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RECONNAISSANCE INVESTIGATIONS FOR URANIUM IN THE COLORADO FRONT RANGE AND ADJACENT AREAS, 1947-1951*

By

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RECONNAISSANCE INVESTIGATIONS FOR URANIUM IN THE COLORADO FRONT RANGE AND ADJACENT AREAS, 1947-1951

by

Robert U. King

ABSTRACT

Reconnaissance investigations for uranium carried out in the Colorado Front Range and adjacent areas in Colorado were made during the period from 1947 to 1951. The investigations consisted chiefly of spot-checking mine dumps, outcrops, and road cuts, and included examination of stream beds, mill tailing ponds, and radioactivity traversing of selected surface areas, and mine workings. Both portable and car-mounted radioactivity-detection equipment were used in the field. The investigations included more than 250 identifiable localities. The radioactive deposits examined are classified into the following types: veins, brecciated shear zones, placers, spring deposits and mine waters, disseminations in igneous and metamorphic rocks, mill products, pegmatites, and disseminations in sedimentary rocks. The most economically significant of these types of occurrences for uranium are the veins, brecciated shear zones, and disseminations in sedimentary rocks. Uranium minerals have not been found in significant quantities in placers; disseminations of uranium in igneous and metamorphic rocks though common enough are so far below ore grade that they are not of commercial significance.

Natural spring waters and waters in mine openings very commonly contain small quantities of uranium in solution; they are not significant for commercial exploitation and their geologic relationships are not well understood.

Uranium minerals are fairly common in pegmatites but are present in such small quantities and so irregularly distributed in the pegmatites that this type of deposit has not proved to be economically significant.

In addition to the known (1) pitchblende-bearing vein deposits in the Idaho Springs-Central City districts in Clear Creek and Gilpin counties, (2) the carnotite deposits near Leyden, Jefferson County, (3) the carnotite deposits of the Colorado Plateau region in the southwestern part of the state, and (4) the radioactive springs that are scattered throughout the western half of the state; significant uranium deposits have been discovered, as a result of the investigations described, in Custer, Jefferson, Larimer, Park, and Routt counties. Some of these recently discovered deposits have since been exploited and have yielded small quantities of uranium ore.

INTRODUCTION

Introductory statement

The reconnaissance investigations for uranium in the Colorado Front Range and adjacent areas described in this report were carried out by the U. S. Geological Survey on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission in the period from 1947 to 1951. The program, for the most part, was outlined early in 1949 and is a consequence of an evaluation of the results of Trace Elements investigations carried on by the Geological Survey as early as 1945, and by the Manhattan District Engineer Project as early as 1943.

The scope of the program included reconnaissance investigations of all types of radioactive occurrences in the Front Range of Colorado, such as vein deposits, placer deposits, springs and mine waters, mill products, pegmatites, disseminated deposits in igneous and metamorphic rocks, and deposits in sedimentary rocks, with emphasis and some detailed studies on those radioactive deposits which, as a result of preliminary field examination, appeared to be most promising for the occurrence of uranium.

The main objectives of the reconnaissance investigations program in the Front Range were to discover and evaluate deposits of radioactive minerals, and to obtain geologic information that would be useful in predicting not only areas favorable for uranium deposits, but also which types of deposits might contain significant concentrations of uranium.

The chief purpose of this report is to summarize for the record the results of the reconnaissance investigations. The classification and evaluation of radioactive deposits are only briefly summarized here as this information has been published elsewhere (King, Leonard, Moore and Pierson, 1953; Kaiser and others, 1952).

Field work

The field work on which this report is based was begun in 1947 with spot examinations of pegmatites and associated rocks for radioactivity. The field work continued during the summer months of 1948-1949-1950 and through the Spring of 1951. The Colorado Front Range project was initiated toward the end of 1948 as a direct result of a request from the U. S. Atomic Energy Commission.

Early investigations for radioactivity previous to the Colorado Front Range project were conducted by the Manhattan District Engineer project and by the Union Mines Development Corporation in 1943.

Trace Elements investigations for uranium in the Colorado Front Range were made in 1944 by Harder and Wyant of the U. S. Geological Survey on behalf of the AEC in the Central City and Jamestown districts. They recommended further study of the deposits in these districts.

In 1945 Harder and Stead of the U. S. Geological Survey recommended that "the mineral districts of Central Colorado be further investigated as this whole area exhibits higher than average radioactivity" (Harder and Stead, 1945).

Eighty-one localities, including 71 pegmatite deposits, were examined for radioactivity by K. G. Brill, Jr., U. S. Geological Survey, in 1947.

Spot property examinations were conducted by Gott and Wyant of the U. S. Geological Survey in the Front Range area in 1948. In December 1948, considerable newspaper publicity was given to the discovery by the Consolidated Caribou Silver Mines, Inc., of pitchblende in the lower levels of the Caribou mine in Boulder County.

The field work consisted principally of radiometric traversing of natural exposures, of mine workings in operating mines, and of accessible portions of abandoned mines. Spot examinations were made of individual properties suspected or reported to contain radioactive minerals. The field work was concentrated in those districts from which there was a known production of uranium, but some examinations for radioactivity were made at localities in many counties outside of the Colorado Front Range area.

Where possible all significant radioactivity anomalies were checked for uranium content by chemical analysis of samples collected in the field. Detailed geologic mapping was done in special cases when significant radioactive deposits were found. Significant radioactivity anomalies are those anomalies that amount to about five times the background radioactivity. Background radioactivity as used in this report is the general level of radioactivity in the area where radioactivity measurements are being made. The radioactivity anomalies were evaluated in their relation to the local geology rather than on the ratio of the radioactivity measurement to the background radioactivity.

Both portable field Geiger-Müller beta-gamma ray counters and car-borne gamma-ray counters were used in the search for radioactive deposits. The portable-type counter was used for detailed traversing of small areas and mine workings. The car-borne type counter was used for general surveys of large relatively flat areas and for traversing along roads. The localities examined are shown on figure 1.

Several different models of portable-type Geiger-Müller counters were used in the field as they were designed, marketed, and made available to the field parties.

The car-borne counters consisted of a modified Victoreen counter and two 2-inch diameter by 40-inch long metal Geiger-Müller tubes. These counters were assembled and mounted on field cars in Denver. The 2- by 40-inch tubes were mounted with the tubes in longitudinal position parallel to the outer edges of the car top on ski racks attached to the roof of the car. The counter was placed in the cab, and the rate-meter (microammeter) was mounted on the dash panel at window level. The cables and electrical connections were water-proofed to permit use in all weather conditions. A more elaborate system of car-borne radiometric equipment used for radiometric reconnaissance in the eastern United States in 1948 and 1949 is described by Nelson (1953).

In making radiometric traverses with car-borne equipment only the relative radioactivity was observed and recorded. This method was useful only for detecting radioactivity anomalies during rapid reconnaissance along roads, and the readings have no quantitative significance. The data obtained from the road logging for radioactivity are shown on table 9. Numerous roads in the Front Range in addition to several hundred miles in other parts of Colorado were traversed using car-borne equipment, but no attempt was made to get complete road coverage. The routes traversed are shown on figure 1.

During the early part of the project it became apparent that the radioactive deposits of possible economic importance were not evenly distributed throughout the entire Colorado Front Range extending from the Colorado-Wyoming border to south-central Colorado, but to a large degree concentrated in that part of the Front Range between Boulder and the Idaho Springs-Central City area, and roughly coinciding with the northeastern part of the Front Range Mineral Belt. This suggested the possibility that reconnaissance in the major metal-mining districts of the central mineral belt of Colorado would be rewarding.

It has also become evident that some of the minor mining districts that flank the central mineral belt are favorable for uranium deposits. Examples of this kind are the deposits at Prairie Divide, Larimer County, Ralston Creek area, Jefferson County, and deposits in the vicinity of Steamboat Springs, Routt County.

Acknowledgments

The writer wishes to acknowledge the assistance given to him in the field by many members of the Geological Survey. He especially wishes to thank T. S. Lovering for many suggestions and for guidance in the field,

W. P. Huleatt, under whose supervision the project was initiated and for his helpful suggestions in the early part of the project, L. R. Page, under whose supervision the project was carried out, for his guidance and criticism of the work, and George Phair for suggestions and cooperation in field and laboratory investigations. The cooperation and assistance given by C. C. Towle of the AEC are gratefully acknowledged.

The writer wishes to express his appreciation to the mining men of the area who assisted by loaning maps, providing guidance through underground workings of abandoned mines, and bringing information about radioactive deposits to the attention of the Survey.

SUMMARY OF GEOLOGY OF THE FRONT RANGE

Location and general features

The Colorado Front Range is the northward-trending mountainous area that extends from Canon City north to Wyoming. The Front Range is bounded on the east by a line passing just west of Colorado Springs, Golden, Boulder, and Fort Collins; its western boundary approximately follows the Continental Divide from the Wyoming line to Hoosier Pass where it swings southeastward toward Canon City. The outline of the Colorado Front Range is shown on figure 1.

Altitudes range from about 6,000 feet above sea level along the eastern border of the Front Range where it joins the Colorado high plains to over 14,000 feet above sea level at the highest summits of Longs and

Pikes Peaks. Because of the high altitudes much of the area has relatively short summers and the field season is consequently limited.

Roads of varying quality make most of the area accessible by car or truck, but a few places are still fairly remote.

The headwaters of two major rivers, the Arkansas and the South Platte, form the drainage of virtually the entire area.

Many local geographic features and place names are referred to in the text that do not appear on any of the illustrations accompanying this report. Such names are included for the convenience of the reader as an aid to locating properties in the field, and they can be readily identified by reference to standard maps such as U. S. Geological Survey topographic quadrangle sheets or County Highway and Transportation Maps.

General geology of the Front Range area

The geology of the Front Range of Colorado has been described by Lovering and Goddard (1950). The Front Range is composed of igneous, metamorphic, and sedimentary rocks that range in age from Precambrian to Tertiary. Most of the rock in the Colorado Front Range is Precambrian in age and consists partly of metasedimentary schist of the Idaho Springs formation that has been intruded by granites. The schist occupies perhaps one-fourth of the area and is distributed irregularly throughout the area. The granites form several large batholiths including the Pikes Peak, Silver Plume, Boulder Creek, and Sherman batholiths. The Boulder Creek batholith is the oldest igneous rock and is considerably smaller than either the Pikes Peak or Silver Plume batholiths. It occupies the central portion of the Front Range and is best exposed in the area south and west from Boulder to Georgetown.

Sedimentary rocks ranging in age from Paleozoic to Tertiary are tilted and faulted against the Front Range on both the east and west flanks, but with few exceptions sedimentary rocks do not occur within the Range.

Small bodies of igneous rocks of Tertiary age are exposed as stocks and dikes cutting the Precambrian schist and granite. These Tertiary intrusives occur in a zone extending southwesterly across the Rocky Mountains from Boulder through Breckenridge to the San Juan Mountains. In the southwestern part of the Front Range a fairly large area is covered with Tertiary volcanic rocks. The Tertiary igneous rocks range in composition from diabase to alaskite and generally have porphyritic textures.

Vein deposits that contain metallic and nonmetallic ores occur throughout the Front Range area from the Wyoming border to Cripple Creek and beyond, but they are most numerous and have been most productive within the Front Range Mineral Belt (fig. 1) or along the southwesterly trend of this belt. The veins are chiefly in Precambrian granite and schist and in or near intrusive bodies of Tertiary igneous rocks. The veins may contain appreciable quantities of uranium and thorium in addition to their precious- and base-metal deposits.

Pegmatite deposits that contain minable bodies of feldspar, mica, and beryl are sparsely distributed in the crystalline rocks of the Front Range area and in other parts of the state.

Important placer deposits are restricted to a few of the streams that drain some of the major mineral districts of the state; rich placer deposits have been worked along Clear Creek, and along the South Platte, Arkansas, and San Miguel rivers.

Distribution of uranium deposits

Uranium deposits in Colorado are widely distributed throughout the western half of the state in igneous, metamorphic, and sedimentary rocks which range in age from Precambrian to Tertiary.

The most productive of the uranium deposits are the carnotite type found in the Salt Wash sandstone member of the Morrison formation in the Colorado Plateau area of southwestern Colorado, northwestern New Mexico, northeastern Arizona, and eastern Utah. The second most productive uranium deposits in the state have been the pitchblende-bearing vein deposits of the Front Range mineral belt in north-central Colorado. The small but significant production of high-grade uranium ore that has come from these vein deposits is shown in table 1. Potentially important deposits of uranium occur throughout the central mineral belt of Colorado and in scattered places northwest and southeast of the mineral belt. The localities examined for uranium in Colorado are grouped by county in tables 2 to 5.

Uranium occurs in metalliferous veins in Precambrian granite, gneiss, and schist in Larimer, Boulder, Gilpin, Jefferson, and Clear Creek Counties. At Caribou in Boulder County uranium is found also in veins in a

Table 1.—Mine production of uranium in Boulder, Clear Creek, and Gilpin Counties, Colorado.

(1871-1948)

Year	Mine	Tons	Percent U_3O_8	Lbs. U_3O_8
1871	?	0.1	60	120
1872	Wood	3.	60	3,600
1873	Wood	2.	50	2,000
1873	Wood	.1	67	134
1873	Wood	.6	10 (?)	120
1874-1883		No record of production		
1884	Wood	3.	70	4,200
1885-1896		No record of production		
1897*	Wood & Kirk	15.	53	15,900
1897	Kirk	2.25	50	2,250
1898	Kirk	8.	50	8,000
1898	Wood	33.	12	7,920
1899	Wood & Kirk (?)	43.	12.5	10,750
1900	Wood & Kirk	6.58	16	2,106
1901-1904		No record of production		
1905-1906	Kirk	20.	35	14,000
1905-1906	Kirk	100.	3.5	7,000
1907-1908		No record of production		

Table 1.—Mine production of uranium in Boulder, Clear Creek, and Gilpin Counties, Colorado—Continued.

Year	Mine	Tons	Percent U_3O_8	Lbs. U_3O_8
1909	Belcher	0.8	30	480
1910	German	.8	30	480
1911	German	.25	30	150
1912	Calhoun	.12	37.5	90
1913	Belcher	.12	70	168
1913	Belcher	.11	20	44
1913	Belcher	1.	2	40
1913	Belcher	5.	2.6	260
1913	Wood	.2	50	200
1914	Kirk	50.	1.49	1,490
1915	—	0	0	0
1916	Wood	10.	60	12,000
1917-1918	—	0.	0	0
1919	Jo Reynolds	8.	72	11,520
1920-1939	—	0	0	0
1940	Wood	.5	13.5	135
1941-1947	—	0	0	0
1948	Caribou	2.5	7.5	375
Totals		316.03	16.7**	105,532

*In addition 17 tons of uranium ore containing about 53 percent U_3O_8 may have been produced in 1897.

**Calculated average grade.

Data from: Bastin and Hill (1917); Lovering and Goddard (1950); Rickard (1906); Moore & Kithil (1913); unpublished and private reports; official communications; newspaper accounts.

Table 2 - Deposits examined in Boulder County

							Mineralogy				
Index number	Name of mine, property or locality	Location Sec. T. R.	Development of property	Host Bock	Type of deposit	Size	Radioactive material	Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium (percent)
1	Argo mine.	13 2N 72W.	Shaft, 5 levels.	Silver Plume granite.	Breccia zone.	60 ft. by 250 ft.	Uraninite (?).	Galena, pyrite sphalerite, quartz, clay materials.	Fluorspar. Sulfides. Dark-purple fluorite.	0.017-0.047 ——— ———	——— 0.004 .016-.031
2	B and A lodes Nos. 1 and 2.	30 2N 71W.	80-ft. adit, pits.	Altered granodiorite.	Pyrite vein.	2 ft. to 10 ft. wide.	Limonite(?).	Pyrite, quartz.	Quartz-pyrite vein.	.005-.007	.001
3	Beryl lode (Lehman) mine.	27 2N 71W.	Adits, glory hole, trenches.	Granite gneiss and schist.	Pegmatite.	300 ft. by 75 ft. by 40 ft.	Black mineral.	Quartz, feldspar, garnet, beryl, cleavelandite, hematite(?), [malachite(?)] biotite.	Pegmatite.	.006	.002
4	Black Crow prospect.	22 2N 71W.	30-ft. adit, trench.	Muscovite schist.	Pegmatite.	100 ft. by 15 ft. by 30 ft.	None	Feldspar, muscovite.	———	———	———
5	Blue Jay mine	30 2N 71W.	300-ft. shaft, 2 levels, short adits.	Altered granodiorite.	Fluorspar vein.	6 in. by 16 ft. by 1000 ft.	Uraninite, uranothorite.	Fluorite, quartz pyrite, galena, clay minerals.	Fluorspar. Dark-purple fluorite. Altered granodiorite.	——— ——— ———	.037-.045 .018-.084 .002
6	Brown Spar mine.	24 2N 72W.	300 ft. shaft, 3 levels.	Altered granodiorite.	Flourspar vein.	7 ft. by 25 ft. by 100 ft: by 300 ft. deep.	———	Fluorite, pyrite, galena, clay minerals, ankerite, quartz.	Vein material with fluorite.	——— .029	.013
7	Buddy lode (Highline prospect).	27 2N 71W.	50-ft. trench.	Granite and granite gneiss.	Pegmatite	100 ft. by 20 ft. by 10 ft.	None	Quartz, potash feldspar, muscovite	———	———	———
8	Burlington mine.	24 2N 72W.	500-ft. shaft, 4 levels.	Sericitized granite.	Fluorspar breccia zone.	20 ft. by 350 ft. by 500 ft. deep.	———	Fluorite, galena, pyrite, quartz, clay minerals.	———	.05(est.)	———
9	Copper Blush mine	17 2N 71W.	Shaft, levels	Silver Plume granite.	Quartz-fluorspar vein.	———	———	Fluorite, pyrite chalcopyrite, quartz, chert.	Fluorspar	.022	.004
10	Curie and Tile radioactive springs.	29 2N 71W.	Springhouse	Silver Plume granite.	Flowing spring.	$1\frac{1}{2}$ gallons per minute	Radium, radon(?) uranium	Water	Water. Evaporite. Granite.	.005-.01(est) .004 .002-.004	.01(ppm)
11	Elkhorn mica mine (Tin Horn lode).	27 2N 71W.	Pit, 20 by 30-ft; adits.	Biotite diorite gneiss.	Pegmatite.	100 ft. by 15 ft. by 50 ft.	Torbernite(?).	Quartz, potash feldspar, muscovite, garnet, mica.	Muscovite with torbernite(?).	.022	.012
12	Emmett mine	24 2N 72W.	1000-ft. shaft, crosscut tunnel, 10 levels, open cut.	Silver Plume granite.	Fluorspar vein.	20 ft. by 200 ft. by 500 ft.	Torbernite, meta-torbernite.	Fluorite, pyrite galena, chalcopyrite, sphalerite, quartz, chalcedony.	Fluorite. Brown muck	.007-.052 .083	.004-.017 .003
13	Energy claim.	19 2N 71W.	Pits and trenches.	Altered granodiorite.	Fluorspar vein.	2 ft. by 150 ft. by 75 ft.	———	Fluorite, quartz, pyrite.	Vein. Granodiorite.	.019 .006	.009 ———
14	Horn prospect.	29 2N 71W.	Pits	Silver Plume granite.	Disseminated.	———	———	Quartz, pyrite.	Granite.	.005-.006	.003-.006
15	Gladstone mine.	13 2N 72W.	Shaft, pits.	do.	Fluorspar breccia zone.	———	———	Fluorite-pyrite, sericite.	Fluorite and pyrite.	.004	.003
16	Lehman lode mine.	19 2N 71W.	67-ft. adit, 16-ft. raise.	Altered quartz monzonite porphyry.	Fluorspar breccia zone.	2 ft. to 5 ft. wide	———	Fluorite, pyrite clay minerals.	Fluorspar.	.007-.035	.003-.005
17	Lehman Mill.	19 2N 71W.	Mill.	———	Mill products.	———	———	———	Sulfide concentrate.	.016-.031	.013-.018
18	McKinley mine	13 2N 72W.	Shafts and adit (caved).	Altered Silver Plume granite.	Fluorspar vein.	———	———	Fluorite, pyrite, quartz, clay minerals.	Fluospar and granite.	.008	.004
19	Nations Treasure mine.	24 2N 72W.	200 ft. of drifts, crosscut tunnel, glory hole.	Silver Plume granite.	Fluorspar, breccia zones.	50 ft by 150 ft.	Torbernite.	Fluorite, quartz, pyrite, galena, chlorite, clay minerals, chalcedony.	Fluorite with sulfides. Granite with torbernite.	.035-.10 .13	.024-.075 ———
20	New Girl (Columbine lode) prospect.	22 2N 71W	4 adits, glory hols.	Biotite-muscovite schist.	Pegmatite.	400 ft. by 50 ft. by 50 ft.	Torbernite.	Quartz, feldspar, muscovite, beryl, columbite.	Muscovite with torbernite.	———	.015
21	Orion mine	24 2N 72W	Shafts, open cuts, drifts, pits, trenches.	Altered granodiorite.	Fluorspar vein.	6 in. to 3 ft. wide.	———	Fluorite, quartz, lematite, pyrite.	Fluorspar vein material.	.01(est)	.004-.008
22	Ozark Mahoning mill	24 2N 72W	Mill.	———	Mill products.	———	———	———	Crushed ore. Sulfide concentrates, fluorspar concentrates. Tails. Concentrates from tails.	——— ——— ——— ——— ———	.01-.034 .035-.19 .003 .005-.034 1.03-1.5

Table 2. — Deposits examined in Boulder County.—Continued.

Index number	Name of mine, property or locality	Location Sec. T.R.	Development of property	Host rock	Type of deposit	Size	Mineralogy Radioactive material	 Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium (percent)
23	Poorman mine.	30 2N. 71W.	60-ft. shaft, 100 ft. of drift.	Altered granodiorite	Fluorspar vein.	-------	-------	Fluorite, quartz, carbonates galena, pyrite, biotite.	Fluorspar. Dump. Mine water.	0.006 ------- -------	------- 0.022 .06(ppm).
24	Rusty Gold and other cerite prospects.	17 2N. 71W.	30-foot adit, pits, trenches.	Silver Plume granite.	Pegmatites.	5 ft. by 75 ft.	Uraninite, monazite.	Allanite, epidote, cerite, tornebohmite, bastnasite, monazite.	Cerite rock. Cerite.	------- -------	.014- .02 .5
25	Spartan No. 5 mine.	19 2N. 71W.	-------	Altered quartz monzonite.	Fluorspar vein	-------	-------	Fluorite, pyrite.	Fluorspar vein material.	.004	.001
26	Yellow Girl mine.	24 2N. 72W.	Crosscut, adits, open cut.	Altered granodiorite.	Vein.	-------	-------	Fluorite, quartz, pyrite, galena, clay minerals.	Fluorspar ore. Water.	------- -------	.004 .22 (ppm).
27	Bell group of mines.	22 1N. 71W.	150-ft. adit.	Boulder Creek granite.	Vein.	-------	-------	Quartz, pyrite	Vein material. Wall rock.	.006-.041 .037	.003-.037 .030
28	Black Cloud mine.	12 1N 72W.	1500 ft. of adit and drifts.	Boulder Creek granite.	Vein.	2 ft. by 200 ft.	Pitchblende.	Quartz, pyrite, gold, silver-bearing galena, sphalerite.	Vein material.	-------	.001-.081
29	Copper King nickel mine.	14 1N. 72W.	500 ft. of drifts, 110-ft. raise.	Amphibolite schist, hornblende diorite gneiss.	Vein.	35 ft. by 250 ft.	None	Pyrrhotite, niccolite, pentlandite, pyrite, chalcopyrite.	-------	-------	-------
30	Grand Republic mine.	19 1N 71W	2000 ft. of workings.	Boulder Creek granite.	Breccia zone.	-------	None	Pyrite, quartz ferberite, marcasite, arsenopyrite.	-------	-------	-------
31	Hoosier dike.	13 1N. 72W	Outcrops and pits.	Granite.	Breccia reef.	10 ft. by 12 miles.	-------	Quartz, hematite.	Quartz with hematite.	.005(est.)	-------
32	Maxwell dike.	27 1N 71W.	Outcrops and pits.	Granite and gneiss.	do.	50-100 ft. by 11 miles.	-------	-------	Silicified granite and gneiss.	.005(est.)	-------
33	Pegmatite prospects on Butzel Hill.	5&6 1N 71W.	Pits and trenches.	Granite gneiss, biotite augen gneiss.	Pegmatite.	100 to 400ft. by 50 ft.	-------	Beryl, columbite, tantalite.	Granitoid rock with biotite pegmatite.	.007(est.) .001-.005(est.)	------- -------
34	Poorman dike.	20 1N. 71W.	Outcrops and pits	Granite.	Breccia reef.	10 ft. by 5 miles.	-------	Hematite	Silicified granite with hematite.	.006-.041(est.)	-------
35	Radioactive quartz monzonite on Butzel Hill.	6 1N 71W	Outcrops.	Biotite augen gneiss.	Disseminated.	30 ft. by 300 ft.	-------	-------	Quartz monzonite.	.001-.004(est.)	-------
36	Snowbound mine.	6 1N. 71W.	Adit and shaft.	Augen gneiss.	Quartz veins.	-------	-------	Quartz, galena.	Quartz vein.	.007	.006
37	Wilson beryl prospect.	7 1N. 71W.	2 pits.	Biotite granite gneiss.	Pegmatite.	200 ft. by 10ft.	-------	Quartz, potash feldspar, muscovite, beryl.	Granite.	.005	.002
38	Yellow Pine mine	20 1N. 71W.	6 levels, shaft, winzes.	Granite, aplite, pegmatite.	Vein	-------	None	Argentiferous galena, freibergite(?), pyrite, sphalerite, quartz.	-------	-------	-------
39	Copper Rock area.	22 1N. 72W.	-------	Porphyry dikes, bostonite, gneiss.	Fracture coatings and disseminations.	-------	-------	Pyrite, chalcopyrite.	Altered porphyry and schist.	.005(est.)	-------
40	Lois, Sunnyview, and Johanna claims.	1 1N 73W.	30-ft. shaft, 70-ft. tunnel.	Idaho Springs schist and Silver Plume granite.	Vein.	-------	None.	Pyrite, quartz.	Vein material (submitted by owner).	-------	.001-.003
41	Hurricane Hill dike	7 1S. 72W	Outcrop.	Granite and schist.	Breccia reef.	10ft. by 15 miles.	-------	Hematite.	Silicified granite and hematite.	.008(est.)	-------
42	Livingston dike.	25 1N. 72W.	do.	do.	do.	10ft. by 15 miles.	-------	Hematite.	Quartz vein.	.017	-------
43	Primos mine.	12 1S. 73W.	Shafts, trenches, adits, and open cuts.	Idaho Springs schist and gneiss.	Vein.	-------	None.	Ferberite, quartz.	-------	-------	-------
44	Pueblo Belle mine.	31 1N. 71W.	Adit	Boulder Creek granite.	Vein.	-------	-------	Quartz, pyrite, ferberite.	Quartz vein. Altered granite.	.071 .008	.005 .002
45	Wheelman tunnel.	31 1N. 71W.	515-ft. adit and 150-ft. of drifts.	do.	Pegmatite.	4-ft. thick	-------	Quartz, carbonates, fluorite.	Granite. Aplite. Pegmatite.	.004 .005 .012	.001 ------- .013

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Table 2. - Deposits examined in Boulder County-- continued.

Index number	Name of mine, property or locality	Location Sec. T.R.	Development of property	Host rock	Type of deposit	Size	Radioactive material	Mineralogy: Associated minerals	Mineralogy: Material sampled	Equivalent Uranium (percent)	Uranium (percent)
46	Antietam mine and nearby shaft.	16 1S. 73W.	390-ft. adit and 145 ft. of drifts.	Quartz,monzonite gneiss, Idaho Springs schist.	Vein.	1/4-in. wide.	-------	-------	Quartz,hematite.	0.005(est.)	0.001
47	Arapahoe Gem mine.	20 1S. 73W.	420-ft. tunnel	Quartz monzonite gneiss,Idaho Springs schist.	Vein	-------	None.	Pyrite,quartz	-------	-------	-------
48	Bluebird group of mines.	2 1S. 73W.	800 ft.of adits.	Granite,pegmatite, andesite,schist.	do.	1/2 to 18 in.	-------	Quartz,galena, chalcopyrite, malachite,specularite,barite.	Pegmatite.	.032	.004
49	Caribou mine.	8,9 1S. 73W.	11,000 ft of workings.	Monzonite.	do.	1/2to 6 in. by 70 ft. by 100 ft.	Massive and sooty pitchblende.	Galena,sphalerite, marmatite,ruby, silver,wire silver, pyrite.	Pitchblende-bearing quartz-carbonate vein.	-------	.001-1.23
50	Congo Chief mine.	4 1S. 73W.	Shaft.	Idaho Springs schist,granite, monzonite.	do.	-------	None.	Galena,sphalerite, Quartz,carbonate.	-------	-------	-------
51	Denver group mine.	7 1S. 73W.	1100-ft. tunnel.	Monzonite.	do.	6 in. to 3 ft.	None.	Pyrite,chalcopyrite quartz, carbonate.	-------	-------	-------
52	Enterprise,Gold Dust,Village Belle and Bird's Nest mines.	20 1S. 73W.	Shafts, adits, and drifts.	Idaho Springs schist,gneiss, and pegmatite.	Veins.	1/2 to 6 in. wide.	None.	Quartz,pyrite, gold tellurides, carbonates.	-------	-------	-------
53	Fourth of July mine.	34 1N. 74W	3000 ft. of adit and drifts.	Idaho Springs schizt and Swandyke gneiss.	do.	2 to 12 in. wide	None.	Pyrite,hematite	-------	-------	-------
54	Golden Reward mine.	15 1S. 73W	322 ft. of drifts.	Schist,pegmatite, porphyry dike.	do.	1 to 2 in. wide.	-------	Quartz,pyrite.	Quartz-pyrite vein.	.01	.001
55	Great Northern mine.	5 1S. 73W.	Shaft.	Idaho Springs schist and monzonite.	do.	-------	None.	Quartz,sphalerite,galena,chalcopyrite,copper carbonates.	-------	-------	-------
56	Mogul tunnel.	21 1S.73W	2500 ft. of workings.	Schist and gneiss.	do.	2 in. to 24 in. wide.	-------	Quartz,calcite, pyrite,roscoelite, gold tellurides.	Iron-stained fracture zone.	.005(est.)	-------
57	Pandora mine.	5 1S.73W.	Shaft.	Monzonite.	Vein.	-------	None.	Pyrite.	-------	-------	-------
58	Platteville mine.	19 1S.73W.	400-ft. tunnel	do.	Vein zone	6 in. to 2 ft.wide.	-------	Gold-silver tellurides,pyrite,quartz	Iron-stained vein zone.	.005(est.)	-------
59	Rosalind group of mines	16 1S.73W.	Adits.	Schist and gneiss.	Veins.	-------	None.	Quartz,pyrite, chalcopyrite.	-------	-------	-------
60	Shirely,May Queen,X-Ray, and Hattie May mines.	19 1S.73W.	600-ft.adit, raises, stopes.	Monzonite near contact with pre-Cambrian schist.	Vein zone.	6 in. to 3 ft.	Unidentified sooty material	Quartz,pyrite.	Quartz vein. Quartz vein.	.009-.072 .014	.001-.034 .001
61	Terror-Roseberry mine.	21 1S.73W.	700-ft.adit, 200-ft.shaft, short crosscuts.	Idaho Springs schist.	Shear zone.	-------	-------	Quartz,pyrite, gold telluride.	Quartz-pyrite vein material	.008-.042	.001-.002
62	Up-to-date mine.	6 1S.73W	1900-ft. adit.	Monzonite.	Veins.	1 in. to 2 ft. wide.	None.	Galena,pyrite, chalcopyrite, quartz,calcite, siderite(?).	-------	-------	-------
63	U.S.Gold Corporation mine.	1 and 12 1S.74W	-------	Granite	Vein.	-------	None.	Pyrite,chalcopyrite, specularite, epidote.	-------	-------	-------

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Table 3.—Deposits examined in Clear Creek County

Index number	Name of property	Location Sec. T. R.	Development	Host rock	Type of deposit	Size	Radioactive material	Associated minerals	Material sampled	Equivalent U(percent)	Uranium (percent)
64	Ajax mica mine	34 3S.72W.	Large cut, several levels.	Schist	Pegmatite	130 by 30 by 20 ft	—	Muscovite, albite, quartz, tourmaline.	Schist.	—	0.003
65	Bostonite porphyry dike (near Jo Reynolds mine)	26 3S.74W.	None	Gneiss and schist	Dike	100 by 100 ft	—	—	Bostonite.	0.008	—
66	Brandt Ranch prospect	12 4S.72W.	3 small pits	Granite gneiss	Pegmatite	100 by 15 by 20 ft	—	Microcline, quartz, mica, beryl, topaz.	Pegmatite.	—	.002
67	Denbigh shaft	22 3S.73W.	Inclined shaft, 2 tunnels	Granite and granite gneiss	Vein	2-6 inches wide	None	Quartz, chalcopyrite, chalcocite.	—	—	—
68	Doctor tunnel	27 3S.74W.	500-ft adit	Granite, schist and andesite porphyry	Quartz-sulphide vein	—	None	Pyrite, chalcopyrite, sphalerite, galena, manganese oxide.	—	—	—
69	Franklin-Silver Age mine	25 3S.73W.	200-ft shaft, adit	—	Vein	—	None	—	—	—	—
70	Griffith tunnel	8 4S.74W.	2 adits and crosscuts	Gneiss	do.	—	None	Pyrite, chalcopyrite, sphalerite, galena.	—	—	—
71	Grover mine	16 4S.72W.	250-ft by 8-ft cut, adit	Granite gneiss	Pegmatite	760 by 25 by 40 ft	Columbite	Beryl, quartz, albite, biotite, muscovite.	Pegmatite.	.001-.011	.001-.011
72	J. L. Emerson mine	22 3S.73W.	—	Granite gneiss and monzonite porphyry	Vein	—	None	Pyrite, hematite, chalcopyrite, galena.	—	—	—
73	Jo Reynolds mine	35 3S.74W.	4500-ft tunnel, drifts, shafts	Schist and granite	Vein	—	Pitchblende	Quartz, siderite, sphalerite, galena, chalcopyrite, pyrite, tetrahedrite	Vein material.	—	.005-.16
74	Lombard mine	1 4S.74W.	150-ft shaft and 2,000 ft of drifts	Schist	Vein	1130 by 1 ft	—	Quartz, sphalerite, galena, chalcopyrite, siderite, pyrite.	Vein material	.005	.003
75	Lone Star mine	3 4S.72W.	200-ft adit	Gneiss and schist	Pegmatite	—	Allanite, uranophane(?)	Feldspar, quartz, biotite.	Pegmatite.	.005	—
76	Martha E prospect	5 4S.73W.	150-ft adit and winze	Biotite schist	Shear zone	—	Metatorbernite autunite, pitchblende.	Pyrite, quartz.	Shear zone material.	.013-.13	.003-.12
77	Nabob tunnel	35 3S.74W.	—	Granite gneiss	Vein	2 in.-6 ft wide	None	Galena, bornite, covellite.	—	.004 (est.)	—
78	Robineau claims	35 3S.74W.	Shafts and pits	Granite pegmatite	Vein	—	Torbernite dumontite	Goethite	Vein material	—	.010
79	United Lead and Silver Company mine	26 3S.74W.	200-ft adit	Schist, gneiss and bostonite.	Vein	—	—	Quartz, galena, pyrite	Bostonite dike	.005 (est.)	—
80	Sawmill Gulch pegmatite prospects	4&5 4S.72W.	Adit	Schist and gneiss.	Pegmatite	—	—	Quartz, potash feldspar, biotite.	Pegmatite.	.002	—

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Table 4.—Deposits examined in Gilpin County

