtained as an arithmetic mean of the sample lengths used in computing grade. Weighted averages of the five samples taken across this block indicate the grade to be 0.38 percent uranium. Using a factor of 12.5 cubic feet of rock per ton, the block is estimated to contain 85 tons of ore of this grade.

About 2 tons of this block was removed in driving the stub drift and presumably was the source of the pitchblende-rich specimens that may be found in the dump. As the ore would be amenable to either visual or radiometric sorting, a smaller tonnage of higher-grade ore could conveniently be produced. The position of the ore zone underground, and of the leached radioactive gossan on the surface suggest that the workings have cut the north edge of an ore shoot that lies in the hanging wall of the fault and plunges in a direction slightly south of the direction of the shaft.
FIGURE 9.—ASSAY MAP OF WALLS OF INCLINED SHAFT AT UNION PACIFIC RAILROAD PROSPECT, JEFFERSON COUNTY, COLORADO.
Such a proposed ore shoot may, however, be modified by cross structures so that the ore will be found to be localized in isolated lenticular bodies within the boundaries of what normally would be the shoot.

The small tonnage inferred is based on the ore now exposed in the workings, but considering that the entire breccia zone, some 3 to 4 feet thick, represents a favorable host rock and that minable ore is now exposed, the potentialities of the deposit may be much greater.

The area of anomalous radioactivity about 75 feet northwest of the shaft will be explored by bulldozer cuts. Bulldozing of the vein south of the cut may also be done if funds are available.

Exploration of the deposit may be proposed for fiscal year 1955 and, if so, will be directed at establishing the structural control of the ore, and will include driving the stub drift southeast to determine the width of the lens or shoot, this work to be followed by driving a crosscut southeast from the bottom of the shaft for at least 50 feet to search for the downward extension of a possible shoot. From the limited geologic information obtained when the shaft was accessible, it seems probable that the breccia zone, and hence the ore shoot, might lie a few feet below the level of a crosscut from the bottom of the shaft. Failure to intersect ore in the crosscut might therefore necessitate probing for radioactive rock with short diamond-drill holes from a station in the crosscut.

Buckman property

As shown on the assay map (fig. 10), uranium-bearing rock occurs at two points along the right wall of the adit. The ore is believed to be related to narrow shear zones, and the best ore was found at the intersection
Head of winze

Wassertilled winze, approximately 25 feet deep

0.062 - 1 foot
0.22 - 0.5 foot
0.26 - 0.5 foot

Portal of adit

EXPLANATION

0.62 - 1 foot
Percent of uranium and length of channel sample.

0.10
Approximate milliroentgen per hour on beta-gamma field counter

FIGURE 10.-ASSAY AND RADIOMETRIC MAP OF ADIT, BUCKMAN PROPERTY, JEFFERSON COUNTY, COLORADO
of one shear with a vein of massive quartz; ore does not occur elsewhere along the shear where it is exposed underground. Because of the limited distribution of the pitchblende in the shear zones the present exposures are inadequate to make a reliable estimate of the ore reserves. As compared with the mineralized shear zones at several of the other properties, the ore-bearing structures at the Buckman adit are relatively weak.

Exploration of the property will include dewatering and sampling of the 25-foot winze near the heading of the adit, for one of the pitchblende-bearing shear zones should cross the winze below the present water level. As the shattered quartz vein in the shear zone near the portal appears to be favorable for pitchblende deposition, the intersection of the vein and the shear offers some hope for a narrow but persistent ore shoot, that according to assay data might contain 0.2 percent uranium over a thickness of half a foot.

The portal of the adit is so close to State Highway 58 that the disposal of any rock moved in exploration or mining would present a serious problem.

Ladwig No. 1

Because the uranium-bearing rock at this occurrence is not exposed, trenching or bulldozing will be done to sample the deposit and to determine the attitude and extent of the vein, now concealed by several inches of soil. Anomalous radioactivity can be detected with a scintillometer over an area of about 50 square feet; a 2-pound sample of rock fragments recovered from the soil contained 1.36 percent uranium.
Ladwig Nos. 2 and 3

A sample of radioactive copper-stained rock from the dump of the 12-foot shaft at the Ladwig No. 2 property contained 0.30 percent uranium, and although fragments of oxidized breccia containing copper and uranium minerals can be found on the dump, the minerals were not seen in the breccia or wall rock exposed in the shaft. As considerable slumping has taken place along the sides of the shaft, there is reason to believe that the shaft may have been originally somewhat deeper, and any exploration of this property should include the removal of the backfill. The carbonate breccia zone that passes through the shaft is at least 200 feet long and from 1 to 6 feet thick; it is slightly radioactive wherever exposed, but except for the material found at the shaft, no copper or uranium minerals have been noted along the zone.

The fragments of uranium- and copper-bearing rock found in the shallow trench 100 feet east of the shaft are probably from another breccia body seen only as float. This is also the case at the Ladwig No. 3 prospect, and trenching or bulldozing will be done to evaluate these two occurrences.