Index number	Name of property	Location Sec. T. R.	Development	Host rock	Type of deposit	Size	Mineralogy: Radioactive material	Mineralogy: Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium percent
81	Alps mine	14 3S.73W.	Reportedly worked to 1300-ft. depth	Gneiss and schist	Vein	------	Uraninite (reported)	Galena, sphalerite, pyrite.	Water.	------	0.14 ppm.
82	American Flag	15 3S.73W.	------	Gneiss and schist	do.	------	None	Quartz, pyrite.	------	------	------
83	Apex claims	25 3S.72W.	Prospect tunnel 20-ft.	Granite gneiss, biotite schist	Dissemination in igneous rocks	------	None	------	------	------	------
84	Ayres-and Taylor-Leavenworth mines	14 3S.73W.	2,000 ft. of drifts	------	Vein	------	Pitchblende	Pyrite, chalcopyrite, galena, sphalerite, enargite, quartz.	Vein material.	0.024-2.80	.001-2.92
85	Belmont mine	22 3S.73W.	820-ft. shaft, 10 levels	Granite gneiss	do.	------	None	Galena, sphalerite, chalcopyrite, pyrite, tennantite.	------	------	------
86	Bezant mine	14 3S.73W.	485-ft. shaft, drifts.	Biotite gneiss, and schist	do.	2½ in. by 20 ft. (reported)	Pitchblende (reported)	Galena, sphalerite, chalcopyrite, pyrite, enargite.	Vein material.	------	.425-17.00 (reported)
87	Blanche M mine	15 3S.73W.	------	Granite gneiss and schist	do.	------	None	Quartz, pyrite.	------	------	------
88	Bob Tail tunnel	7 3S.72W.	35 miles of workings	Silicified granite gneiss	do.	------	Pitchblende (reported)	Pyrite.	------	------	------
89	Bonanza mine	18 3S.72W.	Shaft, drifts.	Schist and pegmatite	do.	2 ft. wide	Pitchblende	Pyrite	Vein material.	------	14.00
90	Bon Ton mine	14 3S.73W.	------	------	do.	------	------	------	Dump material.	.005(est.)	------
91	Buena Vista claim	13 3S. 73W.	Pits, trenches	Gneiss and schist	do.	------	None	------	------	------	------
92	Calhoun and Wood mines	14 3S.73W.	Shafts, drifts	Gneiss and schist	do.	½-18 in.	Pitchblende	Chalcopyrite, quartz, pyrite, galena, sphalerite.	Vein material.	------	.008-14.27
93	Charter Oak claim	15 3S.73W.	------	Silicified gneiss	do.	------	None	Quartz, pyrite, chalcopyrite.	------	------	------
94	Day Spring mine	14 3S.73W.	Shaft	------	do.	------	None	------	------	------	------
95	Delaware mine	15 3S.73W.	do.	Granite gneiss	do.	------	None	Galena, sphalerite, quartz, pyrite.	------	------	------
96	Delmonico mine	14 3S.73W.	do.	Granite gneiss	do.	------	None	Galena, sphalerite, pyrite, chalcopyrite.	------	------	------
97	Druid mine	23 3S.73W.	2 shafts, 8 levels	Granite gneiss and schist	do.	2 in.-11 ft.	None	Gold, pyrite, galena, chalcopyrite, sphalerite, enargite, quartz.	------	------	------
98	Egyptian mine	14 3S.73W.	880-ft. inclined shaft, 7 levels	Granite gneiss	do.	------	None	Pyrite, sphalerite, quartz, galena, chalcopyrite, chalcocite.	------	------	------
99	Eldorado mine	14 3S.73W.	Shaft	------	do.	------	Pitchblende	Pyrite, sphalerite, galena.	Vein material	------	.026
100	Ethan Allen mine	14 3S.73W.	do.	------	do.	------	None	------	------	------	------
101	Fairfield mine	22 3S.73W.	do.	Schist	do.	------	None	Pyrite	------	------	------
102	Fannie mine	23 3S.73W.	------	Granite gneiss	------	------	None	Pyrite, quartz	------	------	------
103	Forfar mine	23 3S.73W.	------	Silicified granite gneiss	------	------	None	Quartz, pyrite.	------	------	------
104	Frontenac mine	24 3S.73W.	Inclined shaft	do.	Vein	------	None	Galena, sphalerite, chalcopyrite, quartz pyrite.	------	------	------
105	Gem mine	15 3S.73W.	270-ft. shaft, 6 levels	Granite gneiss	do.	------	None	Galena, sphalerite.	------	------	------
106	German and Belcher mines	14 3S.73W.	Shafts, 3,000 ft. of drifts	Gneiss and schist	do.	------	Pitchblende	Pyrite, galena, chalcopyrite, enargite, sphalerite.	Vein material	------	.001-1.51
107	Gold Dollar mine	15 3S.73W.	Shaft	Biotite schist and granite gneiss	do.	------	None	Pyrite, covellite, galena, sphalerite, chalcopyrite, quartz.	------	------	------
108	Gold King mine	14 3S.73W.	------	Granite gneiss	do.	------	------	Quartz	Vein material	.003	.002
109	Gold Rock mine	22 3S.73W.	600-ft. shaft	Highly silicified gneiss and schist	do.	------	Pitchblende	Quartz, chalcopyrite, pyrite.	Vein material	.11	------
110	Gomer mine	23 3S.73W.	Shaft	Biotite, schist and gneiss	do.	------	None	Pyrite, sphalerite, galena, quartz.	------	------	------
111	Harsh mine	14 3S.73W.	80-ft. shaft, 60 ft. of drift	Granite gneiss	do.	4 - 6 ft. wide	------	Galena, sphalerite, pyrite.	Vein material.	.007	.011
112	Incidental mine	23 3S.73W.	Shaft	Highly altered granite gneiss	do.	------	None	Pyrite	------	------	------

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Table 4.—Deposits examined in Gilpin County - Continued

Index number	Name of property	Location Sec. T, R.	Development	Host rock	Type of deposit	Size	Mineralogy: Radioactive material	Mineralogy: Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium percent
113	Iron mine	23 3S.73W.	2 shafts,drifts	Granite gneiss	Vein	———	Pitchblende	Pyrite,chalcopyrite, tennantite,quartz.	Vein material. Standing water.	1.19-8.90 ———	1.17-8.38 2.7 ppm.
114	Iron Duke mine	23 3S.73W.	510-ft shaft 2669 ft. of workings	Granite gneiss	do.	———	None	Tennantite,quartz, pyrite,chalcopyrite.	———	———	———
115	Jade lode	22 3S.73W.	Shaft	Biotite gneiss	do.	———	None	Quartz	———	———	———
116	Jasper cuts	13 3S.73W.	Pit,open-cuts	Biotite gneiss. Gneiss,schist, and pegmatite	do. Fracture zone	——— ———	None ———	———	Gneiss and schist	.001-.073	.001-.021
117	Jefferson mine	15 3S.73W.	2 compartment shaft, pits	Granit gneiss	Vein	———	None	Pyrite	———	———	———
118	Jenny Lind Gulch area (Belle Maxville claims)	9 2S.73W.	Pits,shafts	Gneiss,schist, and monzonite porphyry	Vein	———	None	None	———	———	———
119	Kirk mine	14 3S.73W.	400-ft. inclined shaft,5 levels.	Gneiss and schists	Vein	40 in. wide	Pitchblende	Pyrite,sphalerite,galena, enargite,chalcopyrite.	Vein material. Standing water. Vein material from dump .	.005-0.93	.127,1.20 2.7,8.2 ppm. .025-.084
120	Lynne mine	15 3S.73W.	Shaft	Gneiss	do.	———	None	Quartz,pyrite, galena,sphalerite.	———	———	———
121	Minnesota and Hillhouse mines	14,23,3S.73W.	2 shafts	———	do.	———	None	Pyrite	———	———	———
122	Mitchell mine	14 3S.73W.	500-ft. shaft reported	Granite gneiss	do.	———	Pitchblende (reported)	Pyrite,chalcopyrite.	———	———	———
123	Nimrod mine	15 3S.73W.	———	Silicified gneiss	do.	———	None	Quartz,pyrite, chalcopyrite.	———	———	———
124	Ohio mine	14 3S.73W.	———	———	do.	———	None	———	———	———	———
125	Onoko mine	14 3S.73W.	Shaft	Gneiss	do.	———	None	Quartz,pyrite.	———	———	———
126	Payoff mine	12 3S.73W.	1500-ft. adit	Silicified granite gneiss	do.	———	None	Quartz,pyrite, chalcopyrite.	———	———	———
127	Perrin mine	14 3S.73W.	Shaft.	———	do.	———	Pitchblende (reported)	———	———	———	———
128	Pewabic Tunnel in Russell Gulch (Golden Opportunity)	23 3S.73W.	Adit	Silicified granite gneiss and schist	do.	———	None	Pyrite,galena, sphalerite,quartz.	———	———	———
129	Pewabic Tunnel near Blackhawk (N.Clear Creek).	17 3S.72W.	Adit 1500- to 1800-ft. long, drifts	Schist,gneiss, and pegmatite	Dissemination in igneous and metamorphic rocks.	———	Radon(?)	———	Wall rock.	.004-.039	.001-.041
130	Pewabic shaft	23 3S.73W.	1100-ft. shaft,2000 ft. of drifts	———	Vein	———	Pitchblende	Pyrite,sphalerite, galena,chalcopyrite, tennantite.	———	———	———
131	Phoenix shaft	22 3S.73W.	Shaft and prospect pit	Granite gneiss	do.	———	None	Quartz,pyrite.	———	———	———
132	Placer deposits in North Clear Creek	26 3S,72W.	None	Sand banks in creek bed	Placer	5 by 50 ft.	Monazite	Magnetite,garnet, quartz,biotite, feldspar.	Panned concentrate.	.019	.003
133	Placer deposits in Leavenworth and Russell Gulches	13 & 14 3S.73W.	None	———	do.	500by500 ft.	Pitchblende (reported)	———	———	.003(est.)	———
134	Prompt Pay mine	15 3S.73W.	175-ft. shaft and 4 levels	Schist	Vein	———	None	Pyrite,sphalerite, galena.	———	———	———
135	Pyrinees mine	15 3S.73W.	Shaft and 4 levels	Silicified gneiss and schist	do.	———	Pitchblende	Pyrite, chalcopyrite, sphalerite,quartz.	Vein material.	.64	.44
136	Ralls County mine	14 3S.73W.	700-ft. shaft, 7 levels	Granite gneiss	do.	———	None	Pyrite,galena, sphalerite,tetrahedrite.	———	———	———
137	Rough and Ready claim	36 2S.73W.	Adit, prospect pits	———	do.	———	None	———	———	———	———
138	Russell mine	23 3S.73W.	2 shafts, 5 levels, 1000 ft. of drift	———	do.	———	———	———	———	.005 (est.)	———
139	Russell-Pride mine	14 3S.73W.	Inaccessible	———	do.	———	———	Quartz,pyrite.	———	.003(est.)	———
140	Scandia mine	14 3S.73W.	Shaft and adit	———	do.	———	———	Pyrite,quartz.	———	———	———
141	Telegraph(?) mine	14 3S.73W.	Inaccessible	———	do.	———	Uraconite (reported)	———	———	.01 (est.)	———

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Table 4.--Deposits examined in Gilpin County--Continued

Index number	Name of property	Location Sec. T. R.	Development	Host rock	Type of deposit	Size	Mineralogy: Radioactive material	Mineralogy: Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium percent
142	Tom Martin lode	11 3S.73W.	Shaft	Altered gneiss	Vein	-------	None	Pyrite, sphalerite.	-------	-------	-------
143	Topeka mine	14 3S.73W.	2 inclined shafts and 15 levels	Granite gneiss	do.	-------	None	Pyrite, sphalerite, galena, chalcopyrite, native bismuth.	-------	-------	-------
144	Trail mine	14 3S.73W.	Shaft	-------	do.	-------	None	Pyrite, quartz.	-------	-------	-------
145	Waterloo mine	23 3S.73W.	-------	-------	do.	-------	None	-------	-------	-------	-------
146	West Russell mine	22 3S.73W.	-------	Granite gneiss	do.	-------	None	Pyrite	Vein material.	0.006, 0.012	-------
147	Wyandotte mine	14 3S.73W.	Shaft and pits	Granite gneiss	do.	-------	-------	Pyrite	-------	.005 (est.)	-------
148	Bostonite dike	1 3S.73W.	Road cut	Granite gneiss	Dissemination in igneous rock	5000 by 30 ft.	-------	Fluorite, feldspar, sulfides, iron oxide.	Dike material.	.005	-------

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Table 5. — Deposits examined in other counties in Colorado.

Index number	Name of property	County	Location Sec. T. R.	Development	Host rock	Type of deposit	Size	Mineralogy: Radioactive material	Mineralogy: Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium (percent)
149	Mica-Beryl, Falfar, and Gray Hen claims	Chaffee	27 51N.9E.	———	Granite	Pegmatite	———	Monazite, samarskite	Feldspar, mica, beryl.	Selected material	———	1.10
150	Crystal No. 8 mine.	do.	17 14S.77W.	80by30-ft. cut and tunnel	Augen gneiss	Pegmatite	300by40 by30 ft.	Allanite, euxenite.	Biotite, quartz, microcline, garnet.	Allanite and euxenite. Biotite	0.062 .004	.006 .002
151	Lucky Break Placer claim.	do.	2 50N.9E.	50by50-ft. open cut, 75-ft. adit.	Limestone	Breccia zone.	———	———	Hematite, quartz, talc-like material.	Iron ore, Hematite.breccia.	——— .002-.065	.009 .001-.011
152	Homestake mine.	do.	34 51N.9E.	80by80-ft. bench cut.	Biotite-augen gneiss, quartzite.	Pegmatite	240by80by 50 ft.	———	Albite, quartz, microcline, muscovite.	Chlorite schist.	———	.004
153	Last Chance Spar-Mica Dyke prospect.	do.	33 51N.9E.	2 trenches, pit.	Granite	do.	200by40 ft. and 105by35 ft.	Torbernite.	Quartz, potash feldspar, plagioclase, muscovite, beryl, garnet.	Pegmatite with torbernite.	.034	.011
154	Mica-Beryl Pegmatite mine.	do.	21 51N.9E.	100by40-ft. cut.	Granite	do.	450by50by30 ft.	None.	Quartz, microcline, muscovite, plagioclase, beryl.	———	———	———
155	Northern View mine.	do.	11 14S.77W.	40-ft. cut	Granite porphyry	do.	200by50by 40 ft.	Monazite.	Quartz, biotite, garnet, tourmaline, muscovite, microcline.	Garnet, biotite, smoky quartz. Muscovite, tourmaline.	.010 .006	.006 .001
156	Riegel prospect.	do.	3 50N.9E	2 cuts, room 10by 15 ft.	Gneiss	do.	———	None	Quartz, potash feldspar, muscovite, biotite.	———	———	———
157	Rock King prospect	do.	34 51N.9E	25by10-ft. bench.	Augen gneiss, quartzite.	do.	1000by50by 80 ft.	Brown mineral (tantalite-columbite?)	Albite, quartz, beryl, tantalite-columbite.	Tantalite-columbite(?). Limonite rock.	.098 .003	.027 .002
158	Seven Mile Creek pegmatite dike.	do.	25 13S.78W.	———	Granite porphyry	do.	30by10 ft.	None	Hornblende quartz, feldspar.	———	———	———
159	White Swan prospect and Doyle's prospect.	do.	33 51N.9E.	2 shallow shafts	Quartz-mica schist, granite.	do.	———	———	Quartz, beryl, magnetite, potash feldspar.	Granite, magnetite.	.002	.002
160	Haputa Ranch	Custer	12 22S.71W.	4 shallow shafts; several pits.	Granite and schist	Vein	Up to 2 miles by 5 ft.	Thorite(?)	Quartz, barite, galena, chalcopyrite, bornite, marmatite.	Thorium-bearing vein material.	.026-1.42 .007-2.94	14.9(ThO_2) (Maximum)
161	Little Eddy prospect	Douglas	7 10S.69W.	30-ft. trench	Biotite granite porphyry	Pegmatite	200by50 ft.	———	Quartz, feldspar, biotite.	Granite.	.005	.001
162	Magnusson and Sons, Inc., feldspar mine.	do.	10 9S.69W.	25by30-ft. open pit.	do.	do.	100by45 ft.	———	do.	Pegmatite.	.003-.006	.001
163	Skeleton No. 2 mine	do.	36 9S.69W.	100by40-ft. open cut	Granite	do.	400by75by 50 ft.	———	Quartz, potash feldspar, biotite.	Altered granite. Granite.	.007 .004	.003 .001
164	Watson Park feldspar mine	do.	36 9S.69W.	30by30-ft. open cut	Granite porphyry	do.	300by60by 30 ft.	———	Quartz, feldspar, biotite.	Biotite. Pegmatite.	.006 .003-.005	.001 .001 .003
165	Lady Bell mine	Eagle	30 5S.83W.	2 tunnelz	Entrada formation	Disseminated	———	Carnotite(?)	Azurite, malachite.	———	.01(est.)	———
166	Kleckner tunnel	do.	30 5S.83W.	450-ft. tunnel	do.	do.	———	———	———	———	.005(est.)	———
167	Dakota tunnel	do.	30 5S.83W.	260-ft. tunnel	do.	do.	1-2 ft. thick.	None	Azurite, malachite.	———	———	———
168	Mock tunnel	do.	30 5S.83W.	1200-ft. tunnel.	Lower Pennsylvanian formation.	do.	———	None	———	———	———	———
169	Guenon incline	do.	30 5S.83W.	50-ft. incline, drift.	do.	do.	———	None	Azurite, malachite.	———	———	———
170	Colorado shaft	El Paso	17 15S.67W.	Shaft	Pikes Peak granite	Fluorspar-quartz vein	———	None	Fluorite, quartz.	———	———	———
171	Duffields property	do.	17 15S.67W.	Open cut, 2 vertical shafts.	do.	Fluorspar fissure vein	———	Kasolite	Fluorite, quartz limonite, galena, sphalerite.	Vein material	———	.001-1
172	Golden Cycle tailings dump	do.	14 14S.67W.	———	———	Mill tailings dump	Dump 16,000,000 tons	———	———	Mill tailings	.007-.010	.002-.003
173	Mike Doyle carnotite deposit	do.	2 16S.67W.	3 prospect pits	Morrison sandstone	Coatings on fractures and carbonized wood	100by10 ft.	Carnotite, uranophane	———	Sandstone and carnotite. Carbonaceous shale.	.058-.076 .055	.066-.068 .052
174	Syenite porphyry dike	do.	10 16S.67W.	———	Granite gneiss	Dissemination in syenite	900by70by 200 ft.	———	Potash feldspar, magnetite.	Syenite.	.006	.001

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Table 5. -- Deposits examined in other counties in Colorado--Continued.

Index number	Name of property	County	Location Sec. T. R.	Development	Host rock	Type of deposit	Size	Mineralogy: Radioactive material	Mineralogy: Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium (percent)
175	Johnny feldspar mine	El Paso	10 16S.67W.	60by40-ft. open cut	Granite, biotite schist	Pegmatite	350by90by 60 ft.	-------	Quartz, microcline, muscovite, biotite.	Biotite schist	0.006	0.006
176	Pink Lady lode	Fremont	5 20S.72W.	2-ft. prospect pit	Rhyolite	Fault zone	2 ft. wide	-------	-------	-------	.005(est.)	-------
177	Brown Lava lode	do.	5 20S.72W.	10-and 25-ft. shafts	do.	Fracture zones	3 in. to 2 ft. wide	-------	-------	Altered rhyolite	.019-.045	.007-.027
178	Surprise Lode	do.	5 20S.72W.	Prospect pit.	Gneissic granite	Brecciated dike	44 in. wide	-------	Barite, calcite, siderite.	-------	.002-.004 (est.)	-------
179	Griffin Ranch and Federal Land prospects	do.	23 20S.71W.	6 prospect pits	Injection gneiss and lamprophyre dikes.	Barite veins	28 in. to 3 ft. wide	-------	Barite, galena, quartz siderite, specularite.	Vein material	.013-.089	.001-.058
180	Prospect near Badger Creek.	do.	25 51N.75W.	None	Felsite dike and granite	Disseminated	-------	None	Limonite, manganese mineral.	-------	-------	-------
181	Permo-Pennsylvanian coal bed prospect	do.	21 49N.10E.	70-ft. inclined adit	Coal bed	Dissemination in coal	16-20 ft. thick	-------	-------	Coal.	.003-.004	.002
182	Jesus Lode	do.	28 18S.72W.	2 bulldozer cuts	Dakota sandstone	Disseminated on joint planes	-------	Torbernite	-------	Sandstone.	.004-0.037	.002-.034
183	Willis Tuttle	do.	26 20S.71W.	4 shallow pits	Pre-Cambrian complex	Mineralized granite dike	300by5 ft.	Thorite(?)	Quartz	Mineralized granite dike.	.007-.31	.002
184	Eight Mile Park pegmatite prospect No. 1.	do.	22 18S.71W.	2 large cuts	Quartz-mica schist	Pegmatite	300by60by 30 ft.	Torbernite	Quartz, potash feldspar, biotite, beryl.	Biotite.	.13	.10
185	Eight Mile Park pegmatite prospect No. 2	do.	23 18S.71W	30-by-25-ft. cut	Granite gneiss	do.	350by40by 20 ft.	Tantalite(?)	Quartz, microcline, tourmaline, muscovite.	Muscovite.	.012	.004
186	Eight Mile Park pegmatite prospect No. 3.	do.	15 18S.71W.	2 deep trenches, several pits	Granite gneiss	do.	400by30by 50 ft.	-------	Quartz, microcline, biotite, muscovite.	-------	.004(est.)	-------
187	Lower South mine	do.	1 16S.73W.	50by40-ft. cut, 2 adits	Biotite granite gneiss	do.	200by100 ft.	Autunite(?)	Quartz, microcline, muscovite, biotite, garnet, beryl.	-------	.003(est.)	-------
188	Mica lode mine	do.	14 18S.71W.	150by60-ft. cut, adit, several trenches	Granite gneiss, quartz-mica schist	do.	-------	-------	Quartz, muscovite, potash feldspar, beryl.	-------	.033(est.)	-------
189	Meyer's mine	do.	14 18S.71W.	2 open cuts, trenches	Granite	do.	200 by 500 by 1500 ft.	-------	Quartz, muscovite, potash feldspar, beryl.	-------	.003(est.)	-------
190	Climax mica mine	do.	6 16S.72W.	3 adits, several open pits	Quartz-sillimanite schist, granite gneiss	do.	-------	None	Quartz, albite, muscovite.	-------	-------	-------
191	Devil's Hole beryl mine	do.	20 18S.73W.	3 large cuts, 2 adits	Schist, gneiss	do.	-------	None	Microcline, quartz, albite, muscovite, beryl.	-------	-------	-------
192	Rowe's North mine	do.	1 16S.73W.	Tunnel	Biotite granite gneiss	do.	-------	-------	Quartz, microcline, muscovite, biotite	-------	.004	-------
193	Rose Dawn mica mine	do.	32 15S.72W.	2 open cuts, 2 tunnels	Sillimanite schist and gneiss	do.	-------	-------	Quartz, microcline, albite, muscovite.	Sillimanitic schist and gneiss.	.003	.001
194	Star Girl mine	do.	32 15S.72W.	Open cut	Granite gneiss	do.	200by20by 30 ft.	-------	Quartz, microcline, plagioclase, garnet, muscovite.	-------	.002(est.)	-------
195	School Section mine	do.	16 18S.71W.	7 open cuts	do.	do.	-------	None	Quartz, microcline, muscovite, biotite, beryl.	-------	-------	-------
196	Upper South mine	do.	1 16S.73W.	60by20-ft. open cut, adit.	Biotite granite gneiss	do.	150by30by 30 ft.	-------	Potash feldspar, muscovite, biotite, magnetite, hematite.	Biotite and magnetite.	.033	.007
197	Lucky Strike claims	Grand	31 32 2N.79W.	Prospect pits	Sandstone and shale-North Park formation	Disseminated in sandstone and clay	-------	-------	Iron and manganese stained clays.	Sand and clay. Water.	.041-.13	.008 .01 ppm
198	Forest Queen	Gunnison	15(?) 13S.87W.	2 shafts, 1 adit, mill	Volcanics	Fissure vein	-------	None	Quartz, rhodonite, galena, barite.	-------	-------	-------
199	Gunnison mine	do.	4 47N.2W.	Vertical shaft, adit	Schist, gneiss	do.	-------	None	Quartz, limonite pyrite, native gold, chalcopyrite.	-------	-------	-------
200	Anaconda mine	do.	9 47N.2W.	-------	Meta sedimentary rocks	Vein	-------	None	Pyrite, chalcopyrite, copper carbonate.	-------	-------	-------

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Table 5.--Deposits examined in other counties in Colorado--Continued.

Index number	Name of property	County	Location Sec.	T.R.	Development	Host rock	Type of deposit	Size	Mineralogy: Radioactive material	Mineralogy: Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium percent
201	Jeanie No. 6 claim	Gunnison	16	47N.2W	7 prospect pits	Quartzite, basic dike	Vein	------	------	Quartz, limonite	Vein material.	0.001-.018	0.001
202	Little Johnnie Nos. 1 and 2 claims	do.	15	47N.2W.	28-ft. adit, 8 small pits	Schist	do.	3000 ft. long	------	Quartz, limonite.	Vein material	.88	.001 4.4(ThO_2) .5 Rare earth oxides)
203	Mickey Group	do.	18	46N.1W.	Bulldoze. trench, 2 open cuts	Alkalic igneous rock	Igneous rock	------	None	Vermiculite, garnet	------	------	------
204	Loading dump for Augusta(?) mine	do.	1	13S.87W.	Dump	Diorite porphyry	Fissure vein	------	None	Galena, sphalerite, pyrite.	------	------	------
205	Black Mica Company properties (2 properties).	do.	7,12	46N.1,2S.	Open pits and trenches	Pyroxenite	Vein	------	------	------	------	.005-.007(est)	------
206	Unnamed prospect near Lot mine	do	21	47N.2W.	400-ft. adit	Metamorphic rock and mafic dikes	Carbonate -- barite vein	------	None	Barite, calcite	------	------	------
207	Ute Trail mine	do	12	47N.2W.	Caved shaft, dump, 20ft. shaft	Pyroxenite, metasedimentary rocks	Veinlets	------	None	------	------	------	------
208	McIntire claims	Huerfano	19	27S.70W.	Small pits	Sandstone and shale	Disseminated	------	Carnotite, volborthite(?)	Azurite, malachite.	Sandstone.	.008	.007 .50(V_2O_5)
209	Brereton mine	Jefferson	17	2S.71W	45-ft. adit; caved adit	Biotite granite	Breccia reef	------	Torbernite(?)	Fluorite, feldspar. quartz.	Breccia	------	.005
210	Cook property	do.	10	7S.70W.	Shaft, 3 adit, 3 pits	Idaho Springs formation	Veins	------	None	Pyrite, chalcopyrite, galena, covellite, sphalerite, quartz, potash feldspar, malachite, azurite, brochantite, biotite.	------	------	------
211	Fluorite mine	do.	15	5S.71W.	Shaft	Granite gneiss, schist.	Vein	------	------	Fluorite, galena, sphalerite, quartz, pyrite, sericite.	Dump material.	.005	------
212	Radioactivity of rocks in the Morrison-Golden area	do.		2-5S.70W.	Outcrops, prospect pits	Igneous and sedimentary rocks	Disseminated in igneous and sedimentary rocks	------	------	------	Basalt, clay, shale, and sandstone.	.003-.004 .003-.039	.001-.002 .001-.035
213	Noack pegmatite prospect	do.	7,8	4S.71W.	3 open cuts, 1 pit	Hornblende schist	Pegmatite	------	None	Quartz, feldspar, mica.	------	------	------
214	Old Leyden Coal mine	do.	28	2S.70W.	Adit	Laramie formation	Brecciated and silicified zone in a coal seam	------	Carnotite	Pyrite, quartz.	Silicified coal.	------	.14-3.89
215	Union Pacific prospect	do.	19	3S.70W.	Shaft	Idaho Springs formation	Vein	------	Pitchblende	Azurite, malachite quartz, carbonates.	Vein material.	------	.003-5.84
216	Nigger shaft	do.	23	2S.71W.	Shaft, adit	Gneiss and schist	Shear zone	------	Pitchblende	Quartz, limonite, pyrite, chalcopyrite, bornite.	------	------	------
217	Biggar Mica mine	do.	3	6S.70W.	150 by 25 ft. open cut	Hornblende-diorite gneiss	Pegmatite	300by40by 30 ft.	Torbernite(?)	Quartz, microcline, albite, beryl, muscovite, biotite, tourmaline.	Pegmatite with Torbernite(?)	5.0	5.10
218	Centennial Cone prospect	do.	32	3S.71W.	Pits	Biotite granite gneiss	do.	400by10ft.	------	Quartz, potash, feldspar, biotite, muscovite, beryl.	Mica.	.002	------
219	Cresman Gulch mine	do.	17,18	3S.70W.	2 open cuts,	Gneiss, schist	do.	------	None	Quartz, microcline, feldspar, tourmaline, biotite, beryl.	------	------	------
220	Four pegmatites in Swede Gulch	do.	26,27	4S.71W.	4 open cuts, pit	Biotite granite gneiss	do.	------	------	Quartz, microcline, biotite, muscovite, hematite.	Granite.	.012	.006
221	Ramstetter Ranch pegmatites	do.	15	3S.71W.	100by40-ft. cut, trench shaft	Schist and gneiss	do.	------	None	Quartz, potash, feldspar, muscovite, tourmaline.	------	------	------
222	Robinson Gulch prospect	do.	16	3S.71W.	Road cut	Muscovite schist with quartz veins	do.	------	None	Quartz, muscovite, potash feldspar, tourmaline.	------	------	------
223	Roscoe beryl prospect	do.	5	4S.71W.	Prospect pit	Biotite granite gneiss	do.	800by120by 150 ft.	------	Quartz, microcline, beryl, biotite, garnet, magnetite, potash feldspar, muscovite.	Granite, pegmatite, magnetite. Granite and magnetite.	.008 .017	.003 .012
224	Syenite dike	do.	16	3S.71W.	None	Muscovite schist	Disseminated in igneous rock	2000 by 20 ft.	------	Potash feldspar	Syenite dike.	.002	.001
225	Wasson beryl prospect	do.	10	4S.71W.	Adits, pits	Biotite, granite gneiss	Pegmatite	1000by30 by 40 ft.	------	Quartz, microcline, biotite.	Biotite.	.023	.003

Table 5. -- Deposits examined in other counties in Colorado --Continued.

Index number	Name of property	County	Location Sec. T. R.	Development	Host rock	Type of deposit	Size	Mineralogy: Radioactive material	Mineralogy: Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium percent
226	Leadville tunnel	Lake	9S.80W.	Drainage tunnel	Igneous and sedimentary rocks	Igneous and sedimentary rocks	--------	--------	--------	--------	--------	--------
227	Copper King mine	Larimer	8 10N. 72W.	65-ft. shaft, level	Biotite schist with anthophyllite, granite.	Vein	--------	Pitchblende(?)	Feldspar, quartz, biotite, sphalerite, chalcopyrite.	Vein material. Dump material.	0.004-0.45 1.39	0.002-0.50 1.23
228	Spaulding-Woodhams scheelite prospects	do.	23 9N.71W.	30-ft. shaft, adits	Schist, quartzite, gneiss	Disseminated in metamorphic rock.	--------	--------	Scheelite	Vein material	.002	--------
229	Treasure Hill area	do.	10,15 9N.70W.	3 adits, 3 shafts, pits, and trenches	Granite	Replacement	--------	--------	Pyrrhotite, marcasite(?)	Altered wall rocks.	.001	.000-.003
230	Big Beryl mine	do.	28 6N.71W.	Bench and trenches	Mica schist	Pegmatite	275by50 by50 ft.	Torbernite, tantalite, autunite.	Quartz, albite, beryl, muscovite, microcline.	Pegmatite with torbernite. Tantalite.	.24 .004	.26 .003
231	Big Boulder beryl prospect	do.	36 7N.72W.	2 trenches, 4 pits, shaft	Quartz-mica schist	do.	260by100 by 30 ft.	Tantalite, torbernite, gummite.	Quartz, microcline, albite, muscovite, beryl.	Tantalite. Torbernite-gummite.	.007 2.70	.003 2.96
232	Beryl No. 5 prospect	do.	25 7N.72W.	17by9-ft. pit.	Quartz-biotite schist	do.	--------	None	Quartz, muscovite, potash feldspar, perthite.	--------	--------	--------
233	Buckhorn mica mine	do.	29 7N.71W.	3 shafts, several pits, cut	Quartz-biotite schist	do.	--------	--------	Quartz, spodumene, albite, muscovite, cleavelandite.	Schist.	.004	.001
234	Crystal Silica mine	do.	26 7N.72W.	40-ft. shaft, 2 adits, 23 open cuts	Biotite schist	do.	--------	--------	Quartz, beryl, plagioclase, muscovite, microcline.	Schist wall rock.	.003	.001
235	Crystal Snow(?) claim	do.	31 7N.71W.	None	Mica schist	do.	--------	None	Quartz, muscovite, tourmaline potash, feldspar.	--------	--------	--------
236	Double Opening mine	do.	30,31 7N.71W.	2 open cuts	Quartz-biotite schist	do.	250by30 ft.	Uraninite, Autunite, Torbernite, gummite reported	Quartz, beryl, microcline, albite, muscovite.	Pegmatite.	--------	.004
237	Humphrey beryl prospect	do.	25 7N.72W.	Small pit	do.	do.	210by 10 ft.	None	Quartz, muscovite, beryl, potash feldspar.	--------	--------	--------
238	Mica-Beryl prospect	do.	30 7N.71W.	Shallow shaft	Quartz-biotite schist, granite gneiss	do.	--------	None	Quartz, muscovite, beryl, plagioclase.	--------	--------	--------
239	Neville(?) Ranch pegmatite prospect	do.	32 7N.71W.	None	Mica schist	do.	--------	None	Quartz, muscovite, tourmaline, potash feldspar.	--------	--------	--------
240	White Rock prospect	do.	29 7N.71W.	10-ft cut	do.	do.	--------	None	Quartz, potash feldspar.	--------	--------	--------
241	Wisdom Ranch mine	do.	5 7N.71W.	Adit, cut, trenches, and pits	Biotite-sillimanite schist and gneisses, diabase dikes	do.	5000 ft. long	--------	Quartz, albite, muscovite, beryl, microcline, chrysoberyl.	Schist inclusion.	--------	.003
242	Skull Creek carnotite deposit	Moffat	35 4N.101W.	Prospect pits	Navajo sandstone	Disseminated in sandstone	--------	Carnotite	Malachite, azurite, brochantite, volborthite(?).	Sandstone.	--------	.038-.16
243	Garo uranium deposits (Duvall Discoveries)	Park	16 11S.76W.	Shafts, pits, trenches	Micaceous sandstone and shale	do.	--------	Carnotite	Malachite, azurite, volborthite, calcio-volborthite.	Mineralized sandstone. Chert bed.	.009-1.81 .005-.011	.017-2.45 .004-.010
244	Copper King prospect	do.	21 15S.73W.	Cut, 2 caved adits	Biotite and amphibolite schist	Pegmatite	350by300 by 30 ft.	--------	Quartz, muscovite, potash feldspar, biotite.	Muscovite.	.29	.11
245	Lone Pole copper mine	do.	21 15S.73W.	3 shafts	Igneous, metamorphic, and sedimentary rocks	Vein	--------	--------	Chalcopyrite, galena, silver, gold, sphalerite.	Rhyolite.	.003	--------
246	Meyers' Ranch mine	do.	31 14S.73W.	5 cuts, 2 drifts	Granite gneiss	Pegmatite	300by70 by 50 ft.	--------	Quartz, albite, columbite, muscovite, beryl, garnet, microcline.	Muscovite	.033	.012
247	Fair-U claims	Routt	12 6N.84W	2 prospect pits	Schist and granite	do.	100 ft. long	Autunite	Biotite, feldspar.	Pegmatite	--------	.002-.054
248	E.C. Ellis property	do.	1 10N.83W.	4 prospect pits	Gneiss and schist	do.	--------	Uraninite, allanite, euxenite, gummite.	Hematite, magnetite.	--------	--------	--------
249	New Greenville mine	do.	35 9N.85W.	500 ft. adit.	Gneiss, pegmatite	Vein	--------	--------	Chalcopyrite, sphalerite, pyrite.	Fractured wall rock.	.002(est.)	--------

Table 5.— Deposits examined in other counties in Colorado—Continued.

Index number	Name of property	County	Location Sec.	T. R.	Development	Host rock	Type of deposit	Size	Mineralogy: Radioactive material	Mineralogy: Associated minerals	Material sampled	Equivalent Uranium (percent)	Uranium percent
250	Elkhorn mine	Routt	20	12N85W.	------	Gneiss, greenstone, and diabase.	Vein	------	None	Galena, sphalerite, pyrite, chalcopyrite, bismuthinite(?).	------	------	------
251	Tom Thumb mine	do.	9	10N.85W.	Two 200-ft. tunnels	Rhyolite porphyry	Breccia zone	------	None	Galena	------	------	------
252	Royal Flush mine	do.	8	10N.85W.	1000-ft. adit.	Silicified sandstone, rhyolite porphyry	Vein	------	None	Pyrite, chalcopyrite	------	------	------
253	Weatherly prospect (Evans claims)	San Miguel	27?	44N.11W.	40-ft. adit, pits	Limestone and shale	Vein	------	Pitchblende(?), autunite, erythrite.	Chalcocite, pyrite, tetrahedrite, galena, sphalerite, malachite, azurite, barite, calcite, dolomite.	Vein material	------	0.71
254	King Solomon mine	Summit	4	6S.78W.	5700-ft. adit, 9 crosscuts	Gneiss and schist	Veins	------	------	Quartz, pyrite, lead, copper, and zinc sulfides.	Pegmatite. do.	0.001-0.005 ------	------
255	Fluorine mine	Teller	1	15S.70W.	Large open cut and several shafts	Contact between phonolite and breccia	Replacement	------	------	------	Altered phonolite. Manganese bearing rock	.007 .009	.003 .005
256	Gem mine (formerly Crystal Peaks)	do.	12	12S.71W.	60x60-ft. open cut	Granite gneiss	Pegmatite	------	------	Quartz, potash feldspar, biotite, amazonstone.	Pegmatite	.004	------

Tertiary monzonite porphyry intrusive stock. Near Placerville in San Miguel County a metalliferous vein containing uranium cuts sedimentary rocks of Mesozoic age.

Deposits of uranium are found in sedimentary rocks ranging in age from Pennsylvanian to Tertiary in Huerfano, Park, El Paso, Moffat, Jefferson, Grand, Eagle, and Fremont Counties.

Uranium-bearing pegmatites are widespread in the Precambrian rocks of central Colorado from Larimer to Custer counties. The majority of the pegmatite dikes that were examined for radioactivity have been previously studied in detail by Hanley, Heinrich, and Page (1950).

Radioactive springs occur both within the igneous rocks of the Front Range and in the sedimentary rocks within and bordering the Front Range. The distribution of springs containing appreciable radioactivity is shown in table 6.

Appreciable quantities of uranium are dissolved in the mine waters of abandoned mines in the Central City district and in the Copper King mine at Prairie divide, Larimer County. The uranium content of these mine waters is generally less than one part per million but is known to be as much as 8 parts per million as in the Kirk mine in Gilpin County.

Placer deposits containing uranium in the form of pitchblende have not been found in Colorado, but some placers do contain small quantities of uranium and thorium possibly as monazite or as the complex rare earth minerals common to pegmatites.

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Table 6.--Radioactive springs in Colorado 1/

Index number	Name	County	Location Sec.	T.	R.	Type of deposit	Host rock	Radioactivity 2/	Temperature of spring in degrees (Centigrade)	Remarks
501	Pagosa Springs (160, 164) 3/	Archuleta	20,21 22,23	35 N	2 W	Hot and cold springs	Upper Cretaceous Shale	2.3 W and 12.36 G	12 to 65	Two radioactive springs
502	Crystal Springs (16)	Boulder	25(?)	1 N	71 W	Spring	Pierre shale (Cretaceous)	12.61 W	-	
503	Gregory Canyon Spring (14)	do.	1	1 S	71 W	do.	Contact between carboniferous sedimentary rocks and pre-Cambrian igneous rocks	4.33 W	10	
504	Sunshine Canyon Spring (15)	do.	25	1 N	71 W	do.	Spring issues from alluvium	6.08 W	15	
505	Iron Soda Springs (35)	do.	21	1 N	71 W	do.	Pre-Cambrian granite	10.73 W	14.5	(Crisman).
506	Pool Spring (52)	do.	25	1 S	71 W	do.	Carboniferous sandstones and shales	8.35 W and 101.6 G	26	(Eldorado Springs)
507	Sulphur Spring (84)	do.	23(?)	3 N	70 W	do.	Cretaceous sandstone	4.92 W	17	
10	Tile and Curie Springs (207-210)	do.	29	2 N	71 W	do.	Silver Plume granite	Trace to 0.283 P. A.	15	Four radioactive springs
508	Cottonwood Springs (18)	Chaffee	22(?)	14 S	79 W	Hot springs	Near contact of granite and monzonite intrusion	10.35 W	42.5	(Buena Vista)
509	Mt. Princeton Springs (142)	do.	19	15 S	78 W	do.	do.	9.1 W and 13.35 W, 202.2 G, and 656.0 G	9.5 to 83.8	(Hortense Hot Springs)
510	Poncha Springs (175-177)	do.	10	49 N	8 E	do.	Granite	18.62 W, 13.58 W, and 263.9 W, 760.0 G, 0.063 to 0.186 P. A.	West Mound Spring is 71.5 and Gulch Spring No. 1 is 64.5	Three radioactive springs
511	Idaho Springs (86-95)	Clear Creek	1	4 S	73 W	Springs	Area of Idaho Springs fm. intruded by alkali syenite dikes	2.2 W to 15.51 W, and from 101.1 G to 180.15 G	13.0 to 43	Eleven springs
512	Doughty Springs (73-76)	Delta	10(?)	15 S	93 W	do.	Dakota sandstone (Cretaceous)	18.4 W and 229.0 G	16	Four springs
513	Iron Spring (191)	Dolores	25	40 N	11 W	do.	Permian rocks	2.54 W	27.5	
514	Big Dotsero Spring (45)	Eagle	6(?)	5 S	86 W	do.	Carboniferous limestone	15.04 W and 129.5 G	28.3	
515	Manitou Springs (117-133)	El Paso	6(?)	14 S	67 W	do.	Paleozoic sedimentary rocks and granite	From 2.35 W to 16.84 W and 11.49 G to 155.2 G. Little Chief Spring: 0.08 P. A.	9.5 to 22.3	
516	Canyon City Hot Spring (21)	Fremont	32(?)	18 S	70 W	do.	Granite	3.58 W	34.6	
517	Iron Duke Spring (23)	do.	32(?)	18 S	70 W	do.	Dakota sandstone	2.05 W	15.6	
518	Dean Artesian Well (36)	do.	13(?)	19 S	69 W	do.	do.	23.2 G	29.4	
519	Wellsville (252)	do.	19(?)	49 N	10 E	do.	Carboniferous formations	4.4 W	35.5	
520	Glenwood Springs (54-63)	Garfield	9(?)	6 S	89 W	Hot springs	Cretaceous and carboniferous sedimentary rocks	13.74 G to 27.30 G. Vapor Cave No. 3: 0.197 P. A.	50 to 51.5	Three radioactive springs
521	Sulphur Spring (26)	do.	1(?)	7 S	89 W	Spring	Permian rocks	5.85 W	8.5	
522	Hot Sulphur Springs (78-83)	Grand	3(?)	1 N	78 W	do.	Cretaceous sandstone	3.27 W. to 5.99 W, combined springs has 60.32 G	35 to 45	Four radioactive springs
523	Cebolla Hot Springs (179-186)	Gunnison	4(?)	46 N	2 W	do.	Pre-Cambrian granites, gneisses, and schists	8.31 W to 79.25 W, and 112.5 G to 375.6 G	9.9 to 405	Five radioactive springs
524	Waunita Hot Springs (238-251)	do.	2(?)	49 N	4 E	Hot spring	Paleozoic sandstone	10.69 W to 28.57 W, 36.2 G to 1280.0 G; 0.084 P. A.	5.5 to 71 (average is about 57)	Thirteen radioactive springs
525	Jarvis Spring No. 1 (31)	do.	2(?)	13 S	85 W	Spring	Carboniferous sedimentary rocks	2.38 W	6.7	
526	Springer Ranch Spring (107-109)	Huerfano	10	30 S	69 W	do.	Cretaceous sedimentary rocks	11.07 W to 50.20 W, White Sulphur Springs: 164.0 G	9.3 to 10.0	

1/ George, R. D., 1920, Mineral waters of Colorado: Colorado Geological Survey Bull. 11.

2/ Radioactivity of springs is given in Curies of Ra emanation per liter x 10^{-10}. The letter "W" following the unit indicates the radioactivity is associated with water. The letter "G" indicates the radioactivity is associated with gas. Permanent activity ("P.A." in the table) is given in grams Ra per liter x 10^{-10}. Springs that have less radioactivity than 2.00 W or 10.00 G are not included in the table.

3/ The numbers in parentheses after the name of the spring are the reference numbers given in George, R. D., 1920.

Table 6.--Radioactive springs in Colorado--Continued

Index number	Name	County	Location Sec.	T.	R.	Type of deposit	Host rock	Radioactivity	Temperature of spring in degrees (Centigrade)	Remarks
527	Hunter's Spring (148)	Jackson	35(?)	11 N	80 W	Spring	Near contact between Cretaceous and Tertiary sedimentary rocks	2.47 W	13.5	
528	Brand's Spring (150)	do.	15(?)	9 N	81 W	do.	Granite	273.0 W and 334.4 G	10 and 11.5	
529	Golden Lithia water (1)	Jefferson	32(?)	2 S	69 W	do.	Arapahoe fm. (Tertiary)	2.15 W	11	
530	Soda Lake Spring (147)	do.	1	5 S	70 W	do.	Benton shale	69.4 W, tract P. A.	12	
531	Yousse Radium Spring (253-4)	do.	26(?)	3 S	69 W	do.	Denver fm.	5.84 W and 13.63 W, Reservoir Spring: 2.015 P. A.	-	(Palmer Spring, Reservoir Spring)
532	Pinkerton Springs (49)	La Plata	31(?)	37 N	8 W	do.	Pennsylvanian sedimentary rocks	10.10 W		(Cedar Spring)
533	Trimble Hot Springs (229)	do.	10	36 N	9 W	Hot springs	Permian and Pennsylvanian sedimentary rocks	3.75 to 5.14 W, 10.11 to 12.03 G	30.5 to 49.5	Three radioactive springs
534	Ximo Soda spring (111)	Lake	30(?)	9 S	80 W	Spring	Granite	42.38 W	8.5	
535	Iron Spring (113)	do.	30(?)	9 S	80 W	do.	do.	38.07 W 131.6 G	8.5	
536	Lessy's Soda Spring (112)	do.	30(?)	9 S	80 W	do.	do.	28.37 W	9.5	
537	South Spring (115)	Larimer	17(?)	5 N	69 W	do.	Cretaceous sandstone	4.57 W	16.3	(Buckingham Spring)
538	Wagon Wheel Gap (234)	Mineral	36	41 N	1 E	Hot Spring	Granite	Hot Saline Spring is 2.28 W; 15.76 G to 136.6 G	39.5 to 52	Four radioactive springs
539	Soda Springs (28)	Montrose	5	48 N	6 W	Spring	do.	21.02 W	14.5	
540	Ouray Mineral Springs (155-157)	Ouray	31	44 N	7 W	do.	Pennsylvanian sedimentary rocks	6.38 W to 36.9 W	18.5 to 51.5	Four radioactive springs
541	Ridgway Hot Springs (196)	do.	Two miles south of Ouray			do.	Spring issues for alluvium	8.75 W, 36.2 G	53.5	
542	Rhodes Spring (53)	Park	23(?)	10 S	78 W	do.	do.	4.73 W	25	(Warm Spring)
543	Hartsel Hot Springs (71)	do.	8	12 S	75 W	Hot springs	Near contact between granite and Mesozoic sedimentary rocks	15.14 W and 414.0 G; 0.180 P. A.	56.5	
544	Iron Spring (72)	do.	8	12 S	75 W	Spring	Sandstone (probably Dakota)	11.30 W	8.5	
545	Bath House and Hot Iron Spring (5-7)	Pitkin	4	10 S	88 W	Hot springs	Permian and Pennsylvanian sedimentary rocks and diorite	Bath House Spring 6.70 W, Hot Iron Spring 27.84 G	44.5 and 48	
546	Beulah Springs (12-13)	Pueblo	3	23 S	68 W	Springs	Pre-Cambrian granite	26.7 W and 41.44 W	12 and 13.5	Two radioactive springs
547	Carlile Spring (27)	do.	7(?)	20 S	67 W	do.	Cretaceous sandstone	16.8 W and 780 G; P. A. 0.074	8.5	
548	Pueblo Lithia Water well	do.	At Pueblo			do.	Probably Pierre shale	2.05 W	24	
549	Mound Spring (203)	do.	15(?)	21 S	68 W	do.	do.	11.86 W	20.5	
550	Artesian Well (225)	do.	23	20 S	67 W	Artesian well	Niobrara fm.	2.62 W	21	
551	South Fork Spring (206)	Rio Grande	20	39 N	3 E	Spring	Granite	2.64 W	20	
552	Steamboat Springs (211)	Routt	17(?)	6 N	84 W	do.	Near contact, between Pre-Cambrian metamorphic rocks and Mesozoic sedimentary rocks	2.55 W to 14.3 W and from 10.9 G to 63.25 G	15 to 39.5	Six radioactive springs. Largest group of springs in Colorado.
553	Mineral Hot Springs (136-139)	Saguache	12	45 N	9 E	Hot spring	Springs issue from alluvium	One spring has a trace of P. A. 4.93 W, 262.0 G and 391.5 G.	47 and 51	Two radioactive springs
554	Valley View Hot Springs (152)	do.	31	46 N	10 E	do.	do.	10.38 W and 152.35 G	34.7 and 36.1	Two radioactive springs
555	Soda Spring (43)	Summit	20(?)	5 S	77 W	Spring	Dakota sandstone	6.41 W	13.0	
556	Beaver Valley Ranch Spring (34)	Teller	11(?)	15 S	69 W	do.	Granite	23.63 W	8	

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Disseminated deposits of uranium in igneous and metamorphic rocks are rare, one notable example being the Climax Molybdenum deposit in Lake County. Some of the igneous and metamorphic rocks of the Front Range exhibited noticeably higher radioactivity than others. Except for in certain intrusive dike rocks (bostonites) of Tertiary age, the uranium content is very low, generally less than 0.002 percent uranium; and the radioactivity is due to the presence of both thorium and uranium, and possibly to other radioactive elements.

History and production of pitchblende _/

The first discovery of pitchblende in Colorado was made in 1871 by Richard Pearce (1896). The pitchblende was discovered on the dump of the Wood mine in the Central City district, Gilpin County, Colorado. Since that time pitchblende has been found in many other deposits in the Colorado Front Range, but significant production has come only from Gilpin County with small quantities from Boulder and Clear Creek Counties.

Production records show that during 20 years out of the 80 years since the first discovery of pitchblende in Colorado between 50 and 60 tons of uranium oxide have been produced from somewhat over 300 tons of pitchblende ore (table 1).

_/ The term pitchblende as used in this paper refers to the mineral composed of the uranium oxides UO_2 and/or UO_3. As the data on the UO_2-UO_3 ratio are lacking for most of the pitchblende deposits mentioned in this paper, the writer has chosen to use a general term for the uranium mineral seen in the field or reported in older manuscripts regardless of the amorphous or crystalline state of the mineral.

Mineralogy

Both primary and secondary uranium minerals are found in the radioactive mineral deposits in the Colorado Front Range. The primary minerals generally associated with vein deposits consist of pitchblende (variety of uraninite) and rarely urano-thorite. The complex oxides and silicates, euxenite-samarskite, allanite, cyrtolite, and monazite are associated with pegmatite deposits. Uraninite and urano-thorite were identified in the fluorspar ores of the Jamestown district of Boulder County by Phair and Onoda (1950) and Phair and Shimamoto (1952).

Much more widespread are the secondary uranium and uranium-bearing minerals: carnotite, torbernite, and autunite, but volborthite, uranophane, and gilpinite (johannite) have been noted in places.

Reported occurrences of radioactive deposits

Most of the reported occurrences of radioactive deposits in Colorado, exclusive of those within the Colorado Plateau area, have been examined. The following is a list (table 7) of reported occurrences of radioactive deposits that have not been verified by examination in the field because of lack of sufficient information regarding the location or vagueness of the report.

Table 7.—Reported occurrences of radioactive material in Colorado

Locality	Source of information	Type of deposit
Milwaukee Hill Crestone, Saguache Co., Colo.	Min. & Eng. World, Chicago, v. 41, 1914, p. 593	Gold-bearing quartz vein and pitchblende form part of the vein material
Little Corporal mine, Breckenridge, Summit Co., Colo.	Mr. H. Tescher	Unknown
Red Hot mine, Boulder, Colo.	Local miners	Unknown
Villa Grove, Saguache Co., Colo.	Prospector	Pegmatites
Loveland Lode, Boulder Co., Colo.	Mrs. D. S. Mills Los Angeles, Calif.	Unknown (pitchblende reported)
Near Alma, Colo.	Nina Rose Alma, Colo.	Unknown (pitchblende reported)
Sacramento mine, Park Co., Fairplay, Colo.	J. N. Redman	Uranium ore in natural caves in limestone
Near Salida, Chaffee Co., Colo.	William P. Malloy	Pegmatite
Huerfano Co., Colo.	R. W. Thomas	Sandstone
Near Crestone, Saguache Co., Colo.	Roderick Nell	Pegmatites
Area in Larimer and Jackson Counties, Colo.	D. J. Ruterbories	Unknown
South slope of Rhyolite Hill, near Cripple Creek, Colo.	Mining and Scientific Press, v. 89, Sept. 17, 1904, p. 194	Unknown
Mendota mine near Silver Plume, Clear Creek Co., Colo.	A. Holm	Unknown
Rex No. 1 at Wallstreet, Boulder Co., Colo.	Wood, J. R. Mining Science, v. 62, p. 11, 1910	Unknown (pitchblende)

Samples submitted by the public

Many of the deposits in the Front Range and elsewhere were examined for uranium as the direct result of information received from the public. On table 8 are listed the samples submitted by the public. Many more samples and specimens of rocks were received but were not abnormally radioactive and, hence, were not submitted to the Denver laboratory for analysis.

Road logs for radiometric traverses with car-borne equipment are on table 9.

DESCRIPTION OF PROPERTIES AND LOCALITIES EXAMINED FOR URANIUM

Boulder County

Location and general features

Boulder County is at the northeastern end of the Front Range mineral belt, in the north-central part of Colorado. Boulder, the county seat, is in the southeastern part of the county, and is 18 miles northwest of Denver, Colorado. The eastern part of the county contains relatively flat land of the high plains; the western part includes a section of mountainous country of the Front Range of the Rocky Mountains east of the Continental Divide. Altitudes range from slightly over 5,000 feet in the eastern

(Text continued on page 45)

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Table 8.—Samples submitted by the Public

Sample number	Property and/or Location	County	Submitted by	Type of Material	Radioactivity: Equivalent uranium (percent)	Radioactivity: Chemical uranium (percent)
MMC-1	Ozark Mahoning Mill, Jamestown district	Boulder	Ozark Mahoning Company	Slimes from fluorspar mill	0.051	-
MMC-2	do.	do.	do.	Coarse tailings from fluorspar mill	.36	-
OMC-1a	do.	do.	do.	Cylinder underflow	.05	-
OMC-1b	do.	do.	do.	Special cylinder underflow	1.5	-
OMC-1	do.	do.	do.	Emmet mine, uncrushed ore	<.01	-
OMC-2	do.	do.	do.	Blue Jay mine, uncrushed ore	.034	-
OMC-3	do.	do.	do.	Classifier overflow	.017	-
OMC-4	do.	do.	do.	Sulfide concentrate	.094	-
OMC-5	do.	do.	do.	Mill tailings	.034	-
OMC-6	do.	do.	do.	Cylinder classifier concentrates	1.03	-
43062	Black Cloud mine, Gold Hill district	do.	J. F. Little	Vein material and altered wall rocks	.049	0.081
43063	do.	do.	do.	Vein material and altered rock	.011	.006
43064	do.	do.	do.	do.	.004	.002
43065	do.	do.	do.	do.	.005	.003
43066	do.	do.	do.	do.	.012	.002
43067	do.	do.	do.	do.	.010	.001
43068	do.	do.	do.	do.	.012	.003
43069	do.	do.	do.	do.	.010	.004
43070	do.	do.	do.	do.	.015	.005
43071	do.	do.	do.	do.	.024	.002
43072	do.	do.	do.	do.	.006	.002
48202	do.	do.	do.	do.	.130	.170
48810	do.	do.	do.	Material from gold vein with sulfides	.019	-
32032	Lois Lode, Ward district	do.	Mrs. Norma Benson	Silicified granite with pyrite	-	.003
32033	do.	do.	do.	do.	.005	.001
45578	Bluebird Group of mines, Grand Island-Caribou and Eldora districts	do.	C. W. Savery	Vein material	.032	.004
32031	Shirley mine, Grand Island-Caribou and Eldora districts	do.	Sylvia and Andy Geolfos	Silicified granite with disseminated pyrite	.091	.010
41161	do.	do.	do.	do.	-	.005
41162	do.	do.	do.	do.	-	.007
41163	do.	do.	do.	do.	-	.001
41164	do.	do.	do.	do.	-	.001
41165	do.	do.	do.	do.	-	.001

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Table 8.--Samples submitted by the public--continued

Sample number	Property and/or Location	County	Submitted by	Type of Material	Radioactivity: Equivalent uranium (percent)	Radioactivity: Chemical uranium (percent)
41166	Shirley mine, Grand Island-Caribou and Eldora districts	Boulder	Sylvia and Andy Geolfos	Silicified granite with disseminated pyrite	0.091	0.010
41161	do.	do.	do.	do.	-	.005
41162	do.	do.	do.	do.	-	.007
41163	do.	do.	do.	do.	-	.001
41164	do.	do.	do.	do.	-	.001
41165	do.	do.	do.	do.	-	.001
41166	do.	do.	do.	do.	-	.020
41167	do.	do.	do.	do.	-	.004
41168	do.	do.	do.	do.	-	.013
41169	do.	do.	do.	do.	-	.001
41170	do.	do.	do.	do.	-	.034
40146	Terror-Roseberry	do.	W. F. Stover	Vein, quartz and altered granite	-	.001
40147	do.	do.	do.	do.	-	.002
40148	do.	do.	do.	do.	-	.001
48648	Unidentified tungsten mine	do.	H. W. Zook	Radioactive biotite	.043	.004
43811	Nederland district	do.	Wm. Cowdrey	Unmineralized mica schist	.001	-
BW-2778		do.	Barney Wolfe	Quartzitic vein material with sulfides and secondary copper	.006	-
44168	Pegmatite	Chaffe	R. M. Yard	Coarse-grained granite	.072	-
AW-3969		Clear Creek	James R.Manning	Fault gouge	-	.12
48906		do.	George Neisner	Altered granite and schist	.006	-
46694	Martha E claim	do.	Harvey Zook	Mineralized fine-grained schist	-	.10
48492		Custer	Willis Tuttle	Reddish-earthy material	.058	.00
48493		do.	do.	Altered granite	.018	.00
RW-1773	Harpuda Ranch	do.	Lawrence C. Knobbe	Pegmatitic quartz	.48	-
RW-988	do.	do.	do.	Red granite	.011	-
46710		do.	Ernest Sparling	Barite vein material	.23	.002
53411		do.	George Schwiegert	Carbonates and barite	.29	.003
53412		do.	do.	do.	.37	.004
46711		Douglas	Harold Hopper	Yellow-stained sandstone	.001	-
48204		El Paso	H.D.Kellog	Granite gneiss	1.27	.00
RW-783		do.	Homer Moore	Carnotite in sandstone	-	.48
W-2629	Gem Park Mining district	Fremont	Fred H. Leach	Limestone and siderite	.002	-
W-2239	Thor prospect	do.	Albert Walters	Limonitic gouge	.07	-

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Table 8.--Samples submitted by the public--continued

Sample number	Property and/or Location	County	Submitted by	Type of Material	Radioactivity Equivalent uranium (percent)	Radioactivity Chemical uranium (percent)
W-2239	Yellow Penny	Fremont	Albert Walters	Limonitic gouge	0.28	-
W-2239	Darby prospect	do.	do.	do.	.34	-
29194	----	do.	R. M. Yard	Pegmatite	.11	-
47550	Willis Tuttle property	do.	Willis Tuttle	Altered feldspar	.056	0.002
44634	----	do.	Mary McFall	Altered granitic rock	.039	.002
RW-2439	Brown Lady Lode	do.	Boyd W. Coleman	Weathered vein material	-	.048
RW-2439	Pink Lady claim	do.	do.	do.	-	.002
RW-2439	do.	do.	do.	Siderite in sandstone	-	.001
RW-2406	----	do.	H. Coleman	Weathered limestone	-	.001
RW-2406	----	do.	do.	Calcite and hematite	-	.003
RW-1581	Near Parkdale	do.	George P. Moss	Torbernite in sandstone	.1	-
W-1142	do.	do.	do.	Metatorbernite in arkosic sandstone	.15	-
19228	Near Canon City	do.	Ray Bennet	Euxenite and samarskite in pegmatite	.01	-
36593	Bonanza property	Gilpin	Mert W.Harrison	Altered granite or gneiss	.32	.26
36587	Lucky Strike claims	Grand	Dale Tucker	Sandstone	.35	.46
36588	do.	do.	do.	Soil or alluvium	.052	.034
44983	Near Granby	do.	R.C.Hudler and Shigeo Yanaru	Arkosic sandstone	.003	-
58942	---	Gunnison	Donald Knight	Altered granite	.064	.001
RW-2370	Little Johnnie No. 1 & 2	do.	John McGregor	Altered vein material	.697	-
W-1291	do.	do.	do.	do.	.23	-
22274	---	do.	C. W. Martin	Pegmatitic granite	.039	.001
W-2660	---	Jefferson	Fred Swartz	Mineralized breccia	-	.4
RW-1736	Old Leyden Coal mine	do.	Charles Butler	Coal	.4	-
27895	Collbeck property	do.	W. B. Collbeck	Lead-zinc ore	.002	-
27896	do.	do.	do.	Granite	.003	-
27897	do.	do.	do.	Granite	.003	-
53742	Ladwig prospect	do.	L. C. Ladwig		.036	.007
44984	Rutenbories-Bashaw property	do.	F. L. Bashaw and D. J. Rutenbories	Gray shaley-sandstone	.002	-
50000	Twin Lakes mining district	Lake	Helen Wright	Vein material	.001	-
50001	do.	do.	do.	do.	.000	-
36589	Climax Molybdenum Mill	do.	R.E.Cuthbertson	Composite ore	.004	.006
36590	do.	do.	do.		.93	.15
36591	do.	do.	do.	do.	.72	.15
36592	do.	do.	do.	Black mineral	1.19	.84
17552	Copper King mine	Larimer	Harold G.Ismert	Pegmatite vein	1.20	

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Table 8.—Samples submitted by the public—Continued

Sample number	Property and/or Location	County	Submitted by	Type of Material	Radioactivity Equivalent uranium (percent)	Radioactivity Chemical uranium (percent)
52095	Hampshire property	Larimer	Arthur W. Hampshire	Jasperoid and secondary copper minerals	.005	-
30332	Denny property	do.	Samuel S.Denny	Coarse cemented gravel	.011	-
43816	Drake property	do.	E. A. Drake	Quartz-mica pegmatite	.009	.004
17548	Near Creede	Mineral	John J. Fleming	Altered quartz vein	.001	-
17549	do.	do.	do.	do.	.002	-
18329	do.	do.	do.	do.	.003	-
18330	do.	do.	do.	do.	.002	-
52486	Farnsworth uranium gold placer near Craig	Moffat	T. K. Kuhn	Sandstone	.003	.001
52487	do.	do.	do.	do.	.002	.001
52488	do.	do.	do.	do.	.003	.000
51767	Near Skull Creek	do.	D.J.Rutenbories	Carnotite in sandstone	-	1.30
51766	do.	do.	F. L. Bashaw	Carnotite in sandstone	-	.54
53032	Cheri Dea claim near Skull Creek	do.	do.	Silicified wood	.090	.092
W-1679	---	do.	Ben Morris	Carnotite in sandstone	.032	-
27898	Pennsylvania tunnel	Park	O. B. Hart	Weber shale	.005	.005
56097	---	Unknown	E. K. Judd		.008	-
56098	---	do.	do.		.002	-
56099	---	do.	do.		.001	-
-	---	do.	J. W. Meakins	Goethite	.001	-
52318	---	do.	Robert M. Litke	Gneiss	.003	-
W-2286	---	do.	E. Vanderhoss	Igneous rock	.11	-
W-2656	Near Grand Junction	Mesa (?)	Charles H.Smith	Sandstone	-	.9
W-2656	do.	do.	do.	Coaly matter	-	2.4
W-2656	do.	do.	do.	Secondary uranium mineral	-	.76

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Table 9.—Road logging for radioactivity

Miles	Route	Locality	Ratemeter reading	Remarks
0	Colo. 162	Nathrop	11	
4.1	do.	Chalk Creek	11-12	No increase in radioactivity at spring area.
6.8	do.	Mt. Princeton Hotel	12-13	Base of gravel terrace.
10.4	do.	- - -	10-11	Gravel terrace.
15.9	U.S. 24	Buena Vista	10	
21.7	do.	- - -	9	
28.2	do.	Princeton	10	
30.6	do.	Clear Creek	9	
32.7	do.	Granite	9-10	
46.4	do.	- - -	10	Lake beds in valley.
48.4	do.	- - -	10	Slag dumps, American Smelting & Refining Co.
49.4	do.	Leadville	—	
55.4	do.	D. & R.G.W. R.R. overpass	10	
59.0	do.	Homestake Creek	10	
60.6	do.	Tennessee Pass	11	
70.4	do.	- - -	9-10	Schist, granite.
74.0	do.	- - -	8	Cambrian sedimentary rocks.
74.4	do.	Red Cliff	7-8	Leadville porphyry.

Table 9.—Road logging for radioactivity—Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
74.5	U.S. 24	- - -	10	Belden shale.
75.4	do.	Lv. Red Cliff	8	Sawatch quartzite.
75.6	do.	- - -	10	Contact of Pre-cambrian with Cambrian formations.
76.4	do.	Middle of bridge	9	
77.2	do.	- - -	10	Devonian parting quartzite, shale.
77.4	do.	- - -	10	Belden shale, porphyry.
78.9	do.	Rock Creek	10	Belden shale, porphyry.
81.4	do.	Bridge over Eagle River	8	
84.4	do.	Minturn, Colo.	8-9	
86.4	do.	Jct. U.S. 6 and U.S. 24	9	
91.0	do.	do.	9	
92.1	do.	- - -	9	Walchia shales; Maroon formation.
103.3	do.	Jct. U.S. 6 and U.S. 24	8	Chinle formation.
105.9	do.	- - -	8	Cretaceous sedimentary rocks.
110.4	do.	- - -	7-8	Maroon formation, Quaternary alluvium.
124.0	do.	Gypsum, Colo.	8	Maroon formation.
129.4	do.	Colorado River bridge	7	Basalt flow.
138.4	do.	Glenwood Canyon	6-8	Cambrian quartzite.

Table 9.—Road logging for radioactivity—Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
139.4	U.S. 24	- - -	8-9	Granite.
148.4	do.	Glenwood Springs	7	
0	do.	Grand Junction	-	Mancos shale.
17	do.	Cameo	-	Mesa Verde formation.
35	do.	DeBeque	6-7	
0	U.S. 87,287	Denver Federal Center	40-50	
74		Fort Collins	40-60	
79	U.S. 287	- - -	50	Dakota formation.
81	do.	- - -	50-60	Cross Fountain-Lyons formations.
87	do.	Owl Creek Canyon	30-50	Fountain formation.
89	do.	- - -	50-70	Contact of granite with Fountain formation.
89-95	do.	- - -	40-60	
95	do.	Road cut	60-70	Granite.
95-103	do.	- - -	50-70	Granite, Fountain formation.
103	do.	- - -	75	Granite.
104.9	do.	Postoffice at Virginia Dale	60	
105.6	do.	- - -	80	Maximum reading at contact of metamorphic rocks with Sherman granite.
105.6-106	do.	- - -	50-80	

Table 9.—Road logging for radioactivity—Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
107-108	U.S. 287	- - -	70-80	Granite, road cuts.
110.7	do.	Wyoming State line	60-85	
0		Denver Federal Center	45-60	
10	Colo. 93	- - -	50	Precambrian schist and granite.
12	U.S. 6, 40	Genessee Mtn. area	30-50	
20	do.	- - -	50	
20	do.	Floyd Hill	45	
25	do.	Clear Creek	50	
29.8	do.	Idaho Springs	50	
31.3	Colo. 279	Virginia Canyon	50	
33.7	do.	Virginia Canyon at Red Jacket mine	50	
37	do.	Gilpin County line	50	
38.6	do.	Dump of E. Calhoun mine, Central City	80-90	Radioactivity noticeable for distance of 50 feet from shaft house.
0	Colo. 58	Golden Gate Canyon	50-65	
13.6	do.	Jefferson-Gilpin County line	50-65	Precambrian metamorphic rocks.
0	U.S. 50	Grand Junction	5-6	Mancos shale.
45	do.	Delta	—	
62	do.	Montrose	—	
0-26	U.S. 550	Montrose	5-6	

Table 9.—Road logging for radioactivity—Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
26	U.S. 550	Ridgeway	5-6	
0	Colo. 339	Ridgeway	6.5-7.5	Mancos shale.
7	do.	- - -	8-9	Porphyry dike.
12	do.	Dallas Divide	6-7.5	
21	do.	- - -	6	Limestone.
21.1	do.	- - -	7-8	Shale.
22	do.	- - -	5.5-6.5	Cliff in Entrada formation.
24	do.	Placerville, Jct. Colo. 339, 145	6	
59	Colo. 145	Naturita	6-6.5	Dakota formation.
149	U. S. 6	Junction U.S. 6 and 24 near Minturn		Permian red beds.
170	do.	Vail Pass	12-13	Permian red beds.
174	do.	Wheeler, Jct. U.S. 6 and Colo. 91		Granite and schist.
186	Colo. 91	Climax, Colo.	12-14	Pennsylvanian sedimentary rocks.
201	do.	Arkansas River	13-15	Weber formation.
0	U.S. 85-87	Denver	—	
15	do.	- - -	9	
30	do.	1 mile north of Castle Rock	11-12	
31	do.	Castle Rock	10	
54	do.	Monument	9	

Table 9.—Road logging for radioactivity—Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
72	U.S. 85-87	Colorado Springs	10	
0	Colo. 336	Lv. Colo. Springs	10	
2.3	do.	Gold Camp road	9	Dakota formation.
2.6	do.	- - -	12-13	Fault zone in granite.
2.9	do.	- - -	8-9	
3.5	do.		10-11	Weathered granite.
4.9	do.	- - -	13	Granite.
			10	Granite.
5.8	do.	First tunnel	12-13	Granite.
6.5	do.	- - -	13-14	Granite.
6.8	do.	Second tunnel	15	
7.0	do.	- - -	—	Granite.
7.5	do.	- - -	14	Basalt dike.
8.3	do.	- - -	12-13	Granite.
8.8	do.	Third tunnel	12	
8.9	do.	- - -	14	Granite.
10.5	do.	- - -	14-15	Granite.
10.8	do.	- - -	14-15	Granite.
11.7	do.	- - -	16-17	Granite with quartz veins.
12.2	do.	- - -	14	
12.3	do.	Fourth tunnel	15-16	

Table 9.—Road logging for radioactivity—Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
12.6	Colo. 336	- - -	18-20	Cut in granite.
12.7	do.	- - -	20	Road cut, flat-lying pegmatite.
12.9	do.	- - -	13	
13.2	do.	Fifth tunnel	20	Pegmatite.
			13	
14.2	do.	- - -	15	
16.3	do.	Sixth tunnel	14-15	
16.7	do.	Seventh tunnel	14	
17.8	do.	Duffields	20	Fluorite veins in granite.
29.3	do.	- - -	13-15	
32.3	do.	- - -	10-11	Cripple Creek granite.
34.3	do.	- - -	12-13	Granite.
38.3	do.	Jct. Colo. 336 and 268	15	
38.8	do.	- - -	13	Tailings pond.
39.3	do.	- - -	14-15	
40.7	do.	Jct. Colo. 336 and 67	14-15	
43.3	Colo. 143	Cripple Creek (Jct. Colo. 336 and 143)	12-15	
46.3	do.	- - -	9-11	Granite and gneiss.
49.3	do.	- - -	10-13	Pikes Peak granite.
51.8	do.	- - -	8-11	Weathered granite.

Table 9.—Road logging for radioactivity—Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
52.5	Colo. 143	- - -	9-10	Weathered granite.
55.3	do.	- - -	12-13	Road cuts.
57.9	do.	- - -	8-10	Weathered granite; Tertiary lake beds.
59.7	do.	- - -	7-9	"Petrified forest".
60.7	do.	Back on main road	9	Florissant tuff and petrified trees.
62.8	do.	Florissant, Colo.	9-10	Road cut in tuff
65.3	U.S. 24	Jct. Colo. 143 and U.S. 24	9-10	Tertiary sedimentary rocks.
67.3	do.	Lake George, Colo.	8-10	Background reading.
68.6	do.	Tarryall Creek road	8-10	Granite.
70.1	do.	- - -	9-11	Metamorphic rocks.
78.3	do.	Wilkerson Pass	9-12	Metamorphic rocks.
85.3	do.	South Park	8-10	Thrust fault, Cretaceous and
90.3	do.	do.	8-11	Tertiary sedimentary rocks.
92.3	do.	do.	7-9	Cretaceous shale.
93.6	do.	Hartsel, Colo.		
93.8	do.	Lv. Hartsel, Colo.	9-10	Morrison formation.
94.6	do.	Jct. U.S. 24 and Colo. 9		
95.5	do.	- - -	9	Maroon formation.
103.6	do.	- - -	12	

Table 9.--Road logging for radioactivity--Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
104.8	U.S. 24	- - -	10-11	
106.3	do.	Jct. U.S. 24 and Colo. 285		
107.3	do.	- - -	10	Carbonaceous shales.
108.3	do.	- - -	9-10	
110.6	do.	- - -	8	
111.3	do.	- - -	9-10	Paleozoic rocks.
111.6	do.	Front Creek (bridge)	9	
113.3	do.	- - -	10	Granite.
115.0	do.	- - -	11-12	Granite in cuts.
119.6	do.	Arkansas River	10	
120.2	do.	- - -	9	
124.3	U.S. 285	Jct.U.S. 24 and U.S. 285	10	
125.7	do.	- - -	11	Glacial gravel in cut.
133.3	Colo. 291	- - -	11-12	Glacial gravel.
141.9	do.	Enter Salida, Colo.		
144.2	do.	Lv. Salida, Colo. Jct. U.S. 50 and Colo. 291	9	
145.3	U.S. 50	Along Arkansas River	9	Granite.
147.4	do.	do.	8	Contact of granite and sedimentary rocks.
147.8	do.	do.		Paleozoic sedimentary rocks.

Table 9.—Road logging for radioactivity—Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
148.8	U.S. 50	Road to Wellsville	8	
148.9	do.	Arkansas River	8	
149.5	do.	Railroad tracks	8	
150.7	do.	Swissvalle (D&RGW RR)	8-9	
151.1	do.	Underpass (D&RGW)	9	
0	Colo. 149	Baxterville, Colo.	8-12	
22.2	do.	Creede, Colo.	8-12	Tertiary volcanic rocks.
0	U.S. 160	Baxterville, Colo.	8-12	
42.2	U.S. 84	Pagosa Springs, Colo.	8-12	Tertiary volcanic rocks. Cretaceous sedimentary rocks.
66.8	Colo. 364	Blanco Basin, Colo.	8-12	Tertiary volcanic rocks.
0	U.S. 160	Pagosa Springs, Colo.		
62.6	do.	Durango, Colo.	8-12	Quaternary alluvial deposits and Cretaceous sedimentary rocks.
86.3	U.S. 160 and County road	Gold King mine via Mayday	8-12	Cretaceous sedimentary rocks.
0	U.S. 550	Durango	--	
95.5	do.	Ouray	8-12	Tertiary volcanic rocks and granite.
0	U.S. 50	Cerro Summit	8-12	Tertiary volcanic rocks.
26.8	do.	Sapinero	8-12	Tertiary volcanic rocks.

Table 9.--Road logging for radioactivity--Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
0	U.S. 50	Gunnison	--	
75	U.S. 285 and U.S. 50	Salida	8-12	Cretaceous sedimentary rocks, granite and schist, glacial deposits.
0	Colo. 119	Central City	8-12	Granite and schist.
12	do.	Rollinsville	8-12	
0	do.	Rollinsville	8-12	Schist.
4	do.	Nederland	--	
0	Colo. 279	Central City Virginia Canyon	20	One radioactive area 0.3 mile south of Clear Creek-Gilpin Co. line.
9	do.	Idaho Springs	8-12	Granite and schist.
0	Colo. 285	Fall River road	8-12	
10	do.	Alice	8-12	
0	Colo. 103	Idaho Springs	8-12	
20	do.	Mt. Evans	8-12	Granite and schist.
0	County road	Junction Colo. 119 and Sugar Loaf road	8-12	Granite and schist.
8	do.	Sunset	--	Radioactive area at Copper Rock.
13	do.	Salina	15	
0	Sunshine road	Rowena	8-12	Granite and schist.
8	do.	Gold Hill	8-12	
10.5	Gold Hill road.	Lefthand Creek	8-12	

Table 9.--Road logging for radioactivity--Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
24	Lefthand Creek road	Junction with Colo. 7	8-12	
0	Jamestown road	Junction of Lefthand Creek road and Jamestown road	8-12	Radioactive locality at Springdale, granite.
8	do.	Jamestown and vicinity	8-12	
0	Colo. 93	Morrison	12-15	Permo-Pennsylvanian red beds, are radioactive in vicinity of "Red Rocks Park".
11	do.	Morrison	—	
15	do.	- - -	8-12	
0	Colo. 285	Fairplay	8-12	Granite and schist.
72	do.	Morrison	8-12	Jurassic and Cretaceous sedimentary rocks.
0	Colo. 67	Sedalia	8-12	Tertiary sedimentary rocks.
52	do.	Woodland Park	8-12	Granite.
0	Red Feather Lakes road (via Cherokee Park)	3 miles north of the Forks.	8-12	
26	do.	Red Feather Lakes	20	Sherman granite, radioactive locality at Prairie Divide.
50	Red Feather Lakes road (via Log Cabin)	Junction with U.S. 287 at the Forks.	8-12	

Table 9.—Road logging for radioactivity—Continued.