RALSTON CREEK AREA

North Star mine

The North Star mine was worked on two occasions for copper, and possibly silver, and it is reported to have yielded 16 tons of ore, presumably from small concentrations now mined out. Specimens found on the dump indicate that much of the copper ore contains pitchblende and secondary uranium minerals; a 3-pound composite sample of dump material that showed appreciable radioactivity contained 16.83 percent copper, 20 ounces of silver,
and 0.85 percent uranium. Ore approaching this grade was found in only one part of the mine, near the heading of the lower adit (fig. 11), where a one-foot channel sample across the vein contained 5.50 percent copper and 0.51 percent uranium. Elsewhere, the uranium content of samples taken across the vein has been considerably lower, ranging from 0.11 to 0.002 percent; discounting the possible effects of leaching, the copper and silver content of the samples do not appear to have direct relationship to the uranium content as one sample containing only 0.006 percent uranium showed 4.12 percent copper and 6.4 ounces of silver.

The ore at the North Star mine can be expected to extend beyond the present workings, for it occurs along a strong structural break. The deposit has not been sufficiently studied, however, to indicate the factors that controlled the localization of the ore; also the location of the ground in the workings that yielded the 16 tons of presumably high-grade copper ore is not known. Therefore, further studies will be made in an attempt to determine structural relations that may serve to locate additional ore.

Schwartz mine

The pitchblende-torbernite-autunite deposit at the Schwartz mine is the only one of the Jefferson County deposits studied which has been explored for uranium. Intermittent mining by Fred Schwartz, the discoverer of the property, has resulted in the excavation, as an open cut, of a caved adit, and the driving of a new adit for 60 feet beyond the south end of the open cut (fig. 7). About 8 tons of ore, estimated to contain 0.33 percent uranium, were mined from the new adit by the operator and are now stockpiled at the mine. Rock containing pitchblende, torbernite, and autunite is
FIGURE II.-MAP AND SECTION OF UNDERGROUND WORKINGS, NORTH STAR MINE, JEFFERSON COUNTY, COLORADO, SHOWING ANALYSES OF SAMPLES.
exposed at several places in the adit, notably along the east wall (fig. 7). Radiometric and sample data from the workings are shown on figure 12.

The deposit at the Schwartz mine has not been studied sufficiently to determine the extent of the ore body, and no reserve estimates have been made. Because of the commercial grade of the ore mined and the known extent of the radioactive zone, this deposit will be given further study. A detailed surface map of the mine area will be made to relate the ore deposit to local and regional structures. Surface outcrops are few in the vicinity of the mine and physical exploration may be proposed later as a supplement to surface data.

Nigger Shaft

The pitchblende deposit at the Nigger Shaft is in a breccia zone that has been traced by float and radiometric methods for 100 feet to the northwest. In the underground workings the pitchblende occurs as thin seams in carbonate veinlets along the margins of the breccia zone, but the extent and distribution of the uranium-bearing veinlets along the strike of the structure is not known. Three channel samples, AJG-9, AJG-10, and AJG-11 (table 1), taken from the underground workings, show that ore of currently minable grade is confined to the outer few inches of the breccia zone. The uranium content of the channel sample AJG-9 across the full width of the breccia zone was only 0.004 percent. It is not known whether this localization of uranium along the margins of the breccia zone will persist throughout the deposit.
EXPLANATION

100
Approximate milliroentgen per hour on 
beta - gamma field counter

0.021 - 4 feet
Percent equivalent uranium, and length 
of channel sample

Open cut

Dump

TRUE NORTH
MAGNETIC NORTH

Scale: 10 feet

FIGURE 12.—ASSAY AND RADIOMETRIC MAP OF THE SCHWARTZ MINE, 
JEFFERSON COUNTY, COLORADO
Weighted assays of the three channel samples indicate a uranium content of 0.038 percent for the breccia zone in the stope. Using a length of 100 feet, depth of 40 feet and width of 2 feet, and applying the grade derived from the stope samples, the inferred reserves for the deposit would be 600 tons of rock containing 0.038 percent uranium.

Exploration of the deposit will be done by trenching along the surface trace of the vein.

SUMMARY OF PLANS

Limited physical exploration by bulldozing and trenching has been planned and budgeted for this area in fiscal year 1954. It will include trenching or bulldozing at the properties described in this report and at others yet to be examined. No exploratory drilling is planned, at this time, for fiscal year 1954.
FIGURE 3 — GEOLOGIC MAP AND SECTION OF THE UNION PACIFIC PROSPECT, JEFFERSON COUNTY, COLORADO

EXPLORE-BEARING VEIN
BRITTLE BRECCIA
SHEARED AND ALTERED GNEISS
SCHISTOSOMED ROCKS OF THE SANTA FE FORMATION
STRIKE SHOWING DIP OF EXPOSURE
STRIKE AND DIP OF EXPOSURE
STRIKE AND DIP OF JOINTS
LIMIT OF EXCAVATION
LIMIT OF UNDERGROUND WORKINGS
LIMESTONE
DUMP

SECTION ALONG LINE A-A'

\( \text{SECTION ALONG LINE A-A'} \)

\[ \text{mapped by J.W. Adams and A.J. Gude, February 1952.} \]
FIGURE 8.—GEOLOGY OF NIGGER SHAFT, HOFFMEISTER PROSPECT, JEFFERSON COUNTY, COLORADO.