Miles	Route	Locality	Ratemeter reading	Remarks
0	County road	Boulder, Colo.	8-12	
7	do.	Crisman	10-15	Slight increase in readings at tailings pond below Salina.
12	do.	Gold Hill	10-15	
0	Colo. 93	Golden	10-15	
8	do.	Junction, Colo. 72 at Coal Creek	10-15	
20	do.	Boulder	10-15	
0	Colo. 72	Coal Creek	—	Granite and schist.
21	do.	Rollinsville	10-15	
0	Colo. 138	Rollinsville	10-15	Granite and schist.
7	do.	Tolland	10-15	
9.5	do.	End of road (Portal of Moffat tunnel)	10-15	
0	County road	Rollinsville-Tolland road	10-15	
1.5	do.	Jenny Lind Gulch	10-15	Tertiary monzonite porphyry.
0	Tolland-Apex road	Tolland via Baltimore ridge.	10-15	
4	do.	Elk Park	10-15	Granite and schist.
7	do.	Apex	10-15	
12	Colo. 279	Junction of Colo. 279 and 119	10-15	

portion to over 14,000 feet at Long's Peak in the northwestern corner of the county. The county is well traversed by roads of varying quality making most of the area readily accessible.

Localities examined for radioactivity in Boulder County are shown on figure 2.

Jamestown district

Location and general features. -- The Jamestown district is the northernmost mining district in the Front Range mineral belt. The district (fig. 3), centering around the town of Jamestown, is accessible by road, 16 miles from Boulder. Elevations range from about 6,500 feet at James Creek in the eastern part of the district to slightly over 8,500 feet above sea level at Fairview Peak, Bueno Mountain, and Nugget Hill, prominent points surrounding the district. The district is drained chiefly by Lefthand Creek and its tributary, James Creek, which flow eastward toward the plains. Jamestown, with a population of perhaps 100, is the largest town in the district.

Geology.—The rocks of the Jamestown district, which range in age from Precambrian to Tertiary, are faulted and contain many vein deposits. The Precambrian rocks consist of granite and schist that have been intruded by Tertiary stocks and dikes. The Tertiary rocks range in composition from diabase to alaskite. The central part of the district was intruded by a roughly rectangular granodiorite stock and then by a small stock of sodic granite-quartz monzonite porphyry. The rocks of the district have been cut by many faults. The vein deposits are irregularly distributed around the small stock to which they appear to be genetically related. Pegmatite deposits occur in Precambrian granite and schist in the eastern part of the district. The geology and ore deposits have been described by Aurand (1920), Goddard (1935 and 1946), Cox (1945), and Lovering and Goddard (1950).

Ore deposits.—The ore deposits as described by Goddard (1946) consist of fluorite veins and breccia zones, pyritic gold veins, telluride veins, and lead-silver deposits. Fluorite breccia zones range in width from 10 to 80 feet and in length from 50 to 350 feet. Deposits of radioactive fluorite are associated with the faulted, fractured, and brecciated zones (Cox, 1945). Fluorite veins vary from one inch to 15 feet in width and from two to 1,000 feet in length. Minerals identified in the veins and breccia zones are fluorite, quartz, calcite, galena, sphalerite, and chalcopyrite. Finely divided uraninite and uranothorite have been identified in the darker colored fluorite as well as associated with the breccia matrix of the fluorite breccia zones (Phair and Onoda, 1950; Phair and Shimamoto, 1952). Pyritic gold veins fill some of the northeast-trending fault fissures. The chief ore minerals are pyrite and chalcopyrite in a quartz gangue. Galena and sphalerite are locally abundant. The veins range in width from a few inches to 3 feet and are extremely variable in length. The telluride vein deposits fill fissures of northeast trend and range in width from a fraction of an inch to as much as 10 feet. Minerals present in the veins are quartz, finely disseminated pyrite, and telluride minerals. The lead-silver deposits occur as veins and pipelike bodies near the fluorite breccia zones. These deposits are rarely more than 8 feet wide and 50 feet long. Tetrahedrite, chalcopyrite, galena, sphalerite, and pyrite are mixed with a gangue of quartz and some fluorite.

Pegmatite deposits in the eastern part of the district have been prospected for feldspar, mica, beryl, and cerite (Hanley, Heinrich, and Page, 1950). The deposits range in size from 10 by 50 feet to as much as 50 by 400 feet. With the possible exception of the Rusty Gold and other cerite deposits in Central Gulch, however, they do not contain sufficient quantities of uranium to be of economic importance. In a few places torbernite is sparsely associated with mica in pegmatites.

Spring waters at Springdale are abnormally radioactive and contain about 0.01 part per million of uranium.

The Silver Plume granite in the area between Jamestown and Springdale and the altered granodiorite in the area northwest of Jamestown in the vicinity of Bald Mountain are about 3 to 4 times as radioactive as the country rocks in surrounding areas. The radioactivity is equivalent to a content of 0.006 percent uranium, but the rocks contain only 0.001 percent uranium.

Radioactivity studies of the fluorite deposits in the Jamestown district have been made by Harder and Wyant (1944), and Beroni, Granger, and King (1950). In July 1950, V. R. Wilmarth and D. H. Johnson made radioactivity examinations of 47 mines and 2 mills in the Jamestown district. The general relationship and location of mines examined in this area are shown on figure 3.

The telluride vein deposits examined for radioactivity include the Bueno, Consolation and Grand Central mines and unnamed mine. The telluride veins fill northeast-trending fissures and contain abundant quartz and pyrite associated with the telluride minerals. These mines were inaccessible and only the dump material could be examined. Radioactivity surveys of the dumps indicated no abnormal radioactivity. Readings of 3 to 6 divisions on the 0.2 scale of the Victoreen survey meter model 263-B were observed from the dump material.

Nineteen fluorite deposits were examined for radioactivity in the Jamestown district. Detailed radioactivity examinations and sampling of the underground workings were completed at the Emmett, Blue Jay, Argo, Lehman Lode, Nations Treasure, and Orion mines. At the other 12 deposits radioactivity surveys of the mine dumps were made and where abnormal radioactivity was noted, samples were collected. Radioactivity measurements of dump material at the Chancellor, Alice, Upper Alice, Invincible and Big Bore mines indicated no abnormal radioactivity. Average readings of 10 to 12 divisions on the 0.2 scale were obtained on a Victoreen survey meter, 263-B.

During the radioactivity examination of ore deposits in the Jamestown area, the dumps of 22 mines developed on pyritic gold veins were checked, using the Victoreen survey meter, 263-B. The average readings obtained were lower than those of the telluride veins.

Radioactivity car traverses, totaling 29.8 miles, were made along the accessible roads in the area (fig. 3). The equipment consisted of two 2-inch by 42-inch Geiger-Müeller tubes connected in parallel and attached to a modified Victoreen 263-A survey meter. A speed of about 25 miles per hour was maintained during car traversing. The instrument was standardized with radioactive cobalt and by repeated readings at a reference point in Jamestown. The approximate traverse distance over granodiorite was 6.4 miles; over granite, 13.8 miles; and over quartz monzonite porphyry, 0.6 miles. Readings of 14 to 19 divisions in the 2.0 scale were noted from the granodiorite, although a sample of granodiorite, 7.2 miles up James Creek from Jamestown, contained 0.001 percent uranium. Precambrian granite outcrops gave readings of 10 to 18 divisions on the 2.0 scale, except in the area above the McKinley mine (fig. 3) where readings of greater than 20 divisions on the 2.0 scale were recorded. A sample of this granite contained 0.001 percent uranium. Radioactivity of the sodic granite-quartz monzonite porphyry was about equal to that of the granite.

Radioactivity foot traverses totaling about 3.5 miles using the survey meter were made in two areas of the Jamestown district (fig. 3). A foot traverse was made in the area above the Hercules mine to determine if the Silver Plume granite was more radioactive in the vicinity of the cerite deposits, but no abnormal radioactivity was observed. Above the McKinley mine a foot traverse was made to determine the limits of the zone of abnormal radioactivity. The lateral limits appear to be as indicated on figure 3 but the northwestern edge of the zone was not delimited.

<u>Argo mine</u>.—The Argo mine (1) _/ in sec. 13, T. 2 N., R. 72 W., is on the north side of Little James Creek, about a mile northwest of Jamestown. The mine is owned by the Boulder Fluorspar and Radium Company and leased to H. M. Williamson and Son of Boulder, Colorado. The mine was examined in July 1950 by Wilmarth and Johnson.

The geology of the Argo mine has been described by Goddard (1946). Previous radioactivity examination and sampling of the Argo mine was made by Beroni, Granger, and King in 1949. Radioactivity ranging from 0.017 to 0.047 percent equivalent uranium is associated with fluorspar ore and breccia.

The Argo mine workings consist of a vertical shaft with five levels; the upper level is a crosscut adit. In July 1950 the mine was inoperative and only the crosscut adit was accessible.

_/ Numbers correspond to index numbers on the tables and maps.

The mine is developed on a fluorite breccia zone that trends N. 80° E. and dips steeply to the south. The ore is a breccia consisting of granite fragments cemented by white to purple fluorite, quartz, and clay minerals. Locally small pockets of galena, sphalerite, and pyrite are found. The sulfide minerals contain 0.004 percent uranium; dark-purple fluorite contains from 0.016 to 0.031 percent uranium. The uranium mineral associated with the darker colored fluorite has not been identified, but it is suspected to be finely divided uraninite.

<u>B and A lodes Nos. 1 and 2</u>.--The B and A lodes, Nos. 1 and 2, (2), in sec. 30, T. 2 N., R. 71 W., are on the east side of Slaughterhouse Gulch, about one mile southeast of Jamestown. The mines are easily reached by car from Jamestown.

The B and A lode No. 1 is about 200 feet east of the road up Slaughterhouse Gulch. The workings consist of a small discovery pit on a 10-foot wide mineralized zone that strikes N. 10° E. and dips steeply to the north. Pyrite and limonite are the most abundant minerals found on the dump and in the mineralized area. The country rock is sericitized and silicified granodiorite. A sample of the mineralized zone contained 0.001 percent uranium. The radioactivity is equivalent to 0.007 percent uranium.

The B and A lode No. 2 is 150 feet northwest of B and A lode No. 1 and about 50 feet east of the road. The mine is operated from an 80-foot adit driven along a 2- to 3-foot wide vein that strikes N. 65° W., and dips 60° to 65° E. The vein consists of pyrite, limonite, and quartz in sericitized and silicified granodiorite. A sample of the vein at the face of the adit contained 0.001 percent uranium. The radioactivity is equivalent to 0.005 percent uranium.

Beryl lode mine.—The Beryl lode, formerly the Lehman mine, (3), is in sec. 27, T. 2 N., R. 71 W., on the north side of Lefthand Creek, 100 feet above Colorado Highway 7, 0.6 mile east of the junction of James and Lefthand Creeks. It was examined by K. G. Brill, Jr., in 1947.

Development of the property consists of two adits, totaling 100 feet, a glory hole, and several trenches. The deposit is a zoned pegmatite in granite gneiss with bands of biotite schist (Hanley, Heinrich, and Page, 1950, p. 20). The pegmatite contains quartz, potash-feldspar, manganese garnet, beryl, cleavelandite, hematite (?), malachite (?), biotite, and a black mineral with yellow coatings. The pegmatite dike is 300 feet long by 75 feet wide and is exposed to a depth of 40 feet.

The radioactivity of massive beryl-bearing quartz of the core is negligible. A mixture of biotite, hematite, quartz, and black mineral with yellow coatings in the wall zone is estimated to contain as much as 0.006 percent equivalent uranium; the uranium content of the wall zone averages 0.002 percent.

Black Crow prospect.—The Black Crow prospect (4) is on the south side of Spruce Gulch, about 1,500 feet northwest of the New Girl feldspar mine, in sec. 22, T. 2 N., R. 71 W. The prospect was examined for radioactivity by K. G. Brill in 1947. The workings consist of a 30-foot adit and a trench.

The country rock consists of muscovite schist. The foliation strikes N. 45° E. and dips 40° SE.

An indistinctly zoned pegmatite dike is exposed in the workings to a depth of 30 feet. The dike is about 100 feet long and 15 feet wide. It strikes N. 50° W. and dips east. The core consists of pink potash feldspar with small books of muscovite.

Measurements made on the outcrop indicate that the radioactivity of the dike is negligible.

Blue Jay mine.--The Blue Jay mine (5) in sec. 30, T. 2 N., R. 71 W., is about 3,000 feet southeast of Jamestown on the east side of McCorkle Gulch. The mine is owned by the Boulder Fluorspar and Radium Company and is leased to H. M. Williamson and Son of Boulder, Colorado. The Blue Jay mine is developed by several short adits, a 300-foot vertical shaft and drifts at the 150-foot and 300-foot levels. In 1949, Beroni, Granger, and King sampled and made a radioactivity examination of the second (300-foot) level of the mine. V. R. Wilmarth and D. H. Johnson examined the 300-foot level for radioactivity in July 1950.

The geology and ore deposits of the Blue Jay mine have been described by Goddard (1946) and by Phair and Onoda (1950).

The country rock in the vicinity of the Blue Jay mine is altered granodiorite. The Blue Jay vein trends northwest, dips at steep angles, and ranges from a few inches to 16 feet in width and is over 1,000 feet in length. The vein consists of brecciated deep-purple crystalline fluorite, quartz, clay minerals, pyrite, galena, uraninite (Phair and Onoda, 1950), and uranothorite (Phair and Shimamoto, 1952).

A radioactivity traverse of the 300-foot level was made. The average background reading of 0.3 milliroentgen per hour (mr/hr) was noted in the middle of the drift and 0.4 to 0.5 mr/hr on the walls and back. A thin coating of limonite stain along a fault gave a reading of 2.0 mr/hr. Fluorspar ore from the ore chute near the east end of the 300-foot level contained 0.037 percent uranium and fluorspar ore from the hanging wall of vein, 100 feet east of the shaft, contained 0.045 percent uranium. Dark-purple fluorite and fluorite breccia contain from 0.018 to 0.084 percent uranium, whereas the altered granodiorite at the contact with the vein contains only 0.002 percent uranium.

The radioactivity of the fluorspar ore, breccia, and mill products averages nearly twice the uranium content, suggesting that other radioactive elements are present. This is verified by Phair and Shimamoto (1952) who identified uranothorite in the breccia.

Not all the uranium is associated with the fluorite but in part is either free or associated with the sulfides as evidenced by sulfide concentrates that contain from 0.035 to 0.11 percent uranium. Special methods of concentration have in one instance produced a concentrate containing as much as 1.21 and 1.81 percent uranium oxide (MacPherson, written communication, 1950).

Brown Spar mine.--The Brown Spar mine (6) is on the north side of Little James Creek in sec. 24, T. 2 N., R. 72 W., about one mile northwest of Jamestown. The mine is owned by the Boulder Fluorspar and Radium Company and was last operated in 1942 by H. M. Williamson and Son of Boulder, Colorado. A radioactivity survey, using the Victoreen 263-B survey meter, was made of the dump by Wilmarth and Johnson in July 1950. The geology of this mine has been described by Goddard (1946, p. 35). The main vein strikes N. 75° E. and dips steeply southeast. It is composed chiefly of purple fluorite with some pyrite and galena. The gangue minerals include quartz, altered granodiorite and clay minerals and some ankerite. Vein material containing fluorite from one of the dumps contained 0.029 percent equivalent uranium and 0.013 percent uranium.

Buddy lode (Highline prospect).--The Buddy lode or Highline prospect (7) is in sec. 27, T. 2 N., R. 71 W., on the north wall of Lefthand Creek, near an abandoned mine road, 300 feet above the creek. It was examined by K. G. Brill, Jr. in 1947.

Development work consists of a single trench 50 feet long and reaching a maximum depth of 10 feet. The Buddy lode is an indistinctly zoned pegmatite. The wall rocks are Precambrian Silver Plume granite and granite gneiss. The core of the pegmatite is composed of quartz, potash feldspar, and muscovite.

The pegmatite is 100 feet long by 20 feet wide, trending N. 20° W., and dipping northeast. The radioactivity of the pegmatite is negligible.

Burlington mine.--The Burlington mine (8) is in sec. 24, T. 2 N., R. 72 W., about 1 mile northwest of Jamestown. It is owned by the General Chemical Company and was operating at the time the mine was examined in July 1949.

The mine consists of a vertical shaft 500 feet deep and four levels aggregating probably 4,000 feet. It has developed one of the largest fluorite-bearing breccia zones in the district (Lovering and Goddard, 1950, p. 273-274).

The breccia zone strikes N. 55° E. and dips nearly vertical. It is from 7 to 50 feet wide and is at least 350 feet long. It consists of altered granite fragments cemented by a mixture of fine- to coarse-crystalline fluorite, quartz, and clay minerals. Pyrite and galena are locally abundant. Moderate radioactivity comparable with other fluorite deposits in the district is associated with the fluorite breccia but is highest in the dark-purple fluorite. The radioactivity is estimated to average 0.05 percent equivalent uranium.

Copper Blush mine.—The Copper Blush mine (9) is in the SE¼ sec. 17, T. 2 N., R. 71 W., two miles northeast of Jamestown. The surface area only was examined for radioactivity by R. U. King in August 1949.

Development consists of a shaft and several levels, none of which were accessible at the time of the writer's visit. The vein has been prospected for about 1,000 feet horizontally.

The Copper Blush mine explored a quartz-fluorspar vein in Precambrian Silver Plume granite. Fine-grained pyrite and chalcopyrite are sparsely disseminated in a gangue of purple fluorite, quartz, and banded chert. Some sericite accompanies the gangue.

Fluorspar from one of the dumps contained up to 0.022 percent equivalent uranium and 0.004 percent uranium.

Curie and Tile radioactive springs.—The presence of radioactivity in the "Curie" and "Tile" spring (10) waters at Springdale in the vicinity of Jamestown, Colorado, has been noted by George and others (1920, p. 434-437). The reported occurrences consist of four natural springs in the SE¼NE¼ sec. 29, T. 2 N., R. 71 W., along James Creek. The locality was examined for uranium between August 27 and October 1, 1948 by G. B. Gott and J. W. Hill, who procured samples of the water and associated rocks for analysis (Gott, 1948a, 1948b).

The radioactive springs, $1\frac{1}{2}$ miles east of the Jamestown district, are in an extensive area of Silver Plume granite. At this locality there are two sets of fractures, the more prominent of which strikes northeast and the other northwest. Within the general area these fracture zones contain in places deposits of gold, silver, lead, and zinc.

At the time of the investigation by the Colorado Geological Survey prior to 1920, four springs along the north side of the floor of James Creek Valley were active. However, recent road construction along the north canyon wall has covered two of them and almost obliterated a third. At the time of the examination only one of the four original springs was active.

Water from the one remaining spring comes up vertically from the valley floor at the point where the floodplain and the talus slope join. The spring is cased to a depth of $5\frac{1}{2}$ feet where granite was encountered. It was found that the water was coming from a fracture in this rock.

The water was bailed from the cased hole and the granite from which the water is coming was examined. The amount of rock surface thus uncovered was too small to indicate positively that the rock was not an isolated boulder. Assuming that the water was coming from around a boulder, the only apparent source would be in the gravel of the valley floor. However, the position of all four springs at the base of the talus slope indicates that the water is coming from fractures in the granite rather than from the porous gravel fill. Furthermore, the gravel is so porous that any radioactive water contained in it would be diluted by stream water. The alluvial gravel was found to be non-radioactive. The premise that the radioactive water is coming from fractures in the granite is, therefore, the only logical conclusion that can be made.

Five water samples, two rock samples, and one sample of the evaporite were collected from the active spring for analysis. Results of chemical, radioactivity, and petrographic analyses are given below.

Table 10.—Results of chemical analyses of water from flowing spring at Springdale.

Analyses by L. F. Rader, U. S. Geological Survey, 1948.

Sample no.	Parts per million				
	U	T.S*.	SiO_2	SO_4	Cl
GG-8	0.01				
GG-9	.01				
GG-10	.01				
GG-11	.01	3006	86	1306	68

* Total solids.

Table 11.—Radioactivity measurements made on rock samples collected at the flowing spring at Springdale.

Sample no.	Location	Percent eU*
GG-12	Chips from around the crevice at the bottom of the spring.	0.002
GG-13	Silver Plume granite. Collected near spring.	.004
GG-14	Evaporite. Formed on surface near overflow pipe from spring.	.004

*Analyses by J. N. Rosholt, Jr., U. S. Geological Survey, 1948.

Petrography of samples*

GG-12 Essentially a soda feldspar (albite) and quartz. Pieces of ceramic tile also present containing a thin deposit of a white sulfide.

GG-13 A granite gneiss containing quartz, albite, microcline, biotite, and muscovite. Minor amounts of magnetite and other undetermined heavy metal also present.

GG-14 Predominantly a finely divided calcite and gypsum with white incrustations which are probably alunogen ($Al_2(SO_4)_3.16H_2O$). Also some hydrated iron sulfate and considerable organic matter intermixed with a claylike material.

*By J. Berman, U. S. Geological Survey, 1948.

The following data (table 12) pertaining to the four springs mentioned above were recorded by the Colorado Geological Survey in 1920 (George and others, 1920) and the amount of radioactivity determined at that time is in close agreement with the uranium analysis given in table 11.

Table 12.—Data on four springs at Springdale.

Spring	Permanent radioactivity grams radium per liter X 10^{-10}	Temp. F.	Rate of flow gpm.	Excess carbon dioxide. Milligrams per liter.
No. 1	trace	58.1	1½	377.5
No. 2	0.28	54.6		423.8
No. 3	0.283	57.4		422.5
No. 4	0.233	60.0	1½	351.9

The low uranium content shown by chemical analyses is probably no indication of the concentration in the source rock from which uranium is being carried away in solution. However, little can be determined regarding the origin of the radioactive water from a superficial investigation of the type made on these springs although it seems that one of the following possible explanations should adequately explain the presence of the uranium. (1) Meteoric water, following fractures in the granite, came in contact with uranium minerals, possibly the radioactive fluorite a short distance to the west, and carried away some of the uranium in solution. In contradiction to this hypothesis the carbon dioxide content is higher than is normally found in meteoric water. (2) Magmatic water ascended from a deep source and brought along uranium in solution. If the water in the springs were meteoric, its temperature should be close to the mean annual atmospheric temperature. The mean annual temperature is estimated to be about 42 degrees or about 15 degrees lower than that of the spring water. This supports the possibility that the water is coming from a deep source.

The results of radioactivity field studies indicate that the spring waters contained radioactivity equivalent to 0.005 to 0.01 percent uranium. This is much higher than can be accounted for by the uranium content alone of 0.01 parts per million. Probably small quantities of radium or radon, or possibly both of these radioactive elements, are present in the spring waters.

Elkhorn mica mine (Tin Horn lode).—The Elkhorn mica mine (11) or Tin Horn lode is in sec. 27, T. 2 N., R. 71 W., half a mile north of Lefthand Creek. It was examined by K. G. Brill, Jr., in 1947.

Development of the mine consists of an open pit 20 by 30 feet and short adits. The adits were inaccessible at the time of the writer's visit. The deposit is a zoned pegmatite, striking N. 20° W., and dipping 40° E. The wall rock is a biotite diorite gneiss.

The core zone contains quartz, potash feldspar, and muscovite in small books with masses of garnet, mica, and torbernite(?). The wall zone consists of a granite intergrowth. The pegmatite is exposed for 100 feet by 15 feet and is explored to a depth of 50 feet. Measurements made on the outcrop indicate the pegmatite dike is only slightly radioactive, but muscovite with coatings of torbernite (?) making up about one percent of the pegmatite contains 0.022 percent equivalent uranium and 0.012 percent uranium.

Emmett mine.—The Emmett mine (12), in sec. 24, T. 2 N., R. 72 W., is on the south side of Little James Creek about one mile northwest of Jamestown. The mine was being operated by H. M. Williamson and Son during 1950 under lease from the Boulder Fluorspar and Radium Company.

The Emmett mine workings consist of a 1,000-foot vertical shaft connected to a crosscut tunnel and 10 levels. The collar of the shaft is in an open cut 60 feet long and 20 feet wide. Several of the upper levels are inaccessible. The geology of the Emmett mine has been described by Goddard (1946, p. 40-42).

The Emmett mine, one of the largest producers of fluorspar in the Jamestown area, is in a large fluorite vein that strikes N. 65° W., dips steeply northeast and is enclosed in a breccia zone in Silver Plume granite. The Emmett vein varies from 6 to 20 feet in width and is over 200 feet long. The vein in the upper levels and in the open cut is bordered by a 5- to 10-

foot wide breccia zone but in the lower levels the breccia is largely absent. The vein is filled with coarsely crystalline pale-green to dark-purple fluorite fragments that are less than an inch to 2 feet in diameter and are cemented by clay, chalcedony, granular fluorite, chlorite, and quartz. The quartz and coarse fluorite fragments are corroded and partly replaced by later fluorite and chalcedony. Pyrite is erratically distributed throughout the vein and locally has been replaced by chlorite. Small veinlets and irregular patches of galena, chalcopyrite, and sphalerite occur in the vein. Small veinlets of chalcedony and chlorite fill fractures in the quartz and fluorite. In the open cut meta-torbernite and torbernite coat fractures in the fluorite breccia and altered country rock; other radioactive minerals were not identified.

In 1944, Harder and Wyant sampled the 4th level of this mine and obtained fluorspar ore containing from 0.006 to 0.012 percent uranium. A sample of the sulfides contained no uranium (Harder and Wyant, 1944, p. 41). Beroni, Granger, and King (1950, p. 8) sampled and made a radioactivity survey of several levels of the Emmett mine in 1949. One sample of light-colored fluorite from the first level contained 0.004 percent uranium.

In July 1950, Wilmarth and Johnson sampled the mine and made radioactivity surveys of the open cut, 4th, 6th, and 10th levels. On the 10th level, a radioactivity traverse was made through the drift and readings of 2 to 3 divisions on the 2.0 scale were noted. Greater radioactivity was observed from the dark-purple fluorite, which gave readings of 4 to 5 divisions on the 2.0 scale. At one area near the middle of the drift readings of 6 to 7 divisions on the 2.0 scale were noted from dark fluorite intermixed with sulfides. At the west end of the 10th level, the vein appears to be more brecciated and readings of 5 to 6 divisions on the 2.0 scale were observed in the middle of the drift. These higher readings may indicate the presence of radon or that the brecciated areas contain more radioactive material.

A radioactivity traverse was made on the 6th level for 120 feet east of the shaft at which point the drift was caved. Readings of 4 to 5 divisions on the 2.0 scale were observed through the middle of the drifts with much higher readings on the walls and back. The vein material is similar to that in the 10th level.

On the 4th level, radioactivity traverses were made for 50 feet east and 200 feet west of the shaft. Throughout this level readings of 5 to 6 divisions on the 2.0 scale were observed in the middle of the drift. A dull brown coating on a small fault at the east end of the level, gave readings of 12 to 14 divisions on the 2.0 scale.

The open cut was traversed and background readings in the granite of 2 to 3 divisions on the 2.0 scale were recorded. At the west end of the open cut, readings of 4 to 5 divisions on the 2.0 scale were noted from the deep-purple fluorite.

Energy claim.—The Energy claim (13), owned by Mr. C. H. Clark of Jamestown, is about a half mile northeast of Jamestown in sec. 19, T. 2 N., R. 71 W. (fig. 3). The claim is easily reached from Jamestown by dirt road. The claim is developed by a shallow discovery pit on a 2-foot wide fluorspar vein which strikes N. 15° W. and dips 57° W. The vein is exposed along the strike for more than 150 feet and consists of dark-purple coarsely

Table 13.—Radioactivity data on samples collected from the Emmett mine.

Sample number	Description	Percent 1/ eU	Percent 2/ U
W-21	Purple fluorite from near middle of drift, 100 feet west of shaft, 10th level.	0.010	0.004
W-22	Deep-purple fluorite and base-metal sulfides west of shaft, 10th level.	.039	.017
W-23	Fluorite, breccia fragments, clay minerals, and pyrite, west end of drift, 10th level.	.014	.004
W-24	Brown muck, unidentified minerals at east end of drift, 4th level.	.083	.003
W-25	Purple fluorite, 150 feet west of shaft, 4th level.	.052	.005
W-43	Water sample from crosscut tunnel.		.07 ppm 3/
17201	Light-purple fluorite, 1st level.	.007	.004

1/ Radiation by L. F. Rader, Jr., and J. N. Rosholt, Jr., U. S. Geological Survey, 1950.

2/ Chemistry by L. F. Rader, Jr., J. N. Rosholt, Jr., G. W. Boyes, Jr., A. C. Horr, and E. C. Mallory, Jr., U. S. Geological Survey, 1950.

3/ ppm = parts per million.

crystalline fluorite, quartz, pyrite, and two unidentified brown minerals. The country rock is altered granodiorite. The radioactivity of the vein material is equivalent to 0.019 percent uranium. A channel sample across the vein exposed in the pit contains 0.009 percent uranium. Altered granodiorite in the surrounding area contains about 0.006 percent equivalent uranium.

Gladstone mine.—The Gladstone mine (15) is about 1.5 miles northwest of Jamestown in sec. 13, T. 2 N., R. 72 W. The mine can be reached by dirt road that leaves the road up Little James Creek, 1.25 miles from Jamestown. The mine was last operated in 1943.

The mine workings consist of a caved vertical shaft and several small prospect pits developed on a breccia zone that strikes N. 65° E. and dips steeply. The ore is a fine-grained, granular purple fluorite with some coarsely crystalline pale-green and purple fluorite. Pyrite, sericite, and granite fragments make up the rest of the breccia zone. The enclosing country rock is Silver Plume granite.

A radioactivity survey, using the Victoreen 263-B survey meter, was made of the dump and of the granite in the immediate vicinity of the mine. A grab sample of purple fluorite and pyrite contained 0.004 percent equivalent uranium and 0.003 percent uranium.

Horn prospect.—The Horn prospect (14) is on James Creek about one mile east of Jamestown in sec. 29, T. 2 N., R. 71 W. The property is owned by Mr. C. Horn and V. Thomas of Boulder, Colorado. The locality was examined by D. G. Wyant on September 18, 1948, in company with the owners.

Silver Plume granite exposed on the canyon walls locally contains small bodies of alaskite and trachytic granite, and zones of granite with numerous quartz stringers containing disseminated pyrite.

The radioactivity of the rocks in the locality ranges from 0.005 to 0.006 percent equivalent uranium. The uranium content ranges from 0.003 to 0.006 percent. No local concentrations of radioactive minerals occur in the immediate area. Results of analyses of samples of rocks from the area are shown in table 14.

Lehman lode mine.—The Lehman lode mine (16), owned by Mr. A. E. Gray and Mr. R. E. Artle, both of Jamestown, is in the eastern part of sec. 19, T. 2 N., R. 71 W. The mine is accessible from Jamestown by road.

The mine workings consist of a 67-foot adit and 16-foot raise 40 feet from the portal. The workable fluorspar breccia zone strikes S. 60° E., dips from 44° to 89° SW. and ranges from 2 to 5 feet in width. The vein material is made up of granite fragments cemented by a fine-grained, pulverulent, white to purple fluorite and clay. Pyrite is disseminated through the fluorite breccia and the wall rock of altered quartz monzonite porphyry.

Radioactivity examination of the mine was made using the Victoreen 263-B survey meter. The fluorspar breccia zone and adjacent wall rock gave readings of 2 to 3 times background. Channel samples of the fluorspar breccia zone contained from 0.007 to 0.035 percent equivalent uranium and from 0.003 to 0.005 percent uranium.

Lehman mill.—The Lehman mill (17), on the north side of James Creek near the eastern edge of Jamestown, in sec. 19, T. 2 N., R. 71 W., is owned by Mr. C. H. Clark of Jamestown. The mill was last operated in 1942-43.

Table 14.--Radioactivity data on samples collected from the Horn prospect.

Analyses by L. F. Rader, Jr., U. S. Geological Survey, 1948.

Sample number	Material	Equivalent uranium (percent)	Uranium (percent)
207(4431)	Alaskite.	0.005	0.003
208(4432)	Quartz stringers with pyrite.	.005	.005
209(4433)	Trachytic granite.	.006	.006
210(4434)	Trachytic granite.	.006	.003

Ore from the Spartan No. 5 claims, Nations Treasure mine, Poorman mine, and Orion mine were processed and an acid-grade fluorspar and a bulk sulfide concentrate were produced. A radioactivity survey of the mill products was made with the Victoreen 263-B survey meter by Wilmarth and Johnson in July 1950.

The radioactivity of samples of the sulfide concentrates collected by Wilmarth and Johnson ranges from 0.016 to 0.031 percent equivalent uranium. The uranium content of the sulfide concentrate, obtained without special regard to uranium recovery, ranges from 0.013 to 0.018 percent uranium.

McKinley mine.—The McKinley mine (18) is one mile northwest of Jamestown in sec. 13, T. 2 N., R. 72 W. The mine workings, two vertical shafts and an adit, were inaccessible in July 1950 when examined by Wilmarth and Johnson. The vein minerals observed on the dumps are pyrite, purple fluorite, quartz, and clay minerals. The country rock is altered Silver Plume granite. A radioactivity examination of the dump was made using the Victoreen survey meter. The dump material gave readings of 15 to 18 divisions on the 0.2 scale and vein material containing purple fluorite and pyrite gave readings of 5 to 6 divisions on the 2.0 scale. A grab sample of dump material contained 0.008 percent equivalent uranium and 0.004 percent uranium.

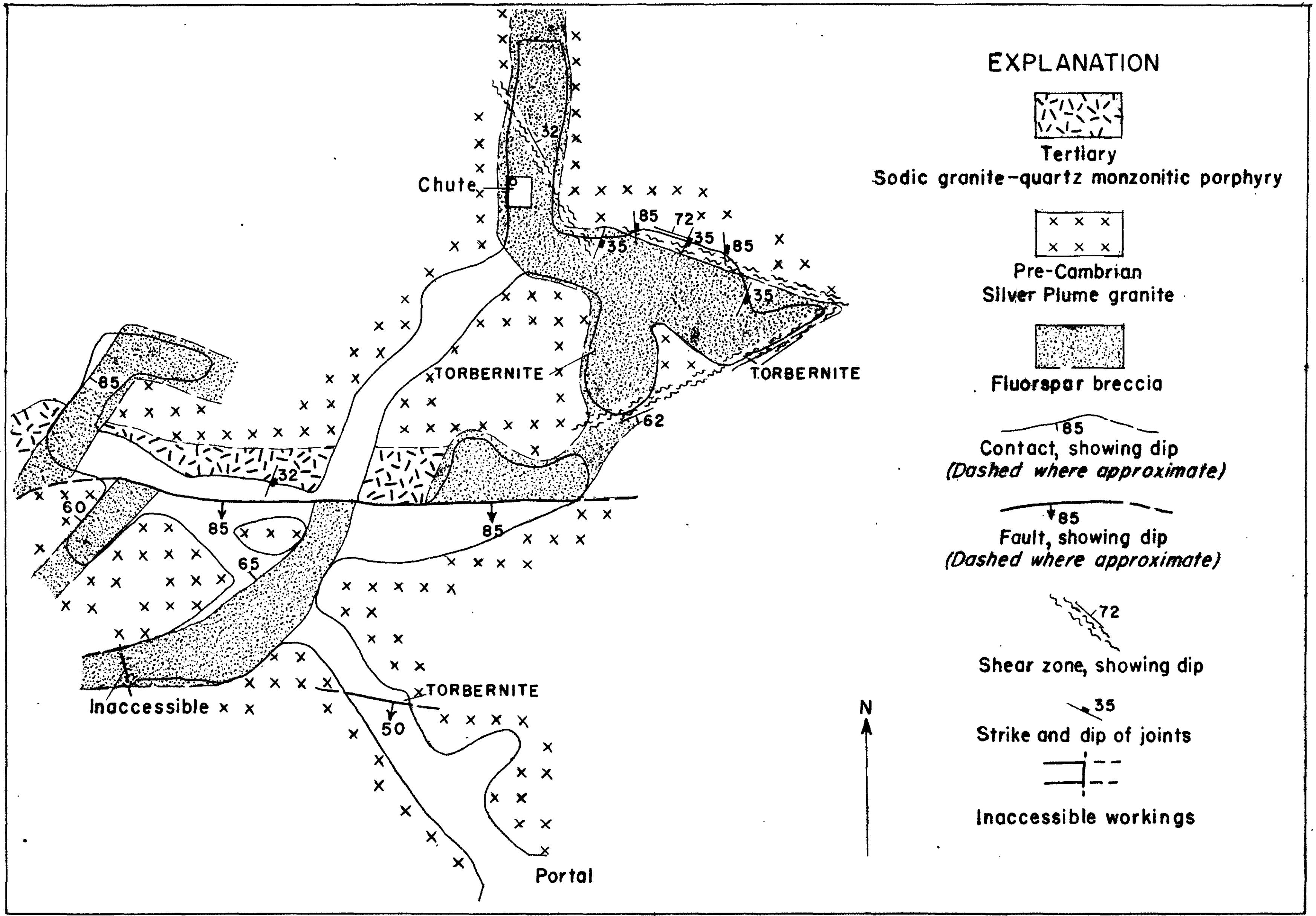
Nations Treasure mine.—The Nations Treasure mine (19) is in the NE¼ sec. 24, T. 2 N., R. 72 W. The mine is owned by Mr. C. H. Clark of Jamestown, Colorado, and was last operated in 1948. Ore from this mine was treated at the Lehman mill in Jamestown. V. R. Wilmarth and D. H. Johnson examined the mine for radioactivity and mapped the geology of the deposit in July 1950.

The mine workings, totaling more than 200 feet, consist of a crosscut tunnel connecting with several short irregular drifts and a large glory hole (fig. 4). All of the fluorspar bodies immediately above and below the crosscut tunnel have been mined out.

Goddard (1946, p. 43-44) has described the geology of the Nations Treasure mine. The mine is on the southeast side of a large northeastward-trending breccia zone that is enclosed in Silver Plume granite. The country rock is mostly granite but a sodic granite-quartz monzonite porphyry dike is exposed in the workings. The mine exploits several small irregular fluorspar veins and breccia zones within an area of 50 by 150 feet. In the northeastern part of the workings an irregular fluorspar breccia body has been stoped to the surface, 20 feet above.

The major structure in the Nations Treasure mine is an eastward-trending fault that dips 85° S. and forms the contact between the granite and sodic granite-quartz monzonite porphyry. Shear zones form the contacts between the country rock and fluorspar breccia in the glory hole. A joint set strikes N. 5° E. to N. 25° E. and dips from 35° to 85° to the south in the same area.

The minerals identified in the ore are coarse- to fine-grained fluorite, quartz, clay, pyrite, galena, limonite, chalcedony, torbernite, and chlorite. In thin sections, the fluorspar breccia contains euhedral to anhedral crystals of pyrite irregularly distributed through the breccia. The pyrite has been locally replaced by galena and chlorite. There are two generations of fluorite; the older, light-colored coarsely crystalline fluorite has been



Geology by V. R. Wilmarth and D. H. Johnson, July 1950

FIGURE 4.- GEOLOGIC MAP OF THE NATIONS TREASURE MINE, JAMESTOWN DISTRICT, COLORADO

20 0 20 40 Feet

brecciated and cemented by clays and a younger fine-grained dark-colored fluorite. The light-colored fluorite is rimmed by the younger darker fluorite. The older crystalline fluorite has been extensively corroded and replaced along grain boundaries and fractures by the younger fluorite. Chalcedony or cryptocrystalline quartz fills many narrow veinlets in the brecciated fluorite. Torbernite coats fractures in the sodic granite-quartz monzonite porphyry and in the granite at or near the contact with the fluorspar breccia. The greatest concentration of torbernite appears to be in the stoped area in the northeastern part of the mine.

A radioactivity survey of the mine workings was made with Victoreen 263-B survey meter. Readings were taken by placing the probe directly on the area from which radioactivity data were desired. The rate-meter readings obtained from the granite and the sodic granite-quartz monzonite porphyry ranged from 1.5 to 2.0 divisions on the 2.0 scale and from the fluorspar bodies from 1 division on the 2.0 scale to 3.0 divisions on the 20.0 scale. Four samples were collected in the mine. The analytical data are given in table 15. A sample of fluorite collected by Harder and Wyant in 1944 was found to contain 0.023 percent equivalent uranium.

New Girl prospect (Columbine lode).—The New Girl prospect (20), or Columbine lode, is in sec. 22, T. 2 N., R. 71 W., about one mile north of Lefthand Creek.

The prospect is developed by four short adits and a glory hole connected by underground workings.

The New Girl prospect is in obscurely zoned pegmatite that strikes N. 45° E. and dips steeply. The wall rock is highly contorted biotite-

Table 15.—Radioactivity data on samples collected from the Nations Treasure mine.

Sample number	Description	Equivalent uranium 1/ (percent)	Uranium 2/ (percent)
W-31-50	Grab sample of galena, pyrite, dark-purple fluorite.	0.083	0.075
W-32-50	1-foot channel across dark-purple fluorite.	.10	—
W-33-50	Grab sample of altered granite with some torbernite flakes.	.13	—
W-34-50	4-foot channel of purple fluorite.	.035	.024

1/ Radiation by J. N. Rosholt, Jr., U. S. Geological Survey, 1950.

2/ Chemistry by G. W. Boyes, Jr., A. C. Horr, and E. C. Mallory, Jr., U. S. Geological Survey, 1950.

muscovite schist. The pegmatite has a core zone of potash feldspar with about 5 percent muscovite; some of the muscovite at the borders of the core is coated with a dark red to brown mineral (probably hematite). The wall zone consists of potash feldspar intergrown with quartz. Beryl and columbite are minor accessory minerals. The pegmatite is 400 feet long by 50 feet wide and is exposed to a depth of 50 feet. Radioactivity ranges from less than 0.001 percent equivalent uranium in the core of the pegmatite to 0.047 percent equivalent uranium in muscovite with coatings of a red mineral and torbernite in the border zone. The radioactive muscovite which makes up probably less than 5 percent of the pegmatite, contains 0.015 percent uranium.

Orion mine.—The Orion mine (21), owned by Mr. C. H. Clark of Jamestown, is about one mile northwest of Jamestown in sec. 24, T. 2 N., R. 72 W. The mine is easily accessible by car from Jamestown.

The mine workings consist of two shallow shafts, two short drifts, two large open cuts, and several prospect pits and trenches. The ore deposit consists of fluorite-amphibole veins and quartz-hematite-fluorite veins. The fluorite is coarsely crystalline and deep purple. The fluorite-amphibole veins are exposed in all workings except one of the shafts, and they range from 6 inches to 3 feet in width, trend northwesterly, and dip steeply to the north. Small quantities of pyrite were observed in these deposits. In one of the shafts, two parallel veins, consisting of quartz, hematite, and fluorite, two feet wide, strike N. 80° E. and dip 80° N. The wall rock is altered granodiorite.

Radioactivity traverses using the Victoreen survey meter 263-B were made through all workings. Readings of from 1 to 1.5 divisions on the 2.0 scale were noted from the wall rock and the narrow fluorite-amphibole veins. In one of the shafts readings of 2 to 3 divisions on the 2.0 scale were noted from the vein material. The maximum radioactivity is estimated to be 0.01 percent equivalent uranium. Channel samples across the veins contain from 0.004 to 0.008 percent uranium.

<u>Ozark-Mahoning mill</u>.—The Ozark-Mahoning mill (22), about half a mile northwest of Jamestown in sec. 24, T. 2 N., R. 72 W., is owned by the Ozark-Mahoning Company of Roseclaire, Illinois.

During 1950 the company was processing in its mill fluorspar ores from the Blue Jay and Emmett mines in the district, and was producing acid-grade fluorspar and bulk sulfide concentrates.

Samples of mill products were collected by Granger and Beroni in 1949 and by Wilmarth and Johnson in 1950. The results of analyses for uranium of these samples and of additional mill products submitted by the company to the U. S. Atomic Energy Commission in October 1950 are shown on a diagrammatic flow sheet (fig. 5).

Some clue to the distribution of uranium in the ore is given by the uranium analyses of the various mill products. The high uranium content of the sulfide concentrates, and of the mill tails, contrasted with the low uranium content of the fluorspar concentrates, may indicate that there are appreciable quantities of recoverable uranium minerals not intimately associated with fluorite.

The district has possibilities for the production of uranium as a byproduct of fluorspar mining. Goddard (1946) estimates the resources of

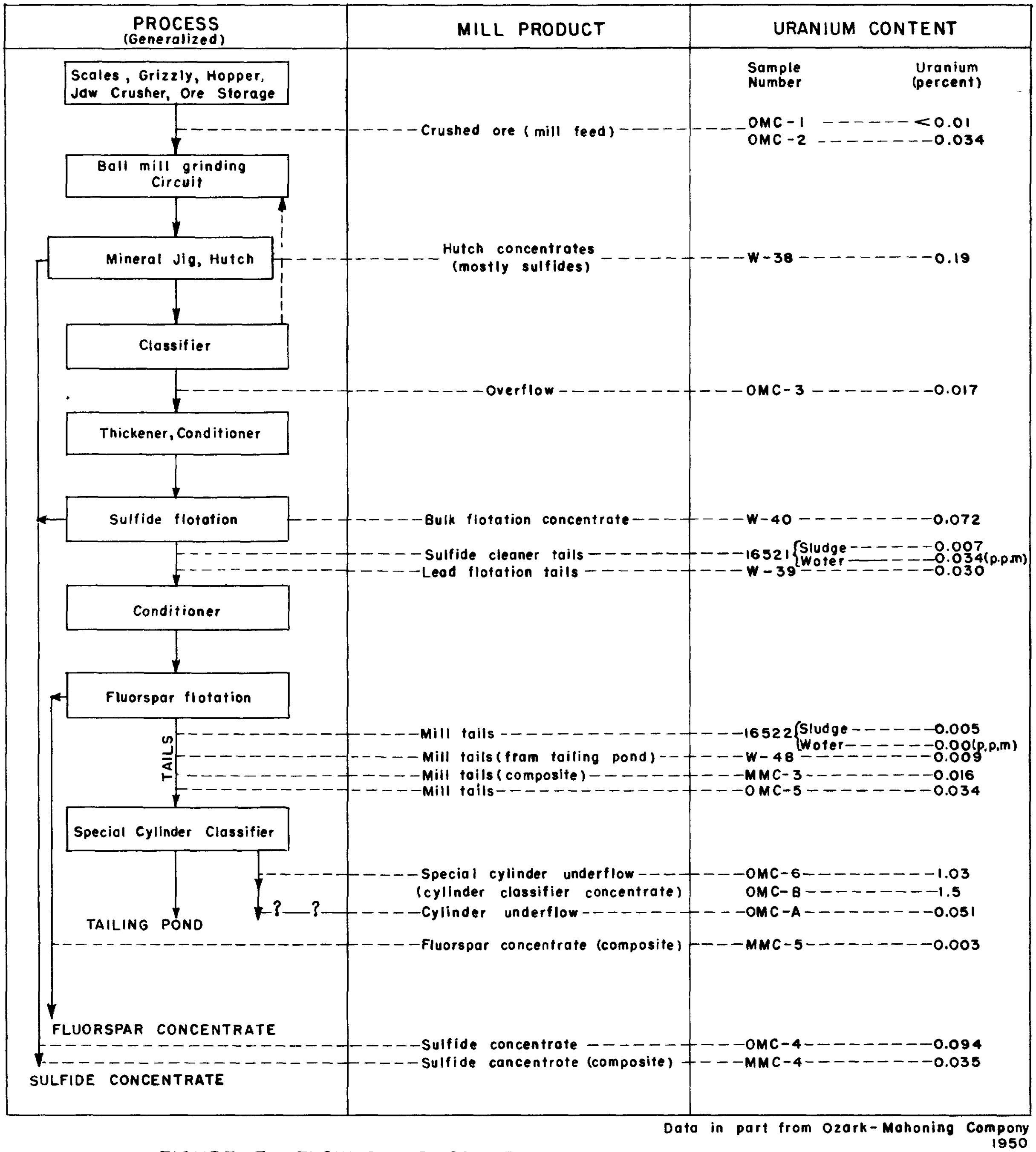


FIGURE 5.—FLOW SHEET OF OZARK-MAHONING COMPANY MILL, JAMESTOWN, COLORADO

fluorspar in the Jamestown district as about 1,000,000 tons of ore at an average grade of 50 percent CaF_2. The tails resulting from the ultimate production of such a tonnage of ore would be about 500,000 tons. The grade of these tails ranges from 0.005 to 0.034 percent uranium oxide and would thus contain from 30 to 200 tons of uranium oxide. The possibility that some of this uranium can be concentrated is indicated by the analyses of the mill products from the "special cylinder classifier"; concentrates have been produced containing from 1.03 to 1.5 percent uranium.

Poorman mine.—The Poorman mine (23), owned by Mr. C. H. Clark of Jamestown, is about 1,200 feet southwest of Jamestown in sec. 30, T. 2 N., R. 71 W.

The mine workings are inaccessible but are reported to consist of a vertical shaft, 60 feet deep, and a drift along the vein for 100 feet. The mine was last operated in 1943.

A radioactivity examination and sampling of the Poorman vein were made by J. O. Harder and D. G. Wyant in 1944, and in July 1950 V. R. Wilmarth and D. H. Johnson made a radioactivity survey of the mine dump using the Victoreen survey meter model 263-B.

The geology of the Poorman mine has been described by Goddard (1946, p. 45). The Poorman mine exploits a fluorspar vein in altered granodiorite. Ore from the Poorman vein consists of fine-grained fluorite containing many small fragments of calcite, biotite, ankerite, quartz, galena, and pyrite. The fluorite is generally colorless but in places is dark purple to black. The altered granodiorite and purple fluorite gave readings of 1 to 1.5 divisions on the 2.0 scale of the Victoreen survey meter, and one specimen containing purple fluorite, pyrite, biotite, and an unidentified yellow mineral gave readings of 6 to 7 divisions on the 2.0 scale. A grab sample from the dump contained 0.022 percent uranium. A sample of fluorspar ore obtained by Harder and Wyant (1944) contained 0.006 percent equivalent uranium. Water from the shaft contained 0.06 parts per million uranium.

Rusty Gold and other cerite prospects.—The Rusty Gold and four other uranium-bearing cerite prospects (24) are clustered in the SE¼ sec. 17, T. 2 N., R. 71 W., about 2 miles northeast of Jamestown. The prospects are accessible by road and trail from Jamestown.

The cerite prospects in this area have been described by Goddard and Glass (1940, p. 381-404) and by Hanley, Heinrich, and Page (1950, p. 21). The locality was examined for uranium in September 1949 by R. U. King and in July 1950 by V. R. Wilmarth.

The prospects are undeveloped except for shallow pits and trenches and a single adit 30 feet long.

The country rock is Silver Plume granite with inclusions of schist.

The cerite deposits are in small steeply dipping quartz-feldspar pegmatites that occur near the borders of schist inclusions in granite. The pegmatites range in length from a few feet up to 75 feet and are as much as 5 feet wide.

Cerite with allanite, brown epidote, törnebohmite, bastnäsite, and monazite occur in irregular masses up to two feet in width in the poorly defined core of the pegmatites. The cerite masses may make up from 2 to 5 percent of the ore.

The uranium content of the cerite-bearing rock ranges from 0.014 percent to 0.02 percent; the cerite itself contains as much as 0.5 percent uranium. The uranium mineral has been identified by Goddard and Glass (1940, p. 401) as uraninite.

Spartan No. 5 mine.—The Spartan No. 5 mine (25) is about half a mile northeast of Jamestown in sec. 19, T. 2 N., R. 71 W. The mine is accessible from Jamestown by dirt road. The mine workings were inaccessible at the time the property was examined by Wilmarth and Johnson in July 1950. Radioactivity traverse was made across the dump with the Victoreen survey meter model 263-B. Readings of 3 to 4 divisions on the 0.2 scale were noted from the dark-purple fluorite and pyrite in a gangue of altered quartz monzonite porphyry. A grab sample of the vein material contains 0.001 percent uranium. The radioactivity of the sample is equivalent to a content of 0.004 percent uranium.

Yellow Girl mine.—The Yellow Girl mine (26) is in sec. 24, T. 2 N., R. 72 W., three-fourths mile northwest of Jamestown. The mine is owned by the General Chemical Company and is accessible from Jamestown by road along Little James Creek. The Yellow Girl mine was last operated in 1943. The workings consist of a crosscut, two short adits, and a large open cut. All of the workings except the open cut were inaccessible at the time of the examination by Wilmarth and Johnson in July 1950.

The geology of the Yellow Girl mine has been described by Goddard (1946, p. 45-47). The Yellow Girl vein is in altered granodiorite and consists of coarse fragments of granodiorite in a matrix of fine- to coarse-crystalline purple fluorite, clay, quartz, pyrite, and galena. In the open cut the vein strikes N. 10° W. and dips steeply to the west.

A radioactivity survey of the open cut was made using the Victoreen 263-B survey meter. The average readings obtained in the open cut are 10 to 12 divisions on the 0.2 scale, with the high reading of 18 divisions on the 0.2 scale noted where dark-purple fluorite occurred with pyrite. A 4-foot channel sample of fluorspar ore taken from the north end of the open cut contained 0.004 percent uranium. A water sample from the lower adit contained 0.22 parts per million of uranium.

Gold Hill district

Location and general features.—The Gold Hill district is in the central part of Boulder County and includes the mining camps of Gold Hill, Rowena, Glendale, Wallstreet, Salina, and Crisman. Elevations within the district range from 5,900 to 8,400 feet above sea level. Lefthand and Fourmile Creeks span the district on the north and south.

Geology.—The geology of the district has been described by Goddard (1940, p. 103-139).

The oldest rocks in the district are the Precambrian biotite and quartz-biotite schists of the Idaho Springs formation, and Boulder Creek granite. These rocks are cut by Precambrian dikes of Silver Plume granite, aplite, cerite, and pegmatite. Laramide intrusive dike rocks include quartz monzonite, latite porphyries, and diabase. The dominant structural features of the Gold Hill district are persistent northeastward-trending faults or breccia reefs that are probably related to Precambrian shear zones.

The ore deposits of the district include gold-telluride veins, pyritic-gold veins, silver-lead veins, a tungsten vein, pegmatites, and a nickel-cobalt-copper replacement deposit.

[illegible]

Pitchblende has been tentatively identified in ore from the Black Cloud mine.

Radioactivity is associated with a few of the pegmatites, and with a vein in the Poorman breccia reef.

Breccia reefs.—The breccia reefs are a series of extremely persistent northwest-trending fractures which extend for miles across the Front Range mineral belt. In many places, the reefs form prominent silicified outcrops which are colored red by finely divided hematite. Displacement along the reefs amounts to hundreds, and at some places thousands, of feet.

These breccia reefs probably exerted a strong influence on the distribution of ore deposits, both in the localization of the districts themselves and in the localization of ore bodies within individual veins (Lovering and Goddard, 1950, p. 79).

The breccia reefs are considered favorable structures for the occurrence of uranium for the following reasons: (1) the reefs are similar in mineral composition and size to the pitchblende-bearing quartz-hematite veins of the Great Bear Lake area in Canada, and (2) recent work done by the U. S. Geological Survey in the Central City area indicates that pitchblende was probably deposited during an early stage of mineralization relative to the deposition of the pyritic-gold type ores. This genetic relationship suggested a possible association between uranium and the early quartz-hematite minerals of the breccia reefs.

Radioactivity traverses were made along parts of eight of the breccia reefs to determine whether these structures contained significant amounts of uranium. Seventeen miles of reef outcrops, representing about 25 percent of the combined lengths of the reefs, were traversed. Approximately 300 mine dumps and prospect holes, on or near the reefs, were checked for radioactivity. Radioactivity car traverses were made along approximately 70 miles of roads which had not been previously traversed.

During the course of the breccia reef investigations, significant radioactivity was noted at three localities: the Bell group of mines on Poorman Hill, the Pueblo Belle mine in Black Tiger Gulch, and the Copper Rock prospect near Sunset.

Bell group of mines.--The Bell group of mines (27), in sec. 22, T. 1 N., R. 71 W., are in the Poorman reef. The locality was examined by C. R. Butler in August 1950.

The workings of the Bell group of mines consist of an adit approximately 150 feet long.

The country rock in the vicinity of the Bell group is Boulder Creek granite. The reef, in places, contains from 10 to 20 feet of horn quartz and highly silicified granite with disseminated pyrite. The workings explore a horn-quartz vein containing disseminated pyrite in the Poorman reef near its junction with the Maxwell reef.

Radioactivity is greatest in the quartz vein but is measurable throughout the wall rock in fractures within and parallel to the reef. Analyses of five samples collected from the Bell group of mines are shown in table 16.

Table 16.—Radioactivity data on samples collected from the Bell group of mines.

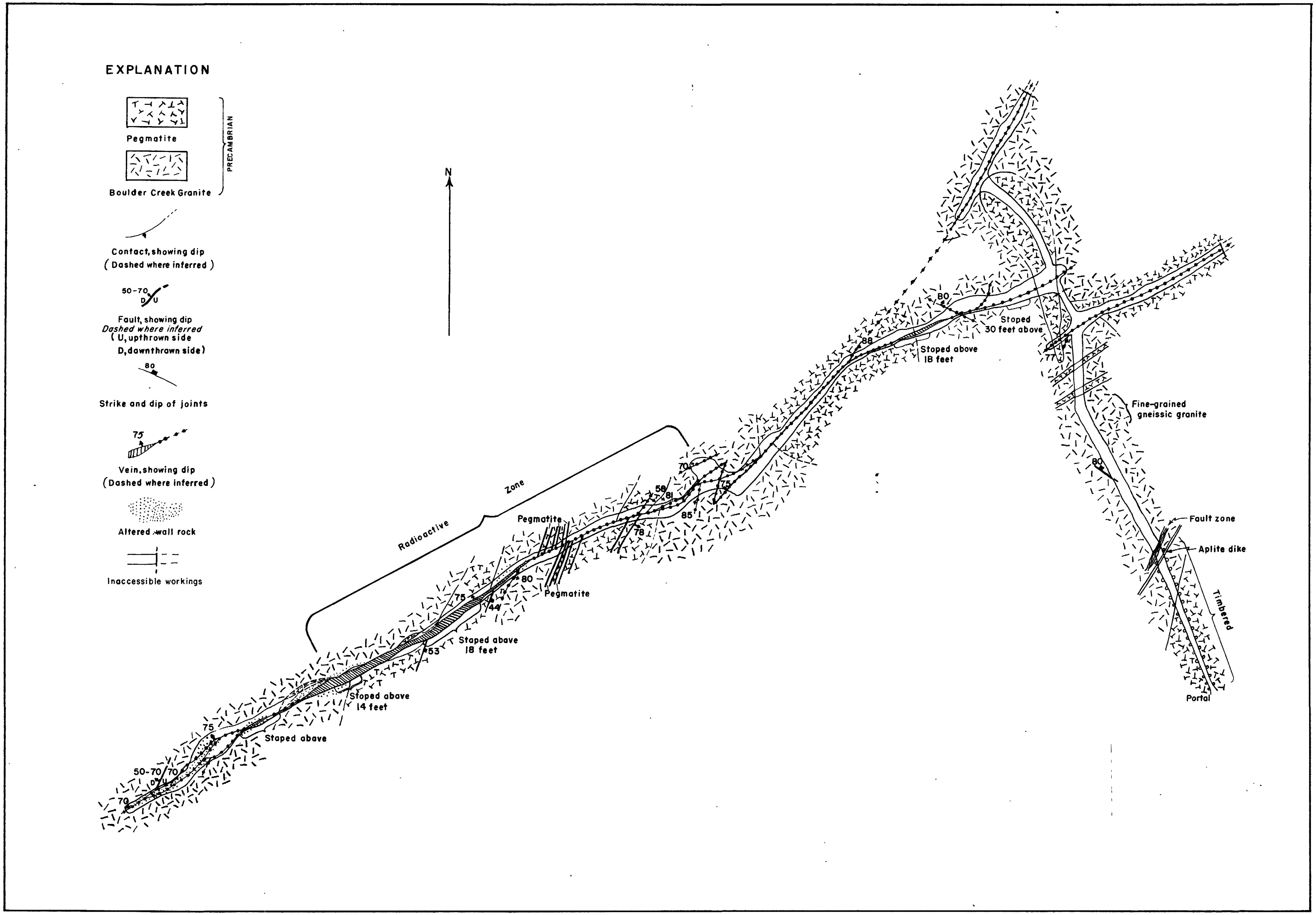
Sample number	Description	Equivalent uranium (percent)	Uranium (percent)
43546	Wall rock from hanging wall of vein.	0.037	0.030
43547	Selected material from 2-inch veinlet.	.041	.037
43548	One-foot channel sample across vein.	.029	.027
43549	One-foot channel sample across vein.	.006	.003
43550	One-foot sample along vein.	.007	.004

Analyses by A. C. Horr and J. N. Rosholt, Jr., U. S. Geological Survey, 1950.

Black Cloud mine.—The Black Cloud mine (28) is one mile east of Gold Hill in the SE$\frac{1}{4}$ sec. 12, T. 1 N., R. 72 W. The present (1950) owners are Mr. J. D. Rodgers and J. F. Little of Boulder, Colorado. Gold, silver, lead, and zinc ores were produced from the Black Cloud mine during operations prior to 1910. In 1945 the mine was reopened for a short period and it is reported that $80,000 worth of ore, principally gold, was mined from a stope below the main level. A sample of radioactive material from an unknown location in the mine contained 0.17 percent uranium. Part of the third level of the mine (fig. 6) was mapped and selected areas sampled for uranium in August 1950 by F. B. Moore, E. N. Hinrichs, and D. M. Sheridan. The workings accessible at the time of this examination consisted of a crosscut adit intersecting the Black Cloud vein, and about 1,500 feet of drift following the Black Cloud vein and a branch vein.

The Black Cloud mine is near the western border of a small batholith of Precambrian Boulder Creek granite that has been intruded into schist of the Idaho Springs formation. The Boulder Creek granite, comprising about 90 percent of the country rock near the Black Cloud mine, is a coarse-grained porphyritic granite with phenocrysts of microcline in a matrix of fine to coarse quartz, oligoclase, and biotite. Irregular masses of pegmatite and aplite cut the granite in many places in the Gold Hill district and in the vicinity of the mine. In the mine as much as 50 percent of the wall rocks is pegmatite and aplite.

These Precambrian rocks are cut by northwest-trending breccia reefs which, as suggested by Lovering (1932, p. 77-78), may be genetically related to the ore. In the Gold Hill district the Hoosier breccia reef, a



Geology by F. B. Moore, E. N. Hinrichs, and D. M. Sheridan, August 1950

FIGURE 6.—GEOLOGIC MAP OF PART OF THE THIRD LEVEL, BLACK CLOUD MINE, BOULDER COUNTY, COLORADO.

northwest-trending silicified fault zone, is 5 to 50 feet wide and about 12 miles long. Northeast-trending fissures near this reef contain gold, silver, lead, and zinc ores. The Black Cloud mine is on one of the northeast-trending fissures and is within 2,500 feet of the Hoosier reef.

The ore deposits of the Black Cloud vein contain gold and silver as the principal ores, but galena and sphalerite occur in sufficient quantities to have yielded some production. The largest ore body occurs east of the crosscut tunnel and extends for about 700 feet along the drift in the 3rd level of the mine, and according to the owners, has been stoped to the surface, 200 feet above. The ore is apparently localized near junctions of the Black Cloud vein and subsidiary branch veins. Material from the mine dump believed to have come from the east drift contained galena, sphalerite, and pyrite in quartz gangue. Specimens from the Black Cloud vein exhibited by Mr. Little showed native gold in vein and leaf form coating coarse crystalline galena. A black clay-like radioactive material occurs in the vein for 200 feet along the west drift on the third level. This material, probably pitchblende, fills fractures in the vein. In the west drift the vein is 2 to 3 feet wide and consists chiefly of dense gray quartz in brecciated iron-stained country rocks. Pyrite is finely disseminated in the quartz. In places radioactive material occurs over the width of the vein but more generally is confined to zones 6 inches to one foot wide on the hanging wall, the footwall or even within the vein. A sample of vein material from the west drift submitted by Mr. Rodgers contained 0.17 percent uranium.

Eleven samples of vein material were collected from the most radioactive part of the west drift on the third level. The analytical data are shown in table 17. The uranium content of the most radioactive interval of the vein in the west drift ranges from 0.001 to 0.081 percent. In ten of the samples the measured radioactivity (eU) is from about 2 to 12 times uranium content; one sample contains 0.049 percent eU and 0.081 percent U.

Copper King nickel mine.—The Copper King nickel mine (29) is about three-fourths of a mile southwest of Gold Hill in the NW¼ sec. 14, T. 1 N., R. 72 W. This nickel deposit has been described by Goddard and Lovering (1942, p. 349-362).

Development of the mine consists of two adit levels aggregating approximately 500 feet and a 110-foot raise connecting the two levels. A few thousand tons of nickel ore has been mined from the deposit.

The country rocks are Precambrian amphibolite schist and hornblende diorite gneiss with some pegmatite cut by a northwest-trending diabase dike of probable Laramide age.

The ore minerals replace beds in the schist and consist of pyrrhotite and small quantities of niccolite, pentlandite, pyrite, and chalcopyrite. The ore body is as much as 35 feet thick and has been mined for a vertical distance of about 250 feet.

The accessible portions of the mine workings and the surface area were examined for radioactivity by Lovering and King in June 1949. Neither the wall rocks nor the ore minerals exhibited radioactivity above normal for the local area.

Table 17.—Analytical data of samples collected from the west drift on the third level, Black Cloud mine.

Sample number	Location (distance west of adit) (feet)	Length of channel sample (feet)	Position in vein	Equivalent uranium (percent)	Uranium (percent)	Silver (ounces per ton)	Lead (percent)	Zinc (percent)
43066	330	1.0	Hanging wall.	0.012	0.002	1.4	0.22	0.02
43067	do.	1.5	Footwall.	.010	.001	1.8	.13	0
43068	340	1.0	Hanging wall.	.012	.003	1.3	.05	0
43069	do.	1.5	Footwall.	.010	.004	1.0	.11	0
43070	350	1.0	Hanging wall.	.015	.005	2.0	.31	0
43071	do.	1.5	Center.	.024	.002	1.2	0	0
43072	do.	1.5	Footwall.	.006	.002	1.4	.03	0
43065	390	1.5	Hanging wall.	.005	.003	1.0	.02	.02
43064	do.	1.0	Center.	.004	.002	1.4	.08	.02
43063	do.	.5	Footwall.	.011	.006	1.3	0	.03
43062	400	1.0	do.	.049	.081	1.2	0	.17

Analyses by J. N. Rosholt, Jr., A. C. Horr, and D. L. Skinner, U. S. Geological Survey, 1950.

Grand Republic mine.—The Grand Republic mine (30) is in Sunbeam Gulch 2 3/4 miles southeast of Gold Hill in sec. 19, T. 1 N., R. 71 W. Radioactivity examination was made of the surface area and mine dumps by Lovering and King in June 1949; the mine workings were inaccessible at the time of the examination.

The following description of the Grand Republic mine is briefly summarized from Lovering and Goddard (1950, p. 251-253).

The output of the mine is valued at over $100,000 chiefly as gold and silver, but over $80,000 worth of tungsten ore is also credited to this mine. The mine is developed by an adit, an inclined shaft, and drifts on several levels totaling about 2,000 feet of workings.

The country rock is Boulder Creek granite and related pegmatite and aplite dikes. The Hoosier breccia reef lies 100 feet east of the shaft.

The ore deposit consists of a strongly mineralized breccia zone, containing disseminated pyrite in stringers of horn quartz. Marcasite, arsenopyrite, and ferberite are present in minor quantities in the veins.

No abnormal radioactivity was noted from wall rocks or vein material on the dumps nor from the Hoosier breccia reef at this locality.

Hoosier dike.—The Hoosier dike (31) or breccia reef, a persistent silicified fault zone, extends S. 40° E. 12 miles from Gold Hill to the sedimentary rocks flanking the eastern edge of the Front Range and crosses Boulder Creek approximately 3 miles west of Boulder.

Approximately 3 miles of the reef between Boulder Creek and Gold Hill were traversed for radioactivity and 50 mine dumps and pits on and adjacent to the reef were examined for radioactivity by C. R. Butler on August 10 and 11, 1950. The locality shown on figure 2 representing the Hoosier dike is that of the Evans mine in sec. 13, T. 1 N., R. 72 W.

The dike is composed of brecciated granite of the wall rocks and fine-grained quartz with veinlets of hematite and disseminated hematite. It is from 5 to 50 feet wide and in places is made up of bull quartz (Lovering and Goddard, 1950, p. 251-253).

Radioactivity greater than that of the surrounding Boulder Creek granite was not observed on the outcrop of the portion of the reef traversed, except in the vicinity of the portal of the Evans mine 1,300 feet west of the reef. At this locality the radioactivity was estimated to be 0.005 percent equivalent uranium. The cause of the radioactivity anomaly was not determined, but may be due to small quantities of accessory radioactive minerals present in the country rock.

Maxwell dike.—The Maxwell dike (32) or breccia reef extends southeastward across the Front Range from Nugget Hill 11 miles to the flanking sedimentary rocks crossing Boulder Creek 2 miles west of Boulder. It may also extend northwestward, several miles beyond Jamestown. It is from 50 to 150 feet wide and is characterized by reddish colored sheared and silicified granite and gneiss (Lovering and Goddard, 1950). Three one-mile intervals of the Maxwell breccia reef were traversed for radioactivity on August 15 and 16, 1950, by C. R. Butler. The intervals selected for traversing were those most accessible by road and included (1) a portion northwest of Jamestown, (2) a portion southeast of Jamestown, and (3) a portion west of Boulder near Boulder Creek in sec. 27, T. 1 N., R. 71 W., the locality shown on figure 2. Approximately 75 mine dumps and prospect pits on and near the dike were included in the traversing.

The highest radioactivity observed along the dike traversed was estimated to be 0.005 percent equivalent uranium.

Pegmatite prospects on Butzel Hill.—Six pegmatite prospects (33) are clustered about the crest of a ridge known as Butzel Hill within an elongate area 300 feet wide by 1,000 feet long in secs. 5 and 6, T. 1 N., R. 71 W. Two of these are known as the Beryl or Gold Hill No. 1 and No. 2 prospects; the other four pegmatite prospects are not identified by name. The locality was examined by K. G. Brill in 1947.

The pegmatite deposits are exposed by shallow pits and trenches along the crest of the ridge and a short distance below the crest on the south and east slopes.

The country rock is granite gneiss and biotite augen gneiss, trending N. 60°–65° E. The pegmatites are tabular and range in size from about 100 feet by 50 feet in the Beryl No. 2 to 400 feet by 50 feet in the Beryl No. 1. The other pegmatites are also tabular and are intermediate in size.

The pegmatites have two distinct strike directions, approximately at right angles to each other, one set strikes about N. 30° E. and the other strikes about N. 65° W. The dips vary from flat to steep and are both to the north and south.

The pegmatites are both zoned and unzoned; where zoned the cores commonly consist of quartz, feldspar, and muscovite with wall zones of coarse-grained granite intergrowth; where unzoned or obscurely zoned the dikes consist of quartz-microcline-muscovite, biotite, and plagioclase pegmatite. In places the dikes are composed of aplite. Some bluish-green beryl and columbite-tantalite is present in the Beryl No. 1 prospect.

No unusual concentration of radioactive minerals was noted in these pegmatitic rocks on Butzel Hill. The maximum radioactivity found in fine-grained granitoid rock with small biotite books in the Beryl No. 2 prospect is equivalent to a content of about 0.007 percent uranium; otherwise, the estimated radioactivity of the pegmatites ranged from less than 0.001 to 0.005 percent equivalent uranium.

Poorman dike.—The Poorman dike (34) or breccia reef strikes N. 85° W. and extends westward for about 5 miles from Boulder, cutting across the Maxwell reef and intersecting the Hoosier reef in sec. 20, T. 1 N., R. 71 W. It is a fault zone 10 to 20 feet wide and consists of sheared and highly silicified granite with disseminated hematite.

Approximately 3.5 miles of the Poorman reef including approximately 25 mine dumps and pits was traversed for radioactivity by C. R. Butler in August 1950. Significant radioactivity estimated to range from 0.006 to 0.041 percent equivalent uranium was detected in the underground workings of the Bell group of mines. The radioactivity is apparently associated with a vein in the reef rather than with the reef itself.

Radioactive quartz monzonite on Butzel Hill.—Radioactive quartz monzonite (35) is exposed in three places on the southeast side of Butzel Hill in the SE¼ sec. 6, T. 1 N., R. 71 W., about two miles northeast of Gold Hill. The locality was examined for radioactivity by K. G. Brill, Jr., during the summer of 1947.

The country rock consists of biotite augen gneiss.

The largest quartz monzonite body is exposed for 300 feet northeasterly along the crest of Butzel Hill. It has a maximum width of 30 feet. Two smaller bodies of quartz monzonite crop out 150 feet to the southeast and 100 feet to the west of the top of the hill.

The quartz monzonite bodies are light-gray, fine- to medium-grained granitoid rocks and consist of quartz, potash feldspar, plagioclase, and biotite.

The radioactivity of the granitoid rocks ranges from an estimated 0.001 percent to 0.004 percent equivalent uranium.

Snowbound mine.—The Snowbound mine (36) is about 2 miles northeast of Gold Hill in sec. 6, T. 1 N., R. 71 W. The mine was examined by K. G. Brill, Jr., in 1947, and the surface area in the vicinity of the mine was examined in 1949 by R. U. King.

The mine is developed by a shaft which has been intersected by an adit at the first level. The extent of the workings is unknown.

The Snowbound mine explores several quartz veins containing gold-silver, and lead. The country rock consists of Precambrian augen gneiss.

The radioactivity ranges from less than 0.001 percent equivalent uranium in the augen gneiss to about 0.007 percent equivalent uranium in an auriferous quartz vein cut by the adit. A sample of a gold-quartz vein, 50 feet S. 40° W. of the sump in the adit contained 0.006 percent uranium.

Wilson beryl prospect.—The Wilson beryl prospect (37) is a mile and a half east of Gold Hill in the E½ sec. 7, T. 1 N., R. 71 W. The prospect was examined for uranium in 1947 by K. G. Brill, Jr. Workings consist of an upper and lower pit.

The country rock consists of Precambrian biotite granite gneiss.

The Wilson beryl prospect is a distinctly zoned pegmatite about 10 feet wide by 200 feet long, trending N. 30° W. The south contact alone is exposed and dips 42° N. The core of the pegmatite is 6 feet wide and contains quartz, potash feldspar, small books of muscovite, and beryl. The wall zone consists of a quartz-feldspar intergrowth with a dark metallic mineral and is 2 to 3 feet wide where exposed on the south side. Part of the north wall zone is obscured by talus.

A sample of the granite from the south wall zone contains 0.005 percent equivalent uranium and 0.002 percent uranium.

Yellow Pine mine.—The Yellow Pine mine (38) is in sec. 20, T. 1 N., R. 71 W., 3 miles southeast of Gold Hill. The dumps were examined for radioactivity in June 1949 by T. S. Lovering and R. U. King. The mine workings were inaccessible.

The following account of the Yellow Pine mine is from Lovering and Goddard (1950, p. 247-249). The mine is developed by six levels, an underground shaft, and several winzes. It is credited with an output of several hundred thousand dollars worth of silver-gold ore.

The country rock is chiefly Beulder Creek granite, but there is some pegmatite and aplite. The mine is near the Hoosier breccia reef, a major northwest-trending structural feature of the area. The veins exploited include the Yellow Pine, Hoosier breccia reef, Mud, Gray Copper, Vaucleuse, and Michner. The chief ore minerals of the Yellow Pine vein are argentiferous galena and gray copper (freibergite (?)), with some sphalerite and pyrite. The gangue is made up of glassy quartz and silicified wall rock.

No abnormal radioactivity was detected on either the ore minerals or wall rocks on the dumps.

Ward district

The Ward district is in the west-central part of Boulder County and includes an area of about 12 square miles southwest of the Jamestown district and west of the Gold Hill district.

The district includes the towns of Ward, Sunset, and Copper Rock.

The geology of the Ward district has been described by Worcester (1921) and Lovering and Goddard (1950, p. 202-206).

The Precambrian rocks exposed in the district consist of schists and gneisses of the Idaho Springs formation and Silver Plume granite. The Precambrian rocks are cut by stocks and dikes of Tertiary age that range in composition from diabase to alaskite. A stock of bostonite porphyry crops out in the southern part of the district between Copper Rock and Sunset.

The Livingston breccia reef, a northwest-trending silicified fault zone, passes through the district near its eastern border. At Copper Rock there is a wide zone of fracturing and brecciation, extending along the east side of the bostonite porphyry stock. The zone has a general north-south trend and is over one-half mile wide by one mile long.

The ore deposits of the district are chiefly in northwest-trending pyritic gold-silver veins. The chief metals produced from the district include gold, silver, and lead, but copper, zinc, and tungsten have also been mined. Some molybdenite and wolframite are noted in the deposits.

Copper Rock area.—The Copper Rock area (39) in sec. 22, T. 1 N., R. 72 W., is about two miles east of Sunset. As the name implies, this locality is easily identified by the conspicuously green copper stained outcrop of about 200 square feet 100 feet north of the road leading from Boulder to Sunset. The area was examined by C. R. Butler in August 1950.

Copper-bearing porphyry dikes and a bostonite porphyry stock intrude brecciated biotite schist of the Idaho Springs formation. The schist is chloritized, sericitized, and silicified and is fractured and brecciated near the contacts with the porphyry dikes.

A wide zone east of the bostonite stock has been unevenly mineralized. Pyrite and chalcopyrite are disseminated along fractures throughout the brecciated rocks (Lovering and Goddard, 1950, p. 208). The close spacing of the mineralized fractures—a few inches to more than a foot—gives a disseminated character to the mineral deposits in the Copper Rock area. Exposures are limited because much of the area is covered by slide rock.

Abnormal radioactivity was detected at this locality by car traversing. Meter readings of the car-mounted geiger counter increased two-fold opposite the outcrop. Radioactive material seems to be concentrated along fractures in the dike rocks. Measurements made on the outcrop indicate the radioactivity of the brecciated rocks is equivalent to a content of about 0.005 percent uranium.

Lois, Sunnyview, and Johanna claims.—The Lois, Sunnyview, and Johanna claims (40) are in the NW¼ sec. 1, T. 1 N., R. 73 W., in the Ward mining district a quarter of a mile northwest of Ward, Boulder County. The claims are owned by Miss N. L. Benson of Denver, Colorado. The property was examined on August 14, 1950, by F. B. Moore, E. N. Hinrichs, and D. M. Sheridan. The mine workings on the Lois claim consist of a 30-foot inclined caved shaft and a 70-foot tunnel.

Precambrian rocks exposed in the tunnel on the Lois lode claim include biotite schist of the Idaho Springs formation and weathered Silver Plume granite (fig. 7). Small pegmatites up to 2 inches in width are generally parallel to the foliation of the schist.

A two-inch copper-stained gougy zone is exposed in the back for about 10 feet from the breast of the tunnel. Gold is reported to occur with pyrite in quartz veins in this area.

Radioactivity above normal was not detected in any of the accessible mine workings, on the dumps, or in the several prospect pits on the Lois, Sunnyview, and Johanna claims. Samples of vein material from the Lois claim submitted by the owner contained from 0.001 to 0.003 percent uranium.

Boulder County tungsten district

The Boulder County tungsten district (Lovering and Goddard, 1950, p. 214-220), in the south-central part of Boulder County, extends in a southwesterly belt 1 to 3 miles wide, from about four miles west of Boulder to a mile west of Nederland. This district has accounted for most of the tungsten produced in Colorado.

Altitudes range from 6,000 feet to 9,000 feet above sea level. The district is drained chiefly by North and Middle Boulder Creeks.

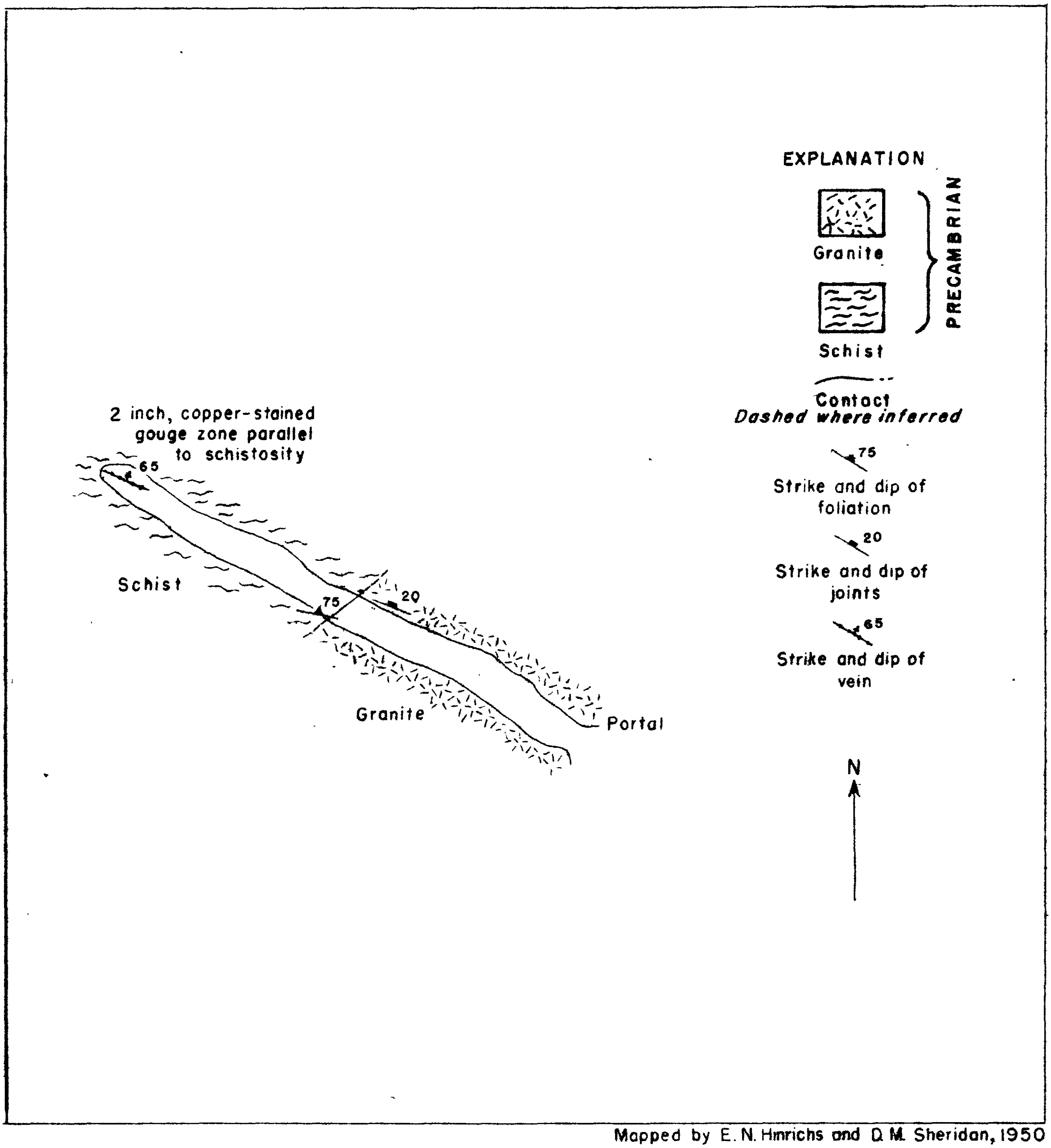


FIGURE 7– MAP OF THE LOIS LODE TUNNEL, BOULDER COUNTY, COLORADO

10 0 10 20 Feet

The eastern three-fourths of the district is in granite of the Boulder batholith and the western part is largely in schist of the Idaho Springs formation. Aplite and pegmatite form small intrusive bodies in both the granite and the schist. The Precambrian rocks are cut by dikes of monzonite and andesite porphyry in the eastern and western extremities of the district.

There are two prominent sets of fractures in the district: a northwest set, the more prominent of which are known as breccia reefs, and a less persistent, though more numerous, northeast-trending set occupied by tungsten veins. The vein materials consist chiefly of quartz and ferberite, but iron, copper, silver, lead, and zinc sulfides are present. Scheelite is an accessory mineral, though in a few veins it occurs in sufficient quantity to be mined as ore. No pitchblende is known to occur in the vein deposits of the Boulder County tungsten district.

Significant radioactivity was noted at only two localities in the district, although more than 130 mines and prospects and more than 5 miles of breccia reef outcrop were examined for radioactivity. Radioactivity amounting to 0.071 percent equivalent uranium is associated with ferberite in a quartz vein at the Pueblo Belle mine. In the Wheelman tunnel radioactivity associated with pegmatite amounts to 0.013 percent equivalent uranium.

Hurricane Hill dike.—The Hurricane Hill dike (41) or breccia reef extends from approximately three miles northwest of Tungsten, Colorado, southeastward for 12 miles through Pine Cliff, Colorado. The locality shown on figure 2 is approximately the northwestern extremity of the reef in sec. 7, T. 1 S., R. 72 W. It is a pre-Laramide fault zone containing silicified brecciated granite and disseminated hematite. It is from 10 to 20 feet wide. The reef was examined for radioactivity by T. S. Lovering and R. U. King on June 13, 1949.

The Hurricane Hill reef is slightly radioactive in the vicinity of the Barker Reservoir. The radioactivity amounts to about three times that of the enclosing Boulder Creek granite and the schist of the Idaho Springs formation. It is estimated that the radioactivity is equivalent to a content of 0.008 percent uranium. Radioactivity traversing by C. R. Butler on August 9, 1950, of two miles of this reef, and of about 75 mine dumps and pits on and adjacent to the reef in the vicinity of Tungsten indicates no significant radioactivity other than that mentioned above.

Livingston dike.—The Livingston dike (42) or breccia reef is a hematitic silicified breccia zone from 10 to 50 feet wide in granite and schist, extending from near Gold Hill southeast for 15 miles, crossing Boulder Creek 6 miles west of Boulder and continuing to the eastern flank of the Front Range. For convenience the locality is shown in sec. 25, T. 1 N., R. 72 W.

Radioactivity traversing by C. R. Butler in August 1950 of about 2 miles of the Livingston breccia reef north of Boulder Creek and of 50 mine dumps and pits on and near the reef showed abnormal radioactivity only at the Pueblo Belle mine. The radioactivity is associated with a quartz vein cutting the reef, and amounts to 0.017 percent equivalent uranium.

Primos mine.—The Primos mine (43) is in sec. 12, T. 1 S., R. 73 W., 1½ miles northwest of Nederland, Colorado. Workings in the immediate area include four inaccessible shafts and numerous small trenches, adits, and open cuts. The country rock is Idaho Springs schist, injection gneiss, and pegmatite. Much of the material on the dumps is bleached and iron-stained. Small quantities of ferberite occur in white vein quartz and in fine-grained, gray-banded quartz. No abnormal radioactivity was observed on the dumps of any of the mine workings.

Pueblo Belle mine.—The Pueblo Belle mine (44) is in sec. 31, T. 1 N., R. 71 W., about six miles west of Boulder. The mine is owned by Mr. Merle Potter, President of the Shattuck Chemical Company of Denver, Colorado. Although the mine has been in operation within the past ten years, the workings were caved and inaccessible at the time the mine was examined by C. R. Butler in August 1950.

Ore minerals, chiefly ferberite, occur in a pyritic-quartz vein in Boulder Creek granite. Radioactivity was noted in the wall rock of a surface trench along the vein, and also in close association with ferberite and gray cherty quartz on the dump. A channel sample of the wall rock contained 0.008 percent equivalent uranium, but only 0.002 percent uranium. A sample of vein material from the dump contained 0.071 percent equivalent uranium and 0.005 percent uranium. The association of radioactivity with tungsten veins is rare in the Colorado Front Range.

Wheelman tunnel.—A radioactive pegmatite dike is exposed in the Wheelman tunnel (45) seven miles by road west of Boulder. The property, including the Paymaster, and Teddy Nos. 1, 2, and 3 claims, are in the Boulder County tungsten district, in sec. 31, T. 1 N., R. 71 W., Boulder County. The property is owned by the M. C. Morrison estate and is under option to Mr. C. W. Hickox of Boulder. The tunnel was mapped by D. G. Wyant and G. B. Gott during September 16-19, 1948 (Wyant, 1949a).

The mine workings consist of a crosscut tunnel (Wheelman) 515 feet long, and two drifts at right angles to the tunnel, totaling 150 feet in length. No production is known from this mine.

The Wheelman tunnel penetrates Precambrian Boulder Creek granite about 1½ miles east of the eastern edge of the Boulder tungsten district, and near a fracture system containing gold, silver, lead, and zinc veins (Lovering and Goddard, 1950).

The granite in the vicinity contains a network of quartz-muscovite pegmatite dikes. An unidentified black mineral occurs in the pegmatites. A fine-grained aplitic dike also cuts the granite. All the dikes are presumably of Precambrian age, and probably fill faults and fractures in the granite. They are irregular in shape and generally lack continuity.

There are probably three generations of faulting and fracturing: an early stage followed by the quartz-pegmatite injection; a later stage followed by the formation of carbonates, fluorite, and some vein quartz; and third or post-mineral stage. The faulting is generally normal, and offsets are small.

The pegmatite dike exposed in the drifts averages about 4 feet in thickness. The dike strikes N. 75° to 80° W. and dips steeply northeast.

The average radioactivity of the Precambrian Boulder Creek granite is equivalent to a content of 0.004 percent uranium; that of the aplite and other quartz feldspar dikes and of some carbonate-healed faults and fractures equivalent to 0.005 percent uranium; and the average radioactivity of the main quartz-feldspar pegmatite dike equivalent to a content of 0.012 percent uranium. The uranium content of the rocks in the Wheelman tunnel ranged from 0.001 percent in the Boulder Creek granite to 0.013 percent in the quartz-feldspar-muscovite pegmatite. The results of analyses of samples of the several rock types from the Wheelman tunnel indicate that not all of the radioactivity is due to uranium and that thorium or other radioactive elements are present in small quantities.

Grand Island-Caribou and Eldora districts

Location and general features.—The Grand Island-Caribou and Eldora districts occupy the southwestern corner of Boulder County and form a rectangular area from Nederland west to the Continental Divide, and from Arapaho Peak south to the Gilpin County line. The area is well traversed by roads so that most of it is accessible by car. Nederland, at the eastern edge of the area, is 17 miles by road west of Boulder.

The districts include the mining camps of Caribou, Grand Island, Cardinal, Hessie, and Eldora.

The topography is moderate in the eastern part of the area to steep and precipitous toward the western part. Elevations range from 8,200 feet at Nederland to over 13,000 feet above sea level at the Continental Divide. The higher portions of the area have been glaciated and glacial waste material partly fills the east-trending valleys. Middle Boulder Creek and its tributaries form the drainage flowing east through Nederland.

Geology.—The area is underlain with Precambrian schist, gneiss, and granite that has been intruded by stocks and dikes of late Cretaceous or early Tertiary quartz monzonite.

The ore deposits consist of lead-zinc-silver veins and gold-telluride veins chiefly within the quartz monzonite but in places they occur in

Precambrian rocks. The veins trend from northeast to east except in the few places where the trend is north-northwest.

Pitchblende occurs in small quantities with argentiferous galena, sphalerite, and pyrite on the lower levels of the Caribou mine.

Significant radioactivity is found only in the Caribou, Platteville, and Shirley mines.

Antietam mine and nearby shaft.—The Antietam mine and nearby shaft (46) are in sec. 16, T. 1 S., R. 73 W., three-quarters of a mile north of Eldora, Colorado. The mine consists of a 390-foot adit at the contact of Precambrian quartz monzonite gneiss and Idaho Springs schist. A drift, 355 feet from the portal, extends 105 feet southwest and 40 feet northeast along a fault zone. This zone is 6 to 18 inches wide and strikes N. 65° E. and dips 70° NW. A one-quarter inch wide quartz-hematite veinlet, striking N. 75° W. and dipping 65° SW., 125 feet from the portal is slightly radioactive and contains an estimated 0.005 percent equivalent uranium, but a channel sample assayed only 0.001 percent uranium. No other radioactivity was noted in the mine, on the dump, or at the caved shaft approximately 300 feet southeast of the portal of the Antietam mine.

Arapahoe Gem mine.—The Arapahoe Gem mine (47) is in sec. 20, T. 1 S., R. 73 W., southwest of Eldora, It is also known as the Swathmore mine. Accessible workings consist of 420 feet of tunnel. Veins of pyrite in vuggy quartz cut Idaho Springs schist and quartz monzonite gneiss. Bastin and Hill (1917, p. 188-189) report probable roscoelite and molybdenite in the ore. No radioactivity was detected in the accessible mine workings.

Bluebird group of mines.—The Bluebird group of mines (48) is in sec. 2, T. 1 S., R. 73 W., on the west side of North Boulder Creek about 2½ miles northwest of Nederland, Colorado. Two tunnels—the Bluebird and the Bravo—are connected by 800 feet of drifts and inclined crosscuts. A 70-foot adit opens to the surface 100 feet north of the portal of the Bravo tunnel. There are numerous flat-lying stopes along the underground workings. The southern part of the workings are in Boulder Creek granite and the northern part cut Precambrian pegmatite, lenses of Idaho Springs schist, and a small dike of andesite porphyry. Quartz-sulfide veins, one-half to 18 inches thick, strike N. 70° E. and dip 15° to 28° SE. The veins consist mostly of quartz, in crystals as much as one inch in diameter. Galena, chalcopyrite, malachite, specularite, and barite occur in vuggy openings in the veins. The quartz-sulfide veins were not radioactive. Radioactivity was found in a body of coarse-grained biotite-rich potash feldspar-quartz pegmatite at a point 240 feet from the portal of the Bravo tunnel along a crosscut to the Bluebird tunnel. A channel sample assayed 0.004 percent uranium compared to 0.032 percent equivalent uranium indicating that much of the radioactivity probably is caused by thorium or other radioactive elements in the pegmatite.

Caribou mine.—The Caribou mine (49) is about five miles northwest of Nederland, Colorado, in secs. 8 and 9 of T. 1 S., R. 73 W., in the Grand Island mining district. A graded dirt road from Nederland provides access to the Caribou mine and vicinity. The Idaho tunnel, the main entrance to the mine, is about 9,700 feet above sea level; the collar of the Caribou shaft is at an altitude of about 10,100 feet. The topography and vegetation are typical of unglaciated areas in the Front Range.

The Caribou mine consists of a 3,645-foot adit, known as the Idaho tunnel (500 level), connecting with the 1,100-foot inclined Caribou shaft, and about 7,000 feet of drifts on five levels above and nine levels below the Idaho tunnel (King, 1950b; Moore, Cavender, and Kaiser, 1954).

Originally the Caribou and other mines of the district were worked for silver and lead. Ore has been produced intermittently from the date of discovery, about 1869, until 1928. No production was recorded from 1928 to 1945. The mine dumps were found to be radioactive by Mr. G. C. Ridland in 1945, and rehabilitation of old workings was started. In 1948 pitchblende was found on the 1,040 level of the mine (Ridland, 1950).

In the vicinity of the Caribou mine, Precambrian metamorphic and igneous rocks have been intruded by stocks of Tertiary monzonite. The Caribou mine is in one of these intrusive bodies, the Caribou stock (Bastin and Hill, 1917, p. 42-49). The Caribou stock is composed of rocks that grade from porphyritic monzonite to diorite. Monzonite exposed in the mine consists of a dark-gray, medium-grained, felsitic matrix and abundant phenocrysts of plagioclase, orthoclase, augite, and biotite.

The stock is cut by numerous faults and fractures, but the amounts and directions of the displacements cannot be determined. Scattered, irregular zones of soft, friable, decomposed porphyry parallel some of the faults, fractures, and veins.

Two prominent sets of quartz-carbonate veins cut the monzonite porphyry in the Caribou district. They intersect at about 45 degrees and for the most part occupy fault fissures. The veins having a northeasterly strike and steep northerly dip (the No Name and Silver Dollar veins) are generally more persistent and may be traced to greater depths than the veins that strike east and dip steeply to the north (the Caribou, Poorman, and Radium veins). The No Name vein strikes N. 50° E. and dips 40° to 85° N. The Radium vein branches from the No Name vein, strikes east, and dips from 70° N. to 80° S.

The relationship between the Caribou and Poorman veins and the Radium vein is not clearly understood. In the upper levels of the mine, the Caribou vein joins the No Name vein at an angle of about 35 degrees and on the 1,040 level of the mine the Radium vein branches to the east from the No Name vein. On the 1,040 level slickensides and gouge are found on the footwall of the No Name vein and one to 10 feet of highly fractured rock at the hanging wall. The grooves and striations of the slickensides are predominantly horizontal. The relative direction of movement of the walls is not clear.

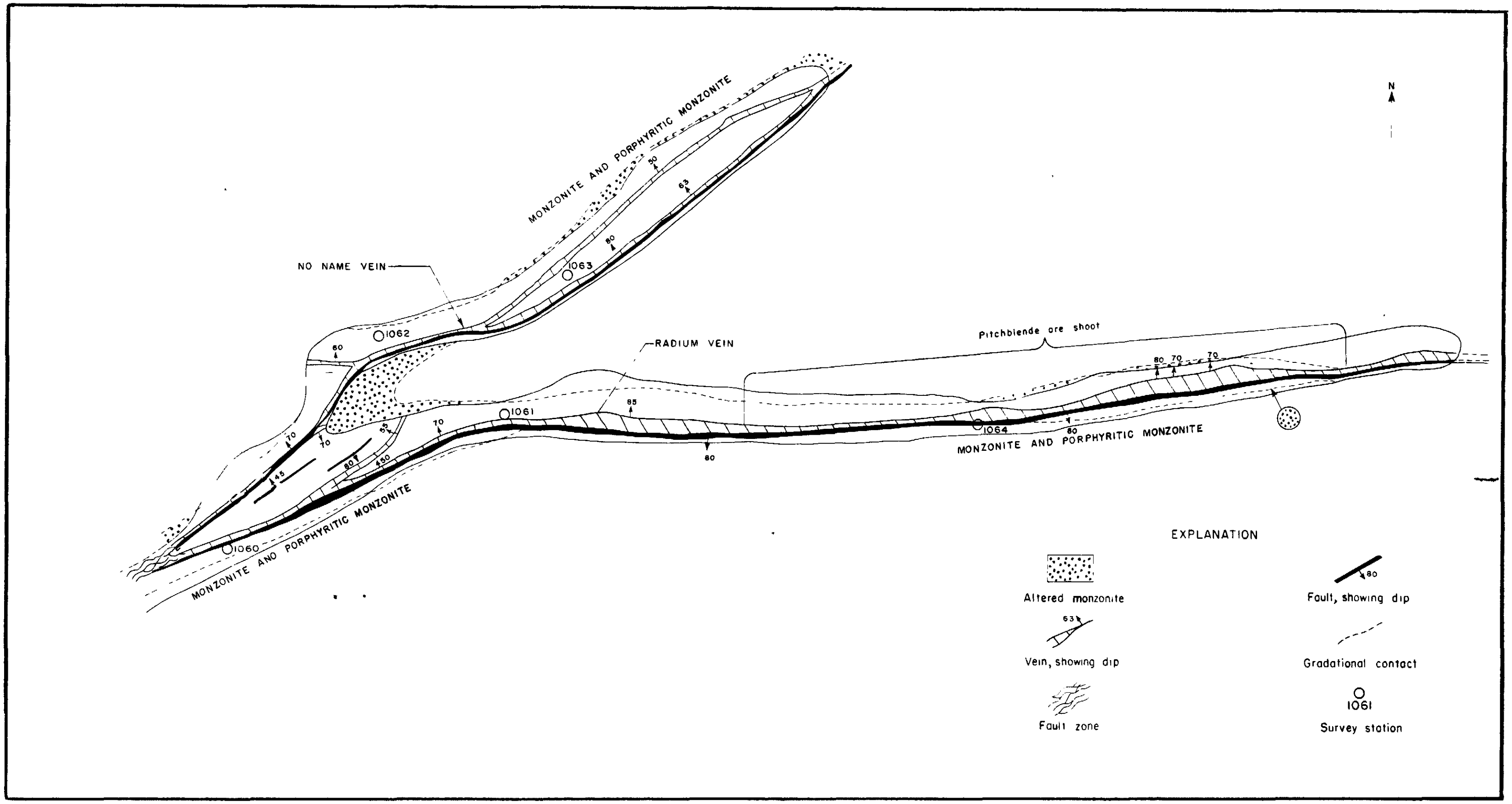
The ore deposits of the Caribou mine are found at or near the intersection of the east-trending and the northeast-trending veins. Hydrothermal alteration of the monzonite adjacent to the Caribou and No Name veins has produced zones, from a few inches to as much as 10 feet thick, of light-gray, bleached, soft, friable rock. Thin hard ribs of silicified monzonite stand out prominently in the altered zones.

The mineral content of the Caribou and No Name veins is similar. Galena and sphalerite are the principal ore minerals; marmatite and ruby silver are present in subordinate amounts. The gangue consists of quartz, dolomite, and gouge. Locally the veins contain vugs lined with crystals of quartz, dolomite, and sphalerite. Rarely, native wire silver is found in small lenticular vugs. In some places, the No Name vein is composed solely of massive fractured dolomite.

The Radium vein is similar in mineralogy and hydrothermal alteration to the No Name and Caribou veins, but in addition carries appreciable quantities of pitchblende. Most of the pitchblende is a sooty black powder mixed with fine-grained pyrite and black gouge. This material is generally found in a well-defined streak up to one inch wide, though rarely up to six inches wide, along the footwall of the vein. At places the streak is split, one portion of it crossing the vein and dying out in the hanging wall or returning to the footwall, and the other part continuing along the footwall.

Some of the pitchblende occurs as solid lenticular masses up to a foot in length. These bodies are irregularly distributed along the vein and are particularly abundant immediately below the 1,040 level. Appreciable quantities of pitchblende occur in the Radium vein along the east drift, 68 to 138 feet from its junction with the No Name vein (fig. 8). In addition, a drift at about the 1,054 level exposed some pitchblende. Radioactivity decreases sharply in the vein where it is exposed in a raise between 50 and 70 feet above the 1,040 level. However, a winze on the vein, driven in March 1950, is reported to have cut small scattered lenses of massive pitchblende in the first 40 feet of workings.

At the 1,040 level the uranium-bearing ore shoot in the Radium vein is known to extend for 70 feet along the strike, and for about 100 feet along the dip of the vein. Samples, taken from this ore shoot,



Map by R U King, E.P Beroni, and H.C Granger, December 1948.

FIGURE 8.– GEOLOGIC MAP OF THE RADIUM VEIN AND PART OF THE NO NAME VEIN, 1040 LEVEL, CARIBOU MINE, BOULDER COUNTY, COLORADO

10 0 10 20 30 FEET

contained from 0.001 to 1.23 percent uranium. The distribution of massive pitchblende within this area is erratic, and the individual lenses or pods are separated by distances as great as 30 feet. The sooty pitchblende has a more uniform distribution. Low-grade (less than 0.008 percent uranium) parts of the vein are as much as 10 feet in extent. In places beyond the limits of the ore shoot, individual assays indicate that the vein material contains as much as 0.5 percent uranium.

Study of the chemical assays suggests that the uranium content appears to vary directly with the copper, lead and silver content, and inversely with the zinc content.

There may be sufficient silver, lead, zinc, and copper in the vein to make it economically minable and there is a definite possibility of increasing reserves of these metals by exploration, either by drilling or drifting on the vein.

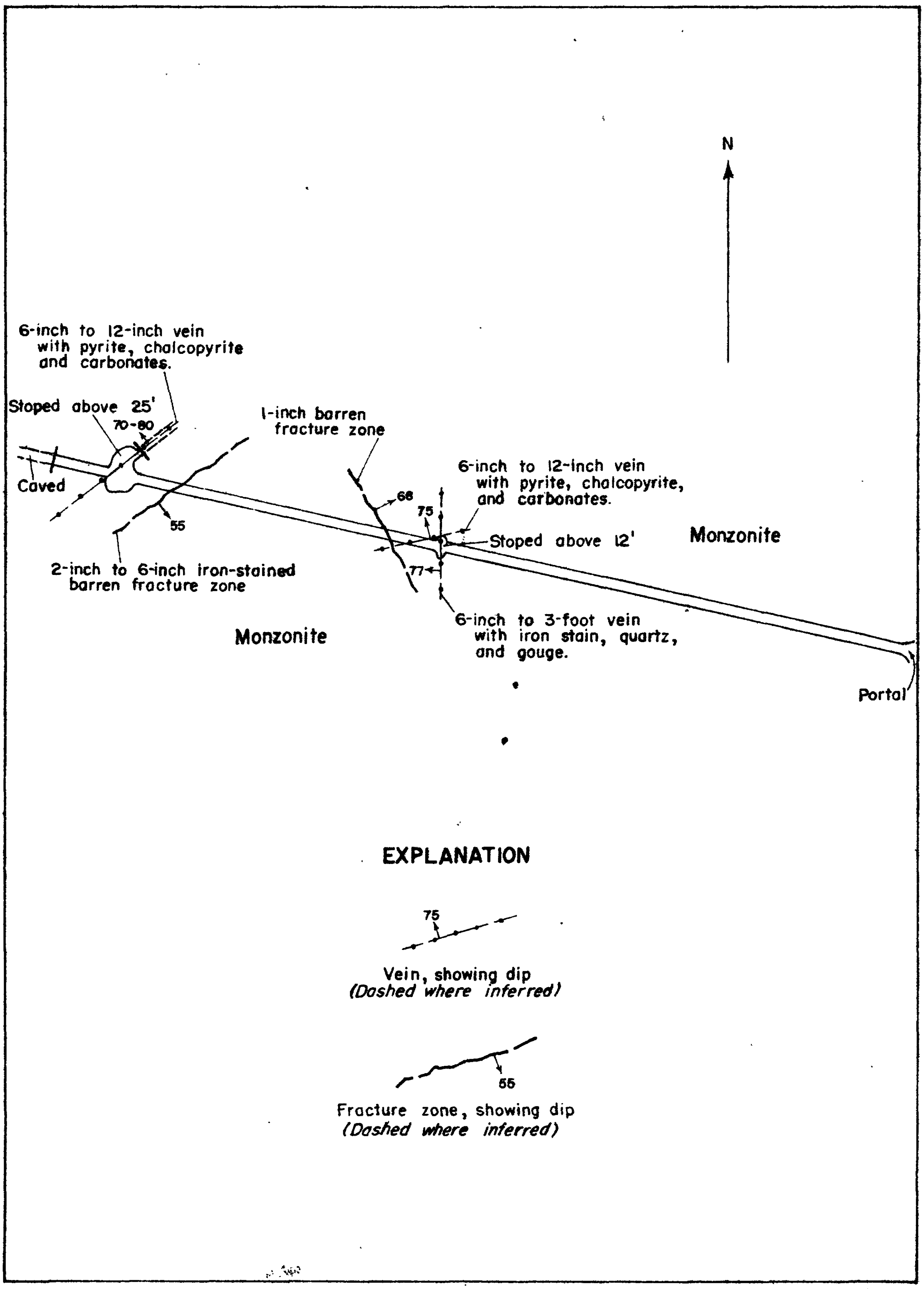
Further study of the distribution of the zinc, copper, and silver values in relation to the uranium values in the Radium vein and associated studies of the distribution of the minor element content, may aid in delimiting veins or parts of veins favorable for uranium deposits.

Congo Chief mine.—The Congo Chief mine (50) is in sec. 4, T. 1 S., R. 73 W., half a mile northeast of Caribou. The mine is in Idaho Springs schist near the contact with Boulder Creek granite to the east and the contact with monzonite of the Caribou stock to the west. The mine workings consist of a shaft of unknown depth which could not be entered. The dumps were examined by D. M. Sheridan and E. N. Hinrichs in September 1950. Vein material from the dump contained galena, sphalerite, and copper-stained quartz-carbonate gangue. No radioactivity was noted on the dump.

Denver Group mine.—The Denver Group mine (51) is in sec. 7, T. 1 S., R. 73 W., one-eighth mile southwest of Grand Island. The mine was worked from a tunnel—accessible for 1,135 feet—driven in a small monzonite stock (fig. 9). Three veins ranging in width from 6 inches to 3 feet are exposed in the tunnel. They contain minor amounts of pyrite and chalcopyrite in quartz and carbonate gangue. No abnormal radioactivity was observed in the tunnel.

Enterprise, Gold Dust, Village Belle, and Bird's Nest mines.—Four mines, the Enterprise, Gold Dust, Village Belle, and Bird's Nest (52) are closely grouped in sec. 20, T. 1 S., R. 73 W., half a mile southwest of Eldora. Mine workings consist of a few hundred feet of shafts and about 500 feet of adits and drifts, for the most part inaccessible. The country rock in the area of the mines is Idaho Springs schist, injection gneiss, and pegmatite. The veins, one-half to six inches wide, which fill fissures in shear zones, contain quartz, pyrite, carbonates, and gold tellurides in small amounts. No radioactive material was found on the dumps or in the accessible workings of these mines.

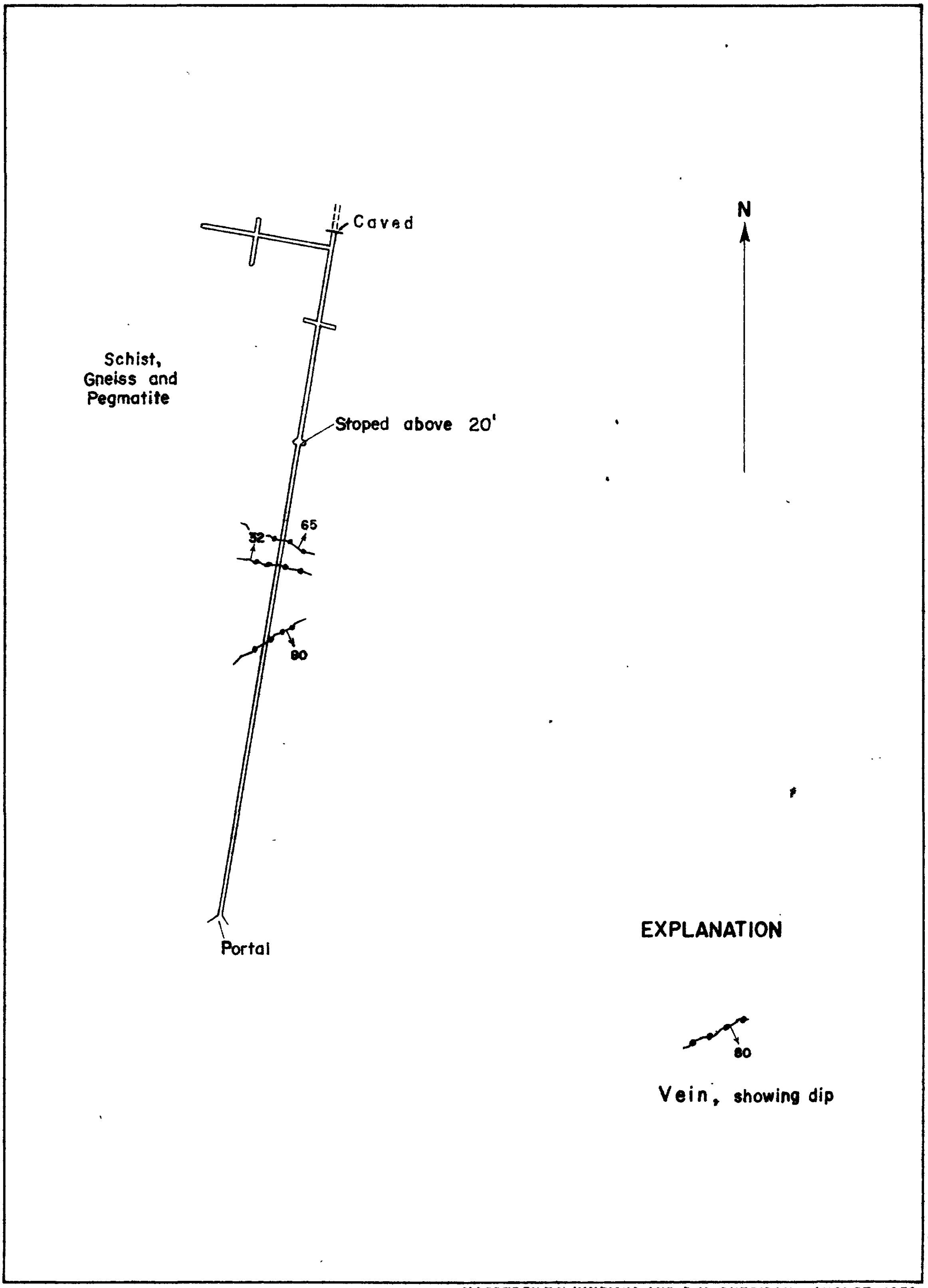
Fourth of July mine.—The Fourth of July mine (53) is in sec. 34, T. 1 N., R. 74 W., on the north fork of Middle Boulder Creek about four miles northwest of Grand Island. Veins two to 12 inches wide of pyrite and hematite cut Idaho Springs schist and Swandyke hornblende gneiss (fig. 10). Pegmatite and pink quartzite are exposed in places in the mine and chlorite occurs in the wallrock adjacent to the veins. No radioactivity was detected in a traverse of 3,000 feet of mine workings or on the dump.



MAPPED BY D.N. SHERIDAN AND E.N. HINRICHS, SEPTEMBER 1950.

FIGURE 9. — PLAN OF DENVER GROUP MINE, BOULDER COUNTY, COLORADO

0 100 200 FEET



MAPPED BY E.N. HINRICHS AND D.M. SHERIDAN, AUGUST 1950.

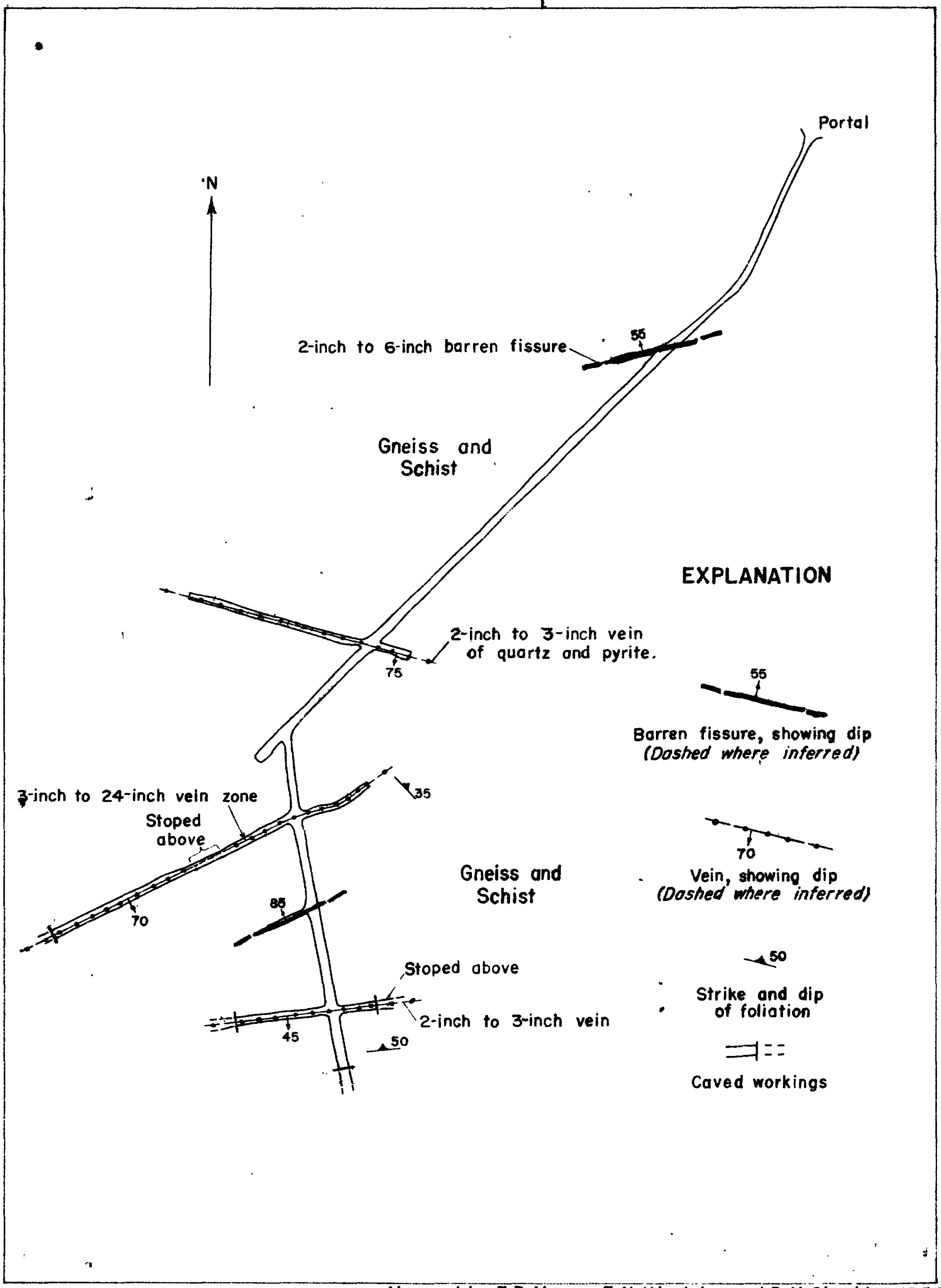
FIGURE 10.- PLAN OF FOURTH OF JULY MINE, BOULDER COUNTY, COLORADO

0 500 FEET

Golden Reward mine.—The Golden Reward mine (54) is in sec. 15, T. 1 S., R. 73 W., about two miles northeast of Eldora. The country rock is Idaho Springs schist intruded by Precambrian granite pegmatite and a Tertiary (?) mafic porphyry dike. There are 322 feet of accessible workings in the mine. A one- to two-inch iron-stained vein, consisting of pyrite in vuggy quartz, 205 feet from the portal, is slightly radioactive (0.01 percent equivalent uranium), but contained no visible mineral. A sample across the vein contained 0.001 percent uranium. No other areas of radioactivity were noted in the mine.

Great Northern mine.—The Great Northern mine (55) is in sec. 5, T. 1 S., R. 73 W., half a mile north of Caribou. The abandoned shaft of the mine is at the contact of Idaho Springs schist and monzonite. According to Bastin and Hill (1917, p. 182) the vein consists of quartz, sphalerite, chalcopyrite, galena, and copper carbonates. Examination of the dump revealed no abnormal radioactivity.

Mogul tunnel.—The Mogul tunnel (56) is in sec. 21, T. 1 S., R. 73 W., one-tenth of a mile south of Eldora. There are 2,500 feet of accessible workings (fig. 11). The country rock is mostly gneiss and schist. Iron-stained fracture zones ranging in thickness from two inches to 24 inches, contain veins of quartz, with calcite and pyrite. The mineralized fractures strike about N. 80° E. and dip 70° to 80°. Roscoelite is intergrown with the quartz or irregularly distributed in the ore, and in places, gold tellurides are visible (Lovering and Goddard, 1950, p. 197). One of the fracture zones, cut by the tunnel, was slightly radioactive and is estimated to contain 0.005 percent equivalent uranium.



Mapped by F.B. Moore, E.N. Hinrichs, and D.M. Sheridan, 1950

FIGURE 11. — MOGUL TUNNEL, BOULDER COUNTY, COLORADO

0 100 200 FEET

Pandora mine.—The Pandora mine (57) is in sec. 5, T. 1 S., R. 73 W., one mile north of Caribou. The shaft explores a vein in monzonite near the contact with Idaho Springs schist. Bleached and iron-stained country rock contains minor amounts of pyrite. Only the dump was examined and no abnormal radioactivity was noted.

Platteville mine.—The Platteville mine (58) is in sec. 19, T. 1 S., R. 73 W., two miles west of Eldora. The tunnel is reported by H. E. Sims, mining engineer, to be 400 feet long and, in the 200 feet that is accessible, an iron-stained vein zone one-half to two feet wide in monzonite is exposed (fig. 12). The ore minerals consist of gold-silver tellurides with pyrite in quartz gangue. Sims states that a 500-pound sample from a branch vein 230 feet from the portal contained 0.5 ounce gold, 6 ounces of silver, and 8.9 pounds of uranium. Only slight radioactivity estimated to represent 0.005 percent equivalent uranium was detected in the accessible portion of the tunnel.

Rosalind group of mines.—The Rosalind group of mines (59) is in sec. 16, T. 1 S., R. 73 W., about one mile north of Eldora. The mines are along the contact between Idaho Springs schist and Precambrian quartz monzonite gneiss.

The mine workings, some of which are inaccessible, include the Rosalind and the Jasper tunnels, a 120-foot adit 350 feet S. 35° W. from the Jasper tunnel, and an inaccessible adit about 600 feet west-southwest of the 120-foot adit. With the exception of the Rosalind vein, which is reported to have contained high-grade silver ore near the surface (Bastin and Hill, 1917, p. 189), the mines of the Rosalind group are believed to have been

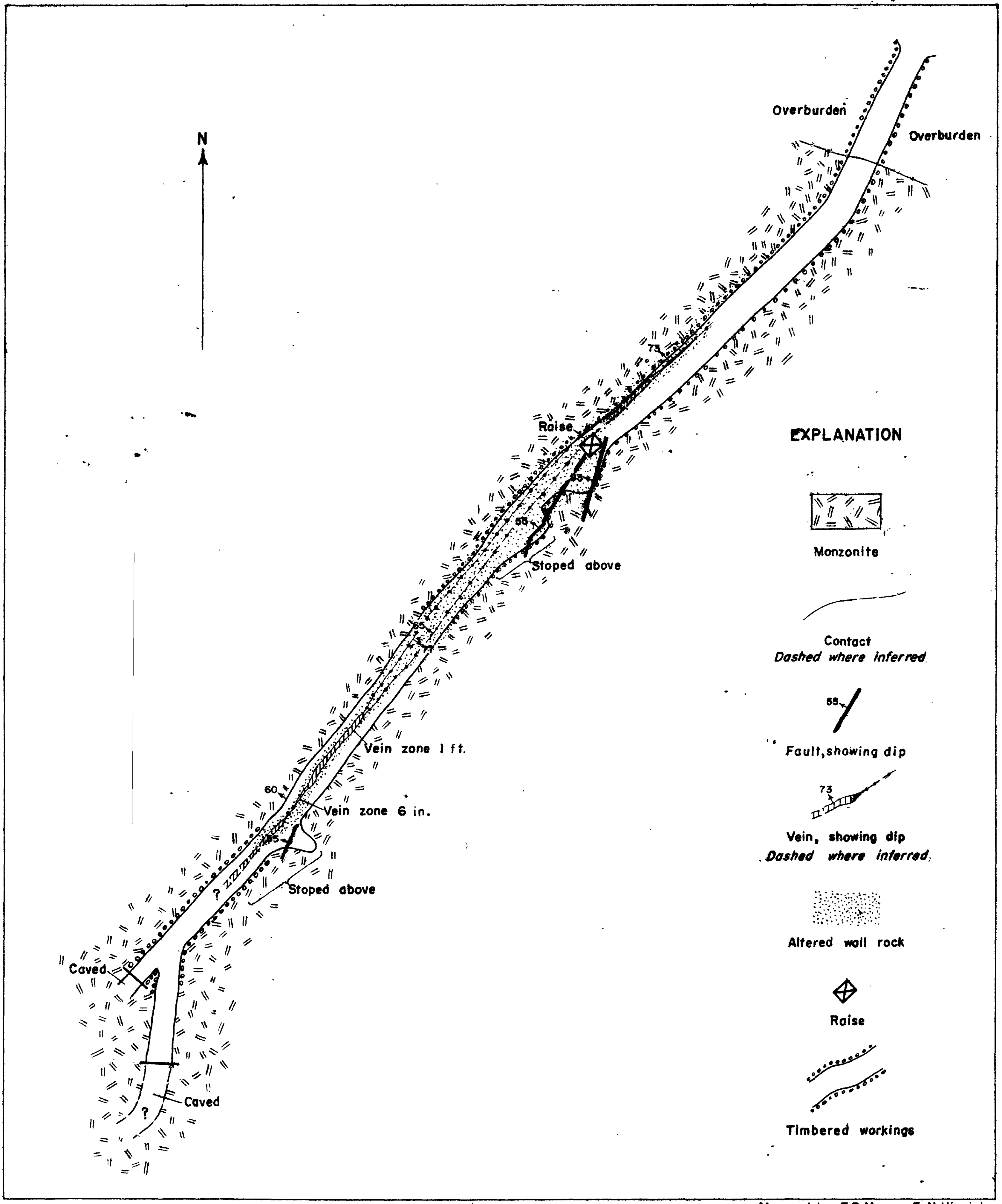


FIGURE 12.—PLAN OF THE PLATTEVILLE MINE, BOULDER COUNTY, COLORADO

0 10 20 FEET

worked for gold. Minor amounts of pyrite and chalcopyrite with iron-stained vuggy quartz were noted on the dumps. No abnormal radioactivity was noted in any of the mine workings nor on the mine dumps.

Shirley, May Queen, X-Ray, and Hattie May mines.—The Shirley, May Queen, X-Ray, and Hattie May mines (60) are in the NW¼ sec. 19, T. 1 S., R. 73 W., 2 miles west of Eldora. The mines are in a Tertiary (?) monzonite stock near its contact with Precambrian Idaho Springs schist. The Shirley mine consists of an adit 620 feet long, three raises, and ten small stopes (fig. 13).

The drift between 300 and 600 feet from the portal exposes a silicified, iron-stained vein zone, six inches to three feet wide, which strikes about N. 30° E. and dips 50° SE. The vein zone is made up of gray or black cryptocrystalline quartz in parallel to subparallel veinlets ranging from a knife edge to one foot in thickness and thin veinlets of pyrite. The vein zone fingers out into discontinuous stringers near the two-compartment raise and near the face of the drift.

Altered monzonite flanks the vein zone. In most places along the hanging wall and the footwall, there is an inner silicified layer, three inches to two feet thick, and an outer, yellow-green, friable, argillized layer, six inches to five feet thick. The thickness of these altered layers is controlled by the extent and degree of brecciation adjacent to the vein zone. The argillized and silicified monzonite is crisscrossed by irregular veinlets of pyrite and cherty quartz.

Radioactive material occurs in seven areas ranging from two to 12 feet in length within a distance of 338 feet along the drift. The radio-

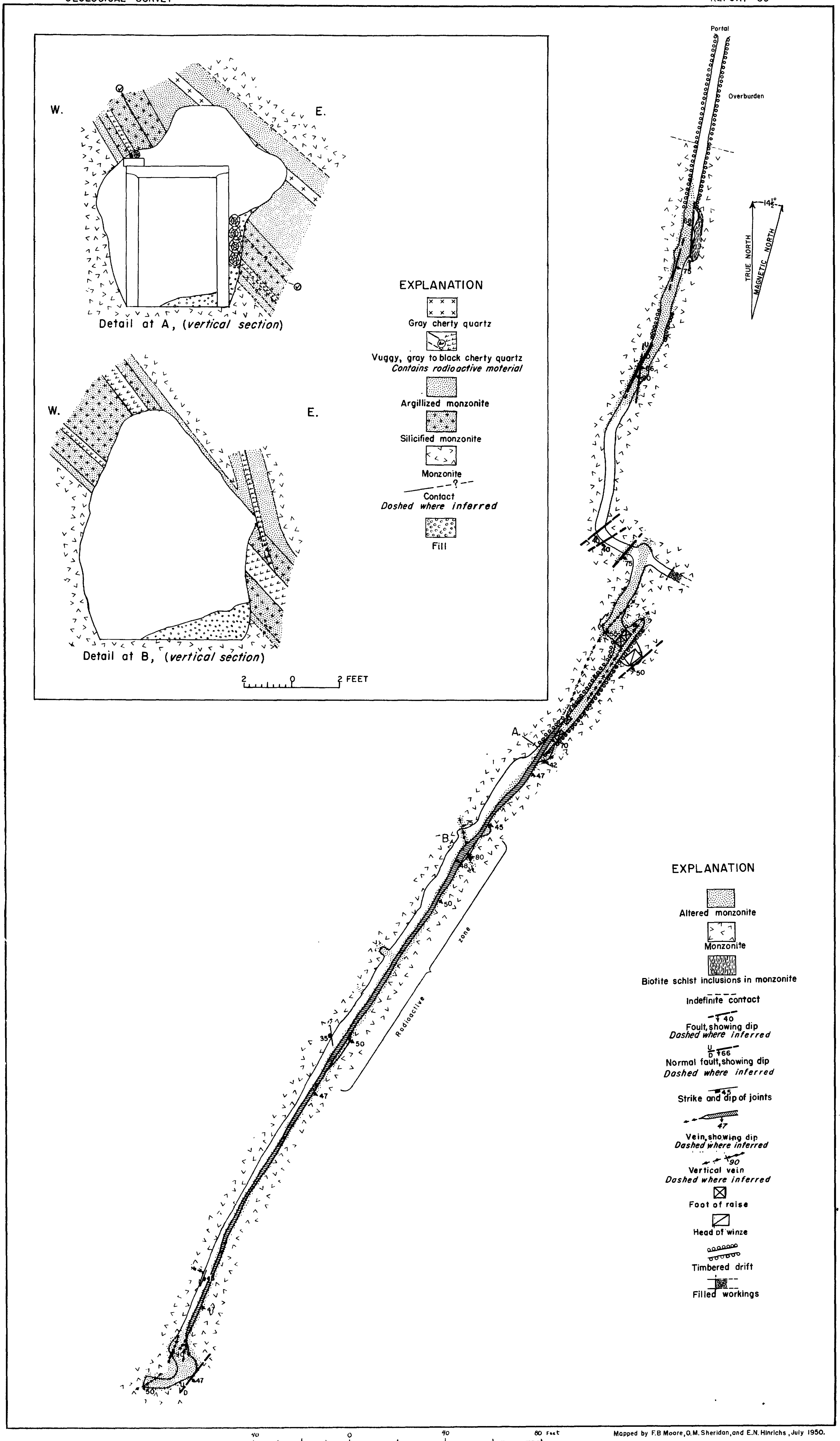


FIGURE 13.—GEOLOGIC MAP OF THE SHIRLEY MINE, BOULDER COUNTY, COLORADO.

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active material is localized in quartz vugs that are coated with sooty material. Most of the vugs are on the hanging wall side of the vein zone, but a few are irregularly distributed from hanging wall to footwall.

No uranium minerals have been identified in samples from the Shirley mine. Samples of the radioactive part of the vein contained from 0.001 to 0.034 percent uranium. The radioactivity of these samples, ranging from 0.009 to 0.072 percent equivalent uranium, is as much as ten times the uranium content. This excess of radioactivity was determined by J. N. Rosholt, Jr., of the Geological Survey to be caused by the presence of abnormal amounts of disintegration products of uranium.

The adits of the May Queen, X-Ray, and Hattie May mines are inaccessible. One abnormally radioactive specimen was found on the X-Ray dump, 149 feet above the Shirley adit. It contained 0.014 percent equivalent uranium but only 0.001 percent uranium. No abnormal radioactivity was noted on the dumps of the May Queen and Hattie May mines.

Terror-Roseberry mine.—The Terror-Roseberry mine (61) is in the SW¼ sec. 21, T. 1 S., R. 73 W., half a mile southeast of Eldora. The workings consist of a vertical shaft about 200 feet deep, an adit about 700 feet long, and short crosscuts. The adit connects with the shaft at a depth of 130 feet. The country rock is schist of the Idaho Springs formation with local facies of injection gneiss and pegmatite. The northeast-striking mineralized shear zone contains quartz, pyrite, and gold telluride. Radioactivity was noted along the adit at two places. Channel samples cut across the vein at the radioactive places assayed 0.001 and 0.002 percent uranium. The radioactivity was equivalent to a content of 0.008 and 0.042 percent uranium, respectively.

Up-to-date mine.—The Up-to-date mine (62) is in sec. 6, T. 1 S., R. 73 W., about one mile west-northwest of Caribou. The country rock is Tertiary (?) monzonite with masses of diorite and hornblendite. The main workings of the Up-do-date mine consist of an adit 1,900 feet long (Bastin and Hill, 1917, p. 178-179). The adit was inaccessible at the time of the examination in September 1950. Galena, chalcopyrite, and pyrite are associated with quartz, calcite, and siderite (?) in the vein material on the dumps. No abnormal radioactivity was noted on the dumps.

U. S. Gold Corporation mine.—The U. S. Gold Corporation mine (63) is on the north fork of Middle Boulder Creek in secs. 1 and 12, T. 1 S., R. 74 W., one mile northwest of Grand Island. The mine is in Boulder Creek granite near the contact with a Tertiary (?) quartz monzonite stock. The mine is inaccessible, but minerals noted in vein material on the dump are pyrite, chalcopyrite, specularite, and epidote. No abnormal radioactivity was detected on the dump.

Clear Creek County

Location and general features

Clear Creek County is in central Colorado west of Denver. The county seat is at Georgetown.

The county is completely within the Front Range. Clear Creek on the north side of the county is the main stream and with its tributaries makes up the drainage system. Altitudes range from over 14,000 feet to less than 7,500 feet along Clear Creek.

Except for some Tertiary igneous intrusives, all the rocks are Precambrian granites, gneisses, and schists.

Ajax mica mine.—The Ajax mica mine (64) in sec. 34, T. 3 S., R. 72 W., is on the north wall of Clear Creek, 0.3 mile by steep mine road east of the junction of Colorado Highway 119 and U. S. Highway 40. The mine was examined by K. G. Brill, Jr., in 1947. The geology of this deposit is described by Hanley, Heinrich, and Page (1950, p. 27-29).

The mine workings consist of a large cut with several levels.

The country rock consists of biotite and muscovite schist. The Ajax pegmatite dike is about 130 feet long and 30 feet wide, and is exposed to a depth of 20 feet. It is a zoned pegmatite that strikes N. 85° E. and dips 50° N. The wall zone consists of granite pegmatite with large crystals of black tourmaline and small books of muscovite. The core consists of quartz, albite, and muscovite.

Measurements made on the outcrop and country rock indicate negligible radioactivity. A sample of the schist contained 0.003 percent uranium.

Bostonite porphyry dike.—A bostonite porphyry dike (65) crops out along the northern end of Saxon Mountain, in sec. 26, T. 3 S., R. 74 W., 1,500 feet northwest of the Jo Reynolds mine. The locality was examined in October 1950 by R. U. King and F. B. Moore.

The country rock consists of gneiss and schist. The dike is 100 feet wide and crops out intermittently over a distance of about 100 feet. It trends N. 30°-40° W.

A sample of bostonite contained 0.008 percent equivalent uranium.

The radioactivity of the bostonite dike was sufficiently great to produce a deflection of two to three times normal readings on the ratemeter of a car-borne Geiger counter.

Brandt Ranch prospect.—The Brandt Ranch prospect (66) in sec. 12, T. 4 S., R. 72 W., lies on the south wall of Beaver Brook about 0.5 mile by road from U. S. Highway 40. It was examined by K. G. Brill, Jr., in 1947.

The pegmatite dike on Beaver Brook has been explored by three small pits. The country rock consists of granite gneiss. The dike is about 100 feet long and 15 feet wide with a maximum depth of 20 feet. It is zoned pegmatite that strikes N. 88° E. and dips at a high angle to the south and has a core of microcline and a wall zone of quartz, microcline, mica, beryl, and topaz.

Measurements made on the outcrop indicate that there is very little radioactivity. A sample of finely crystalline quartz and microcline contained 0.002 percent uranium.

Denbigh shaft.—The Denbigh shaft (67) is in sec. 22, T. 3 S., R. 73 W., at the head of the east fork of York Gulch about half a mile southwest of the town of Russell Gulch. The mine workings are largely inaccessible, but consist of two tunnels and an inclined shaft. The vein in general strikes N. 47° E., dips about 75° NW., and is two to six inches in width. The country rocks are granite and granite gneiss. The vein filling is white or light-gray sugary quartz, carrying pyrite and in places chalcopyrite. In some places the pyrite is coated with a thin film of chalcocite. No abnormal radioactivity was observed on the dumps.

Doctor tunnel.—The Doctor tunnel (68) is in sec. 27, T. 3 S., R. 74 W. The tunnel was caved at the time of the examination but is reportedly 500 feet long. From material on the dump, it is inferred that the deposit is a quartz-pyrite vein in schist, granite, and andesite porphyry. Ore minerals noted included pyrite, chalcopyrite, sphalerite, and galena. The vein quartz is stained by manganese oxide. No abnormal radioactivity was detected on the dump.

Franklin-Silver Age mine.—The Franklin-Silver Age mine (69) is in sec. 25, T. 3 S., R. 73 W., in the Silver Age Gulch. The property is developed by the Franklin shaft, which is 200 feet deep with short levels at 100, 135, and 200 feet, and the Silver Age tunnel. All the workings were inaccessible at the time of the examination. No abnormal radioactivity was detected on the dump of the Silver Age tunnel.

Griffith tunnel (Griffith lode).—The Griffith tunnel (70) is northeast of Georgetown on the city limit, in sec. 8, T. 4 S., R. 74 W. The property is developed by drift adits at two levels and a number of crosscuts. The upper tunnel was driven on a weak vein for about 100 feet, and then crosscut to the Griffith vein. The Griffith vein strikes N. 45°-60° E. and dips about 60° N. The wall rock consists chiefly of gneiss, but also of pegmatite, alaskite, and hornblendite. The ore minerals include pyrite, chalcopyrite, sphalerite, and galena. Petzite has been reported from the vein, but none was noted during the examination.

No abnormal radioactivity was detected in either tunnel.

Grover mine.—The Grover mine (71), sec. 16, T. 4 S., R. 72 W., is on a spur on the east slope of Santa Fe Mountain on a tributary of North Beaver Brook, 4.5 airline miles southeast of Idaho Springs. It was examined by K. G. Brill, Jr., in 1947.

The country rock consists of granite gneiss. The Grover pegmatite dike is about 760 feet long, as wide as 25 feet, and is exposed to a depth of 40 feet. The dike strikes east and dips about 90 degrees. It is obscurely zoned. The pegmatite is composed of quartz, albite, muscovite, beryl, biotite, and small amounts of columbite. The dike has been explored by a deep narrow cut 250 by 8 feet on two levels, and an adit was being driven at a lower level.

Measurements made on the outcrop indicate that the country rock in the vicinity of the dike and the columbite in the dike are radioactive. The columbite forms a fraction of one percent of the dike. The analyses of samples from the dike are given in table 18.

Table 18. Radioactivity data on samples collected from the Grover pegmatite dike.

Sample number	Description	Equivalent uranium (percent)	Uranium (percent)
1	Beryl crystal.	0.001	0.001
2	Mica in albite.	.011	.011
3	Rosette of biotite and sooty mineral.	.003	.001

_/ Analyses by U. S. Geological Survey Laboratory, Washington, D. C.

J. L. Emerson mine.—The J. L. Emerson mine (72) is in sec. 22, T. 3 S., R. 73 W., in Davenport Gulch. The mine workings are all inaccessible. Country rock on the dump indicates that the mine is in granite gneiss and monzonite porphyry. Ore minerals noted include pyrite, hematite, chalcopyrite, and galena. No abnormal radioactivity was noted.

Jo Reynolds mine.—The Jo Reynolds mine was briefly examined in December 1948 and June 1949. A radiometric traverse of the Elida tunnel, the only accessible underground working at the mine, was made by R. U. King on December 30, 1948. Samples of the vein were collected where abnormal radioactivity was indicated. The dumps and surface area immediately adjacent to the mine were examined for radioactivity on June 28, 1949, by E. P. Beroni and H. C. Granger.

The Jo Reynolds mine (73) is in sec. 35, T. 3 S., R. 74 W., near the abandoned mining town of Silver Creek in the Lawson mining district. It is about half a mile southeast of Lawson, and 30 miles west of Denver, and can be reached from Lawson by following a narrow dirt road southeastward from U. S. Highway 6 and 40.

The mine is owned by the Jo Reynolds Mining, Milling, Drainage, Tunnel, and Transportation Company, of which Mrs. R. B. Morton of Boston, Mass., is the chief stockholder. At the time of this examination the property was under lease to Mr. Charles O. Parker.

The Jo Reynolds claims were located in 1865, and since that date have been developed by an upper (Daily) tunnel, driven about 1880; a lower (Elida) tunnel, driven during the period 1900 to 1903; nine levels of workings connected to the lower tunnel by an underground (Main) shaft; a second underground (Moore) shaft; and numerous crosscuts. An 80-foot winze near the Main shaft connects the Elida tunnel with sublevel drifts. The Daily tunnel and 1st-level workings are at an altitude of about 9,000 feet; the Elida tunnel is about 700 feet lower.

At the time of the writer's visit, the 4,500-foot Elida tunnel was the only accessible part of the mine; the Daily tunnel was caved at the portal; workings above the Elida level were inaccessible, and the winze and 80-foot sublevel drifts were water-filled. After the first examination, caving of the Elida tunnel at a point about 1,000 feet from the portal prevented further geologic study of the mine.

The country rocks in the vicinity of the Jo Reynolds mine are of Pre-cambrian age and consist of quartz-biotite schist of the Idaho Springs formation, granite gneiss, and Silver Plume granite. A few pegmatite dikes crop out approximately a mile south of the lower tunnel. These rocks and the general geology of the area have been described by Bastin and Hill (1917, and original notes 1917), and by Spurr, Garrey and Ball (1908).

The silver, lead, and zinc deposits at the Jo Reynolds mine are in northeast-trending carbonate-quartz veins that dip steeply to the northwest. The details of the vein system are not known to the writer but Bastin and Hill (1917, p. 340) state that three veins were worked on the upper levels and only one was worked below the fourth level. Most of the workings, including the Main shaft and Elida tunnel, appear to be in what is referred to as the "No. 2 vein". The shape of the second, third, and fourth level workings northeast of the Main shaft suggests that there is a junction of another vein with the "No. 2 vein" between the fourth and fifth levels.

Bastin and Hill (1917, p. 340-341) state that the silver, lead, and zinc ores obtained from this deposit contain galena, sphalerite, pyrite, chalcopyrite, and gray copper (tetrahedrite) as primary minerals, and polybasite, pearcite, proustite, argentite, native silver, chalcopyrite, and galena as secondary minerals. They report that native silver, as scattered flakes in a talc-like material, occurred as deep as the ninth level. Sphalerite, galena, and native silver have been the most important ore minerals.

The presence of uranium on the second and third levels of the Jo Reynolds mine was reported as early as 1886 in newspaper accounts. The reports do not mention the uranium mineral found. Pitchblende was later identified in the deposit by Bastin and Hill (1917, p. 124) who described the mineral in ore from the Elida tunnel level near the bottom of the Main shaft and about 1,000 feet below the surface. They state that "microscopic examination of polished surfaces showed fragments of pitchblende having characteristic botryoidal forms embedded in a matrix of quartz, siderite, sphalerite, galena, and chalcopyrite."

In 1919, a discovery of pitchblende at the Jo Reynolds mine is reported (Guillotte, G. B., written communication, 1944) to have yielded 16,000 pounds of uranium ore containing 72 percent U_3O_8. It is presumed that the pitchblende ore body occurred on or near the 80-foot sublevel.

A black powdery mineral, tentatively identified as pitchblende, was found in the vein in the area sampled. This mineral occurs as paper-thin seams and coatings on minor fractures in the vein material. A traverse of the Elida tunnel disclosed radioactivity appreciably above normal in the vein 100 to 200 feet southwest of the Main shaft. The radioactivity was strongest near the center of the vein. No significant radioactivity was detected on the dumps and surface areas adjacent to the Jo Reynolds mine.

Three channel samples and one grab sample were taken across the radioactive part of the "No. 2 vein". Assay data are tabulated on table 19.

Table 19.—Assay data on the Jo Reynolds "No. 2 vein".

Sample number	Length (feet)	Uranium (percent)	Lead (percent)	Zinc (percent)	Silver (ounces per ton)
61	1	0.01	1.18	1.79	(1)
62	2	.16	.61	.65	(1)
63	1	.008	1.94	2.04	(1)
64	Grab	.005	8.89	11.12	42

(1) The silver content is probably less than 3 ounces per ton, but was not determined because its presence was not detected during ordinary chemical analyses for other elements.

Analyses by D. L. Skinner and J. N. Rosholt, Jr., U. S. Geological Survey, 1949.

The radioactivity examination and sampling of the Jo Reynolds mine failed to show the presence of significant quantities of uranium ore on the Elida level (King, 1951). It is probable that the ore body which was reported to have yielded eight tons of high-grade pitchblende ore was cut in the lowest mine workings. An adequate evaluation of the pitchblende ore bodies reported to occur on this property cannot be made until the inaccessible workings, both above and below the Elida tunnel, are rehabilitated.

Lombard mine.—The Lombard mine (74) is in sec. 1, T. 4 S., R. 74 W., in the upper part of Cumberland Gulch. The vein, which trends generally N. 55°-60° E. and dips 50°-75° NW., has been developed for about 2,000 feet by a shaft 150 feet deep and by four drifts.

The lower drift or No. 4 Tunnel begins near the mill, trends about N. 45° E., and is about 780 feet long. The wall rock is entirely schist of the Idaho Springs formation. The vein branches in numerous places and in general is not strongly mineralized.

The No. 3 Tunnel is about 1,440 feet in length and follows the Lombard vein for 1,130 feet of this distance. In general the vein as exposed in this tunnel is well defined and ranges from a crevice to about two feet in width. It is barren in places but elsewhere shows one or more narrow veins of galena, sphalerite, chalcopyrite, and pyrite.

Tunnel No. 2 connects through a raise with the Lombard shaft. The wall rock is Idaho Springs formation with some pegmatite. The vein ranges from two inches to two feet in width and shows the usual alternation of barren and mineralized zones along strike. Quartz predominates in the veinlets, but sphalerite, galena, chalcopyrite, and pyrite are present locally.

The highest level or No. 1 Tunnel is about 800 feet long. Most of the ground between No. 1 and No. 2 Tunnels has been stoped.

In general the ore from the Lombard vein consists of, in order of abundance, white quartz, sphalerite, galena, chalcopyrite, and pyrite, with light-colored siderite in places.

An examination of the dump disclosed radioactivity equivalent to 0.005 percent uranium. A sample of vein material assayed 0.003 percent uranium.

Lone Star mine.—The Lone Star mine (75), in the NE¼ sec. 3, T. 4 S., R. 72 W., is on the north side of the road, about one mile east of the junction of Colorado Highway 119 and U. S. Highway 6.

The mine was first visited in December 1949 and several times during the driving of the adit in 1950 and in 1951, by C. R. Butler and R. U. King. Radioactivity had previously been noted at this locality with car-borne Geiger counters.

Development of the Lone Star mine consists of an adit about 200 feet long.

The country rock in the vicinity of the mine is gneiss and schist of the Idaho Springs formation.

The adit is driven toward a granite pegmatite dike composed of a mixture of feldspar, quartz, and biotite, with scattered crystals of allanite. A radioactive yellow-stain, possibly uranophane, coats a part of the rock outcrop beside the road. No radioactive material was seen on the dump from the mine.

The radioactivity at the Lone Star mine is sufficient to cause a deflection on the rate-meter of a car-borne Geiger counter of twice the normal readings. Measurements at the outcrop indicate the radioactivity of the pegmatite is in the order of 0.005 percent equivalent uranium.

Martha E prospect.—The Martha E prospect (76) is in Spring Gulch about 3½ miles southwest of Idaho Springs in sec. 5, T. 4 S., R. 73 W. The prospect is on a claim originally called the Daisy Freese, which was first prospected by the Stanley Mines. James R. Manning and Harvey W. Zook of Louisville, Colorado, acquired the claim in 1948. The property is developed by a 150-foot adit and a 15-foot winze.

The principal rock of the Martha E is biotite schist of the Precambrian Idaho Springs formation. The foliation in the area trends about N. 70° E.; the prevailing dip is northwest.

Three prominent shear zones occur in the adit. They have an average strike of N. 82° W., and dip 48°-50° NE. A one-inch vein of pyrite and quartz is present in the winze. Metatorbernite, autunite, and minute amounts of sooty pitchblende occur as: (1) irregular patches and flakes in the gouge of shear zones, (2) disseminated flakes along foliation planes in the biotite schist that borders the shear zones, and (3) thin irregular coatings along joint surfaces. Radioactivity of samples from the shear zones ranged from 0.013 to 0.13 percent equivalent uranium. Chemical analyses of the samples ranged from 0.003 to 0.12 percent uranium.

Nabob tunnel.—The Nabob tunnel (77) is in sec. 35, T. 3 S., R. 74 W., on the hill above Silver Creek. The vein strikes N. 65°-70° E. and ranges from a few inches to six feet in width. Vein material is highly siliceous and contains galena, ruby silver, bornite, and covellite. Many stringers are highly fluorescent. The wall rocks consist largely of granite gneiss, but granite, pegmatite, alaskite, and biotite schist occur in places. Weak abnormal radioactivity amounting to three to four times the background intensity was noted in places. Field measurements indicate that the radioactivity of the feldspar-rich rock is equivalent to about 0.004 percent uranium.

Robineau claims.—The Robineau claims (78), sec. 35, T. 3 S., R. 74 W., consist of one patented claim, the George Peabody, and two unpatented claims, the MacGregor and Little Mac, and are owned by L. G. Robineau and J. H. Harris of Dumont, Colorado. At the time of the field examination the claims were reportedly leased to J. H. and M. R. Phillips of Leadville, Colorado.

The claims are at an altitude of approximately 10,000 feet on a ridge separating the valleys of Clear Creek and Silver Creek and are about one mile from the abandoned town of Silver Creek.

The claims were examined for uranium on July 18, 1949, by H. C. Granger and R. U. King (King and Granger, 1950).

All accessible mine workings and outcrops within an area of about half a square mile were traversed radiometrically using Beckman and El-Tronics survey meters.

The workings on the George Peabody claim consist of two shallow, caved shafts and a number of small prospect pits. The west shaft is about 40 feet deep, and there is said to be a 30-foot crosscut at the bottom. Both shafts were sunk in a fractured zone of the granite country rock.

The rocks in the immediate vicinity of the Robineau claims are Pre-cambrian in age. A quartz-biotite schist of the Idaho Springs formation is the oldest rock in the area. This schist has been intruded by granite, and is now an injection gneiss. The schist and gneiss are cut by coarse-grained quartz-feldspar-biotite gneiss and Silver Plume granite. The youngest Precambrian rocks of the area are small granite pegmatite dikes that are generally less than 15 feet wide and 100 feet long.

Radioactive material at the Robineau claims appears to be restricted to discontinuous veins in granite pegmatite. Fracture surfaces of pieces of rock on the dump and at the collar of the west shaft on the George Peabody claim are coated with a heavy black mineral, tentatively identified as goethite. Bright-green scales of torbernite also occur as coatings on fracture walls and seem to be closely associated with brown and black iron-oxide stains. A non-fluorescent, dull yellow, radioactive mineral, identified by geologists of the U. S. Atomic Energy Commission as dumontite, occurs as minute acicular rosettes lining fractures in the pegmatite. Although autunite has been reported from the deposit (Randall, 1886), none was recognized in the field. All of the observed minerals appeared to be secondary, and no sulfide minerals were noted.

No uranium minerals were found in any of the prospect pits on the MacGregor and Little Mac claims. In the pits only iron-stained, fractured granite and schist are exposed.

The radioactivity at most of the prospect pits on the Robineau claims is slightly higher than background. Background readings taken at several stations in the immediate vicinity averaged five divisions on the 0.2 scale of an El-Tronics field counter. The average radioactivity of Idaho Springs schist at the east shaft is 10 divisions on the 0.2 scale or two times background. The dump at the west shaft on the George Peabody claim, where torbernite is visible, is the most radioactive area and rate-meter readings averaged about 13 divisions on the 0.2 scale (between two and three times background). Selected samples of torbernite from the dump give readings as high as three divisions on the 20 scale. One composite sample of waste rock taken from seven parts of the dump contained 0.010 percent uranium.

The Robineau claims are not considered to be a potential commercial source of uranium. The presence of secondary uranium minerals at these claims, and the reported production of pitchblende from the nearby Jo Reynolds mine, however, suggest that other uranium-bearing deposits may be present in the area.

United Lead and Silver Company mine.—The United Lead and Silver Company mine (79) in sec. 26, T. 3 S., R. 74 W., Lawson mining district, is on the north end of Saxon Mountain. The mine dump was examined in October 1950 by R. U. King, F. B. Moore, and E. N. Hinrichs.

The workings consist of an adit, 200 feet long. The country rock consists of schist and gneiss and bostonite dike rocks. Vein material on the dump consists of galena and pyrite in a quartz gangue. The vein deposit appears to be localized at the contact of the bostonite and the schist and gneiss.

Slight radioactivity above normal was noted on the bostonite but not associated with the ore minerals. The radioactivity is estimated to be about 0.005 percent equivalent uranium.

Sawmill Gulch pegmatite prospects.—Two pegmatite dikes (80) crop out on the west side of Sawmill Gulch on the north side of Santa Fe Mountain, about 0.6 and 0.5 mile above Snyder's fish ponds in secs. 4 and 5, T. 4 S., R. 72 W., respectively. They were examined by K. G. Brill, Jr., in 1947.

The lower dike has been explored by an adit, the other apparently has not been prospected.

The country rock consists of biotite schist and granite gneiss. The pegmatite dikes are zoned and have an east trend with a 90 degree dip. The cores consist mostly of quartz. The wall zones consist mostly of quartz, potash feldspar, and biotite.

Radiometric measurements made on the outcrops indicate the radioactivity is negligible in both dikes. A sample from the lower dike contained 0.002 percent equivalent uranium.

Gilpin County

Location and general features

Gilpin County lies nearly in the center of the Front Range Mineral belt. Central City, the county seat, is about 25 miles by road west of Denver.

The county includes a relatively small area between the Continental Divide and the Front Range. Altitudes range from 7,000 feet at the junction of Clear Creek and North Clear Creek in the southeastern corner to over 13,000 feet at the Continental Divide near James Peak. North Clear Creek is the major stream traversing the county.

Igneous and metamorphic rocks of Precambrian age and acidic intrusive rocks of Tertiary age are exposed within the county. The Precambrian rocks consist of biotite schist of the Idaho Springs formation intruded by granite gneiss, monzonite gneiss, and pegmatite. These rocks are in turn cut by Tertiary stocks and dikes including monzonite, quartz monzonite, alkali syenite, and bostonite.

The ore deposits of Gilpin County consist of quartz-sulfide veins valuable chiefly for their gold and silver content, and to a lesser degree for their lead and copper content.

Localities examined for uranium in the Quartz Hill area, Gilpin County, which includes parts of secs. 14, 15, 22, and 23, T. 3 S., R. 73 W. are shown on figure 14.

Alps mine.—The Alps mine (81), on the summit of Quartz Hill, is in the SE$\frac{1}{4}$NW$\frac{1}{4}$ sec. 14, T. 3 S., R. 73 W. The mine appears to be on the eastward extension of the Delmonico vein. The workings were inaccessible in 1950 at the time of the examination but reportedly reach a depth of 1,300 feet. A study of the dump indicated that the mine is in gneiss and schist of the Precambrian Idaho Springs formation. Vein material is largely of the galena-sphalerite type, although it is reported that the ore of the deeper levels was mainly of pyritic type. Although uraninite has been reported from the property (Bastin and Hill, 1917, p. 244), an examination of the dump disclosed no uranium minerals and no abnormal radioactivity. Standing water in the Alps shaft contains 0.14 parts per million of uranium.

American Flag mine.—The American Flag mine (82) is on King's Flat in sec. 15, T. 3 S., R. 73 W. As the mine workings were inaccessible, only the dump was examined. Wall rocks include gneiss and schist of the Precambrian Idaho Springs formation. Fragments of quartz-pyrite vein material were noted. No abnormal radioactivity was observed.

Apex claims.—The Apex claims (83), sec. 25, T. 3 S., R. 72 W., consist of four unpatented claims owned by Mr. R. W. Carroll and Mr. Ivar Jordin of Denver, Colorado.

In May 1949, R. U. King of the Geological Survey made an examination of two of the four claims, the Apex No. 1, and the Apex No. 1-A claims (fig. 15). The examination consisted of a radioactivity traverse up the Bates Creek draw from Colorado Highway 119, north across Apex No. 1 claim, and then west across Apex No. 1-A claim.

The rocks exposed in the Apex No. 1 and Apex No. 1-A claims are chiefly Precambrian granite gneiss and biotite schist, with small scattered bodies of hornblendite, pegmatite, aplite, and sillimanite schist. Banding in the granite gneiss and cleavage in the biotite schist are essentially parallel, strike roughly east, and dip 40°-50° N. The pegmatite bodies are generally parallel to the schistosity and banding. The largest pegmatite is approximately 50 feet wide and 300 feet long.

The radioactivity of the rocks along Bates Creek and on the Apex claims was measured at 10 stations (table 20) with El-Tronics and Beckman survey meters (King, 1950a). Three one-minute gamma-ray counts with the probe five inches from the ground were made at each of the 10 stations, and the average value of the counts was calculated for each station. The radioactivity at station 1 was assumed to be normal for the rocks of the area crossed by the traverse.

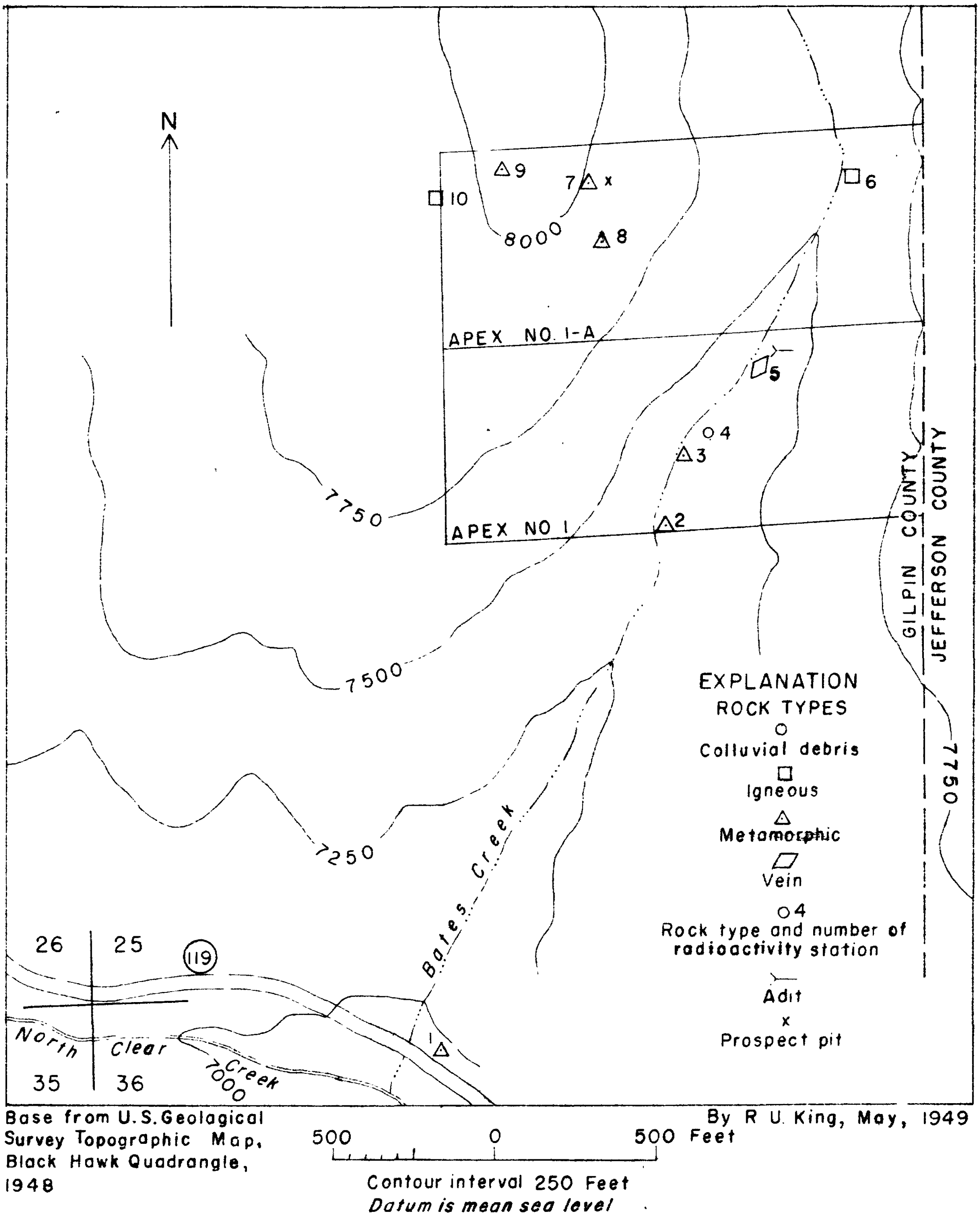


FIGURE 15.-MAP OF THE APEX CLAIMS, GILPIN COUNTY, COLORADO AND STATIONS ON THE RADIOACTIVITY TRAVERSE

Table 20.—Log of radioactivity traverse in vicinity of the Apex claims.

Station	Average c/m (gamma) 1/ Beckman	Average c/m (gamma) 1/ El-Tronics	Location	Geology
1	51	69	Jct. Bates Cr. and north fork Clear Cr. at Colo. Highway 119.	Gneiss and schist.
2	51	61	S. sideline Apex No. 1 claim, Bates Cr.	Iron-stained sheeted zone in schist.
3	55	70	200 feet N. of Sta. 2, along Bates Cr.	Fine-grained schist and gneiss.
4	68	73	Approx. center of Apex No. 1 claim on Bates Cr.	Bed rock covered. Large boulders of granite and granite pegmatite.
5	53	65	At portal of 20 ft. prospect tunnel. Apex No. 1 claim.	Quartz vein in iron-stained sheeted zone in iron-stained schist.
6	78	84	Northeast part of Apex No. 1-A claim in Bates Cr.	Granite pegmatite at north contact.
7	78	90	Prospect pit on hill. North-central part of Apex No. 1-A claim.	Quartz vein in fine-grained schist.
8	64	75	Apex No. 1-A claim 200 feet south of Sta. No. 7	Sillimanite schist.
9	61	62	Northwest corner of Apex No. 1-A claim.	Do.
10	73	72	50 feet west of Apex No. 1-A claim.	Aplitic and porphyritic granite.
11	50	60	Jct. Bates Cr. and north fork Clear Cr. Check at end of traverse.	——

1/ Average counts per minute of three consecutive one-minute counts, gamma-ray only; probe five inches from ground.

The slight increase in radioactivity recorded from station 1 to station 7 is probably not significant and is no greater than that which might be expected from different rock types.

Ayres- and Taylor-Leavenworth mine.--The Ayres- and Taylor-Leavenworth mines (84) are in Leavenworth Gulch in sec. 14, T. 3 S., R. 73 W. The mines are on the same vein about 200 feet apart. Both mines were inaccessible at the time of the visit and the extent of the workings is not known. It is estimated that the two mines contain about 2,000 feet of drift. Vein material on the dump contained pyrite, chalcopyrite, galena, sphalerite, enargite, quartz, and pitchblende. A radiometric reconnaissance of the dump showed radioactivity ranging from 0.024 to 2.80 percent equivalent uranium. Analyses of samples ranged from 0.001 to 2.92 percent uranium.

Belmont mine.--The Belmont mine (85) is in sec. 22, T. 3 S., R. 73 W., about half a mile west of Russell Gulch. The workings, said to consist of an 820-foot shaft and 10 levels, were not accessible as the mine was last worked in 1907. Dump material consisted of granite gneiss and ore. The ore consisted largely of pyrite and tennantite but showed some galena, sphalerite, and chalcopyrite. A radiometric examination of the dump disclosed no abnormal radioactivity.

Bezant mine.--The Bezant mine (86) is in sec. 14, T. 3 S., R. 73 W., on the south side of Leavenworth Gulch a short distance west of the Russell Gulch-Central City road. The property is developed by a 485-foot shaft with levels at depths of 75, 165, 225, and 420 feet. Vein material on the dump showed galena, sphalerite, chalcopyrite, enargite, and pyrite. The wall rocks are Precambrian granite gneiss and biotite schist. Pitchblende has been reported on the 225-foot level west of the shaft in a shoot $2\frac{1}{2}$ inches by 20 feet. Analyses of material from the shoot reportedly ranged from 0.425 to 17 percent uranium. No abnormal radioactivity was noted in the parts of the mine that were accessible at the time of the visit.

Blanche M mine.--The Blanche M mine (87) is on the southeast slope of Alps Hill in sec. 15, T. 3 S., R. 73 W. The mine workings are inaccessible and their extent is unknown.

The country rock is granite, gneiss, and schist. Vein material consists of pyrite disseminated in quartz gangue. No radioactivity was detected on the mine dumps.

Bobtail tunnel.--The Bobtail tunnel (88) starts at Blackhawk in sec. 7, T. 3 S., R. 72 W. It was driven in a southerly direction under Bobtail Hill, and is reported to include some 35 miles of drifts and other workings.

The first vein cut in the tunnel is the Fisk, which, where cut, is 2 feet wide and shows numerous irregular veinlets of pyrite traversing silicified granite gneiss. The vein has been fractured subsequent to mineralization and the fractures filled with cherty silica. The Ground Hog vein is cut next. It is 16 inches wide and includes a half-inch veinlet of solid pyrite bordered by two inches of silicified granite gneiss; the remainder of the vein is gneiss carrying disseminated pyrite.

Pitchblende has been reported from the tunnel, but as the majority of the workings were inaccessible at the time of the visit, no confirmation was possible.

Bonanza mine.--The Bonanza mine (89) is on the south side of Justice Hill, in sec. 18, T. 3 S., R. 72 W. The mine was examined by F. B. Moore,

D. M. Sheridan, and E. N. Hinrichs in 1950. The mine consists of a shaft at least 160 feet deep, with an adit level at a depth of 64 feet, and a level at a depth of 102 feet (fig. 16). The country rock is Precambrian Idaho Springs schist and pegmatite. The vein, which strikes N. 65° E. and dips about 75° SE., consists of a fractured, iron-stained zone two feet wide. It was mined for gold. Pyrite and pitchblende, the only visible minerals, occur in discontinuous stringers in a two-inch streak along the footwall of the vein. The pitchblende is exposed in the shaft at depths of 58 to 80 feet below the surface. No other radioactive areas were found. Samples of the vein material in the radioactive area contained as much as 14 percent uranium.

Bon Ton mine.—The Bon Ton mine (90) is located in sec. 14, T. 3 S., R. 73 W. The mine workings are inaccessible. A radioactivity survey of the dump indicated that the vein material contained about 0.005 percent equivalent uranium.

Buena Vista claim.—The Buena Vista claim (91) is in sec. 13, T. 3 S., R. 73 W. At the time of the examination, the property was being prospected by pits and trenches. The workings appeared to be along the contact of gneiss with schist. No abnormal radioactivity was detected.

Calhoun and Wood mines.—The Calhoun and Wood mines (92) are on the south side of Quartz Hill in sec. 14, T. 3 S., R. 73 W., about 1.5 miles southwest of Central City. The Realty Company of Denver, Colorado, owns the Calhoun mines and leases the Wood mine. The mines are connected with the Central City-Idaho Springs road by a quarter of a mile of unimproved road.

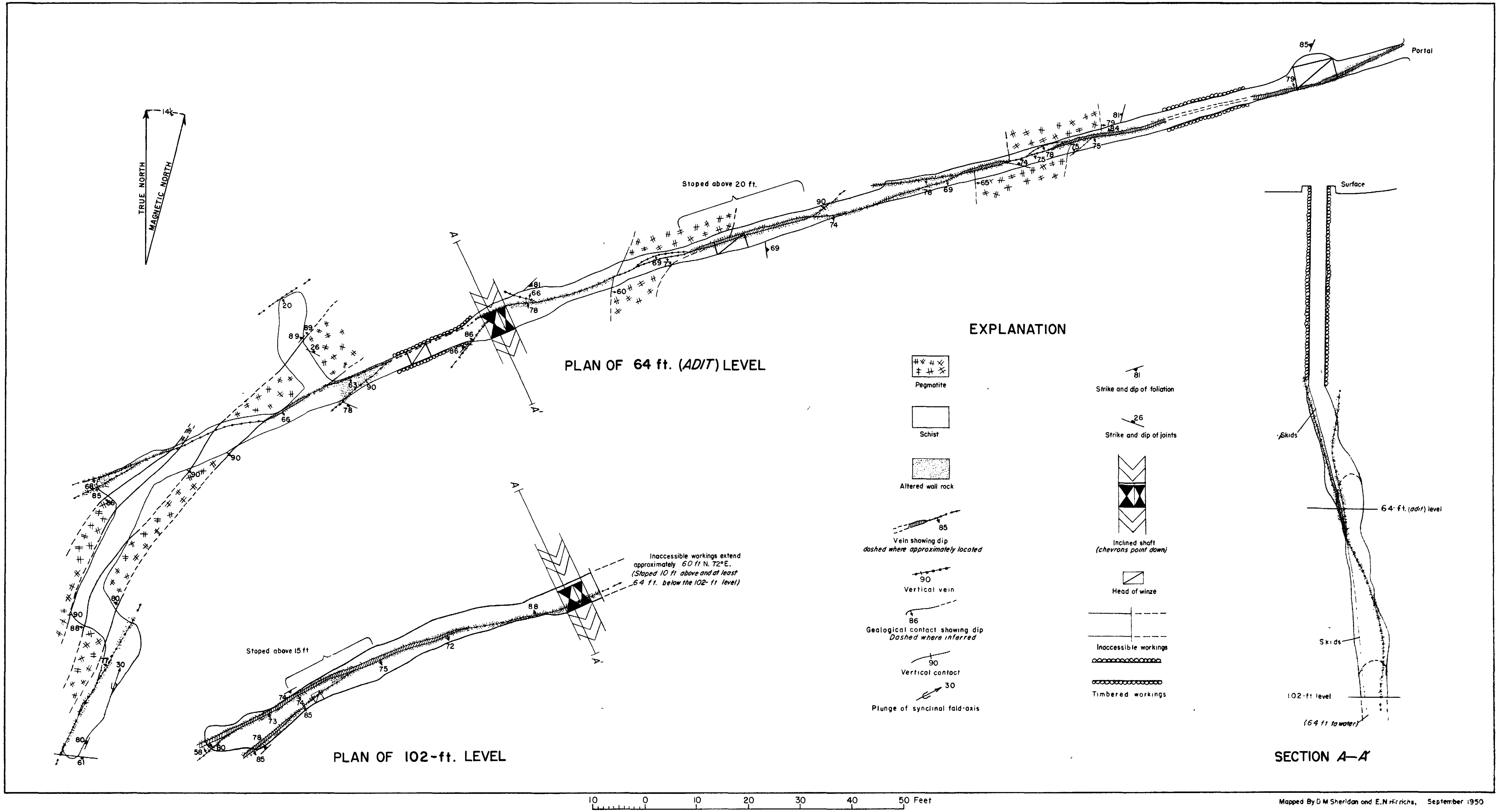


FIGURE 16.-GEOLOGIC MAPS AND SECTION, BONANZA MINE, CENTRAL CITY DISTRICT, GILPIN COUNTY, COLORADO.

The pitchblende-bearing veins are, for the most part, in medium-grained gneiss of Precambrian age (Moore and Butler, 1952). Hornblende schist, lime-silicate rock, pegmatite, and biotite granite are less abundant. Bostonite porphyry dikes of Tertiary (?) age radiate from a center near the mines. An unusual characteristic of these dikes is their radioactivity which is commonly three times as great as the radioactivity of the surrounding gneiss. A series of faults that strike east to northeast and dip steeply north or south cut all the rocks on Quartz Hill. The displacement along these faults is rarely more than a few feet. The faults may have served as channelways for the mineralizing solutions.

The East Calhoun shaft is accessible to a depth of 650 feet and accessible drifts are at 131, 219, 350, 413, 502, 583, and 643 feet below the collar. The mine is reported to have been worked to a depth of 980 feet.

The Calhoun vein strikes N. 65° E. and dips steeply south. At the East Calhoun shaft, the Calhoun vein intersects the north-dipping Bezant vein. The Calhoun vein ranges in width from 0.5 to 18 inches. Above the 413-foot level, the vein material consists of pyrite, quartz, and chalcopyrite, but on the 413-foot and 583-foot levels, sphalerite and galena are also present. Pitchblende was found only on the 131-foot level where very small quantities occurred in pyrite stringers. The pitchblende exposures are less than one-eighth inch thick and are localized in areas a few feet square.

The collar of the West Calhoun shaft is 710 feet southwest of the collar of the East Calhoun shaft on the same vein. The mine is developed by a shaft and drifts at depths of 115, 223, 245, 274, 387, and 500 feet . At the time of the visit, the 245-foot level was accessible for about 100 feet and the 387- and 500-foot levels for nearly 250 feet. Other levels were caved near the shaft.

The shaft is collared in gneiss which constitutes the wall rock to a depth of about 260 feet. Levels at 274 feet and below are in quartz-biotite schist of the Idaho Springs formation. The Calhoun vein, on this property, strikes N. 65°-70° E. The vein maintains a constant dip of 87° S. from the surface to the 387-foot level where it flattens to 79° S. It ranges in thickness from one to six inches, and is composed of sphalerite, pyrite, quartz, and subordinate amounts of chalcopyrite and galena. Pitchblende occurs on the walls of the 223-foot and 387-foot levels.

The collar of the Wood shaft is 180 feet N. 66° W. of the collar of the East Calhoun shaft. The accessible workings of the Wood mine consist of a nearly vertical shaft and drifts at 65, 135, 197, and 275 feet below the collar. The total length of these drifts is about 1,050 feet. Inaccessible workings include an older shaft and two drifts below the 275-foot level. The Wood vein is in a fault fissure that ranges in width from 1 to 18 inches and is bordered by a one- to two-foot zone of disseminated pyrite. The ores of the Wood vein are similar to the ores of the Calhoun vein. Above the 197-foot level the vein material consists chiefly of quartz, pyrite, chalcopyrite, and locally pitchblende. On the 197- and 275-foot levels sphalerite is also found. The present exposures of pitchblende, thought to be near the borders of mined-out pitchblende-rich lenses, are at the side of the vein near gouge. Sample returns ranged from 0.008 to 14.27 percent uranium.

Charter Oak claim.—The Charter Oak claim (93) is in sec. 15, T. 3 S., R. 73 W. The mine workings were inaccessible at the time of the visit. The dump consisted of silicified gneiss and quartz vein fragments with pyrite and sparse chalcopyrite. No abnormal radioactivity was noted.

Day Spring mine.—The Day Spring mine (94) is in the SW¼ sec. 14, T. 3 S., R. 73 W., about 500 feet west of the West Calhoun mine. Workings consist of a shaft house, inaccessible shaft, and a small dump. Quartz vein material and gneiss are exposed on the dump. No abnormal radioactivity was noted on the dump.

Delaware mine.—The Delaware mine (95) is on Alps Hill in sec. 15, T. 3 S., R. 73 W. The property is opened by a shaft. The wall rock of the quartz-pyrite vein is granite gneiss. Minor amounts of galena and sphalerite are also present. No abnormal radioactivity was noted.

Delmonico mine.—The Delmonico mine (96) is in sec. 14, T. 3 S., R. 73 W., near the summit of Alps Hill. The property is developed by a shaft which is said to be 1,100 feet deep but which was inaccessible at the time of the visit. The vein material on the dump contains pyrite, sphalerite, galena, and chalcopyrite; the country rock consists of granite gneiss. No abnormal radioactivity was noted.

Druid mine.—The Druid mine (97) is in sec. 23, T. 3 S., R. 73 W. The property is developed by two shafts and eight levels. The workings above the 350-foot level are in schist and those below are in granite gneiss. The vein is of the composite type, and consists of gold, pyrite, chalcopyrite, galena, sphalerite, and enargite in quartz gangue. The vein system consists of a series of subparallel mineralized fractures which range from two inches to 11 feet wide. The vein system strikes N. 40°-70° E. and dips 55°-80° NW. No abnormal radioactivity was noted on the property.

Egyptian mine.—The Egyptian mine (98) is in sec. 14, T. 3 S., R. 73 W., about a mile southwest of Central City near the summit of Quartz Hill. The property is developed by an inclined shaft 880 feet deep, connecting with levels at 100, 200, 300, 400, 500, 600, and 700 feet. At the time of the examination the workings were inaccessible. The dump is composed of fragments of granite gneiss and vein material. Minerals noted include pyrite, sphalerite, gray quartz, galena, chalcopyrite, and chalcocite. No abnormal radioactivity was noted.

Eldorado mine.—The Eldorado mine (99) lies about 250 feet south of the Kemp-Calhoun, in sec. 14, T. 3 S., R. 73 W. The property is opened by a shaft which was inaccessible at the time of the visit. Vein material on the dump consisted of pyrite, sphalerite, galena, and pitchblende. Analysis of a selected sample showed 0.026 percent uranium.

Ethan Allen mine.—The Ethan Allen mine (100) is 500 feet west of the Kirk mine in sec. 14, T. 3 S., R. 73 W. The property was opened by a shaft which is now inaccessible. The large dump indicates rather sizable mine workings. An examination of the dump showed no abnormal radioactivity.

Fairfield mine.—The Fairfield mine (101) is in sec. 22, T. 3 S., R. 73 W. The property is developed by a shaft which appeared to be in good shape at the time of the visit. The underground workings were not examined. Schist and pyritic vein material were noted on the dump. No abnormal radioactivity was detected.

Fannie mine.—The Fannie mine (102) is on the north side of Pewabic Mountain in sec. 23, T. 3 S., R. 73 W. The dump consisted of granite gneiss and quartz-pyrite vein fragments. No abnormal radioactivity was noted.

Forfar mine.—The Forfar mine (103) is in the NE¼ sec. 23, T. 3 S., R. 73 W., in Russell Gulch. The mine workings were inaccessible at the time of the visit. Highly silicified granite gneiss and quartz-pyrite vein fragments were found on the dump. No abnormal radioactivity was detected.

Frontenac mine.—The Frontenac mine (104) is in sec. 24, T. 3 S., R. 73 W., at the upper end of South Willis Gulch. The property was opened by an inclined shaft that is now inaccessible. The dump was composed of silicified granite gneiss and quartz-pyrite vein material with minor amounts of galena, chalcopyrite, and sphalerite. No anomalous radioactivity was noted.

Gem mine.—The Gem mine (105) is in sec. 15, T. 3 S., R. 73 W., on the south slope of Alps Hill. The mine was inaccessible at the time of the visit, but the workings are said to consist of a 270-foot shaft with short levels at depths of 50, 100, 125, 150, 200, and 250 feet. The mine appears to be on the eastward extension of the Gold Dollar vein. Ore on the dump consisted of galena and sphalerite; the wall rock was granite gneiss. No abnormal radioactivity was observed.

German and Belcher mines.—The German and Belcher mines (106) are on the summit of Quartz Hill about 1½ miles southwest of Central City in the NW¼ sec. 14, T. 3 S., R. 73 W. The German shaft is 600 feet deep, has an average dip of 80° S., and connects with levels at 130, 250, 400, and 500 feet. The underground workings of the two mines are connected at the first and second levels and consist of approximately 3,000 feet of drifts. The wall rock is mainly schist of the Idaho Springs formation and associated pegmatite. Granite gneiss and bostonite porphyry dikes are present also. The vein strikes about N. 75° E. and dips 75°-80° S. In places the vein is a typical fissure filling, but in most parts of the vein replacement proceeding outward from small fractures has been equally important. Ore minerals include: pyrite, chalcopyrite, galena, sphalerite, enargite, and pitchblende. Low-grade uranium ore consists of schist or pegmatite altered and highly impregnated with pyrite and other sulfides. The high-grade pitchblende ore occurs as irregular masses in the low-grade disseminated ore. A reconnaissance of the dumps showed high abnormal activity. Dump sample results ranged from 0.001 to 1.51 percent uranium.

Gold Dollar mine.—The Gold Dollar mine (107) is on Alps Hill in sec. 15, T. 3 S., R. 73 W. The property had been developed by a shaft that was caved at the time of the examination. The dump material was composed of biotite schist, granite gneiss, and vein material. Minerals noted include pyrite, galena, sphalerite, chalcopyrite, covellite, and quartz. No abnormal radioactivity was noted on the dump.

Gold King mine.—The Gold King mine (108) is in sec. 14, T. 3 S., R. 73 W., in Leavenworth Gulch. The mine workings are inaccessible, and their extent is unknown.

The country rock is Precambrian granite gneiss. Vein material on the dump consists of quartz and altered granite gneiss. Radioactivity of about four times background was noted on the dump.

A sample of the siliceous vein material from the dump contained 0.003 percent equivalent uranium oxide and 0.002 percent uranium.

Gold Rock mine.—The Gold Rock mine (109) is in sec. 22, T. 3 S., R. 73 W. The mine is opened by a shaft which is said to be 600 feet deep. At the time of the examination, the shaft was inaccessible. Vein material, consisting of quartz, chalcopyrite, pyrite, and pitchblende, was observed on the dump. The wall rock was highly silicified gneiss and schist, presumably of the Idaho Springs formation. A selected sample showed radioactivity equivalent to 0.11 percent uranium.

Gomer mine.—The Gomer mine (110) is in sec. 23, T. 3 S., R. 73 W., in Russell Gulch. The property is developed by a shaft. At the time of the examination, the shaft house, hoist, and shaft ladder appeared to be in good shape. The workings were inaccessible, however, as the shaft was flooded to the 50-foot level. Waste rock on the dump includedgneiss and biotite schist. Pyrite, sphalerite, and galena in a quartz gangue were also noted on the dump. No abnormal radioactivity was detected.

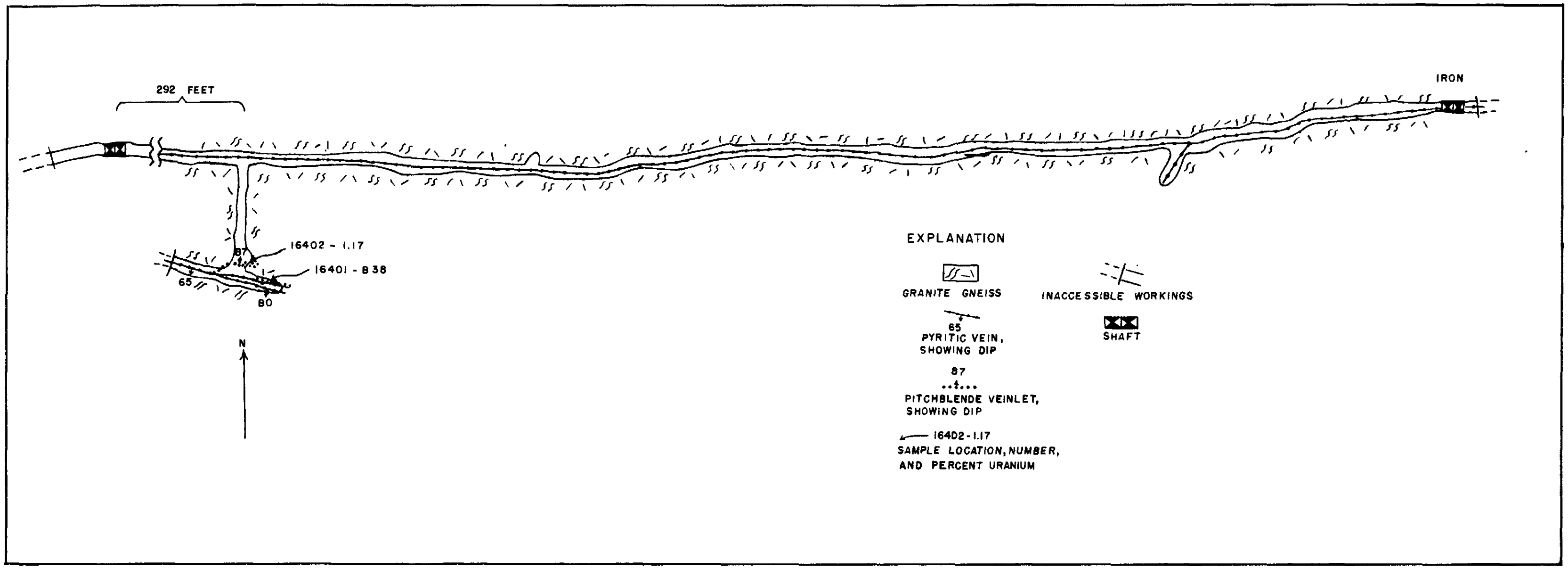
Harsh mine.—The Harsh mine (111), in Leavenworth Gulch, is in sec. 14, T. 3 S., R. 73 W., about 500 feet west of the point where the Central City-Russell Gulch road crosses Leavenworth Gulch. The mine workings consist of an 80-foot shaft with drifts 50 feet west and 10 feet east at the bottom. The underground workings are entirely within granite gneiss. The vein ranges from four to six feet in width, strikes N. 61° E., and is nearly vertical. The ore is crushed silicified granite gneiss carrying abundant coarse-grained disseminated pyrite. Minor amounts of galena and sphalerite are present also. A reconnaissance of the dump disclosed abnormal radioactivity. A sample of dump material from the most radioactive zone assayed 0.007 percent equivalent uranium and 0.011 percent uranium.

Incidental mine.--The Incidental mine (112) is in sec. 23, T. 3 S., R. 73 W. Development consists of a shaft, shaft house, head frame, ore bin, and mill building. The shaft is apparently in good shape, but is flooded to within 35 feet of the collar. The dump consists of highly altered granite gneiss and pyrite-bearing quartzose material. No abnormal radioactivity was detected on the dump.

Iron mine.--The collar of the shaft of the Iron mine (113) is on the north slope of Pewabic Mountain half a mile southeast of the town of Russell Gulch in the NE¼ sec. 23, T. 3 S., R. 73 W.

The property is developed by a two-compartment vertical shaft and several levels driven along the Iron vein. In 1949, the 288-foot level was the lowest working place not flooded. This level connects with another shaft on the west. Two minor crosscuts extend to the south from the 288-foot (third) level. From one of these crosscuts, drifts were run southeast and northwest following a vein split (fig. 17).

Pitchblende occurs on the third level to the west, of the Iron shaft, in a quartz-pyrite vein. The vein is approximately 50 feet south of the Iron vein, strikes N. 73° E. and dips 65°-80° S. The wall rock is Precambrian granite gneiss except for a small amount of bostonite porphyry. The Iron vein and the pitchblende-bearing vein are similar in mineral character. Although pyrite is the principal ore mineral, chalcopyrite and tennantite also occur in minor quantities.



40 0 40 FEET

MINE SURVEY BY J.W.HILL, 1947; GEOLOGY BY E.P.BERONI, 1949.

FIGURE 17.—MAP OF PART OF THIRD LEVEL, IRON MINE, GILPIN COUNTY, COLORADO.

Two samples of the radioactive vein material contained 1.19 and 8.90 percent equivalent uranium. Chemical analyses ranged from 1.17 to 8.38 percent uranium. Standing water in Iron shaft contained 2.7 ppm. uranium.

Iron Duke mine.—The Iron Duke mine (114) is in the NE$\frac{1}{4}$ sec. 23, T. 3 S., R. 73 W., a quarter of a mile south of Russell Gulch. The property is developed by a 510-foot shaft (now inaccessible), and the underground workings are said to total 2,669 feet. Material on the dump indicates that workings are in granite gneiss. Vein fragments consist of the quartz and pyrite with minor amounts of tennantite and chalcopyrite. No abnormal radioactivity was observed on the dump.

Jade lode.—The Jade lode (115) is about 350 yards south of the Gold Rock mine in sec. 22, T. 3 S., R. 73 W. The property is developed by a shaft of unknown depth. A small dump is composed of biotite gneiss and small amounts of quartz vein material. No abnormal radioactivity was detected.

Jasper cuts.—The Jasper cuts (116) are on Bobtail Hill in sec. 13, T. 3 S., R. 73 W. The deposit consists of a fracture zone in Precambrian pegmatite, gneiss, and schist. The property has been prospected by a 7$\frac{1}{2}$-by 9-by 10-foot pit and three open-cuts. Radiometric examination of the pit disclosed radioactivity ranging from 0.001 to 0.073 percent equivalent uranium. Fractured gneiss and schist contains from 0.001 to 0.021 percent uranium.

Jefferson mine.—The Jefferson mine (117) is located in sec. 15, T. 3 S., R. 73 W. Mine workings consist of an inaccessible two-compartment shaft and nearby prospect pits on the Calhoun vein. The country rock is granite gneiss. Dump material consists of pyrite and altered granite gneiss. A radiometric survey of the area showed very little abnormal radioactivity.

Jenny Lind Gulch area (Belle Maxville claims).—The Belle Maxville claims (118), in the Jenny Lind Gulch area, are in sec. 9, T. 2 S., R. 73 W. The claims are owned by Mr. Scott Hyde of Denver, Colorado.

Development of the claims consists of discovery shafts and pits. The rocks exposed within the area covered by the claims are gneiss and schist of the Idaho Springs formation with associated pegmatites, and intrusive monzonite porphyry. Quartz veins are exposed in some of the pits.

Radioactivity traverses made of the Belle Maxville claims and of a one-half square mile nearby area, south of the old town of Phoenix, revealed no radioactivity above normal.

Kirk mine.—The Kirk mine (119) is in sec. 14, T. 3 S., R. 73 W., on the south side of Quartz Hill. The property, idle for many years, was opened for sampling by Union Mines Development Corporation in 1944. Development consists of a 400-foot inclined shaft with levels at 97, 140, 200, 300, and 400 feet. The mine was partly flooded at the time of the examination (1949).

The Kirk lode is three to six feet wide and seems to be a fissure vein in gneiss and quartz-mica schist of the Precambrian Idaho Springs formation. The vein strikes almost due east and dips about 80° S.

Ore minerals, in addition to pitchblende, include pyrite, galena, sphalerite, enargite, and chalcopyrite. Two samples of vein material from the first level and shaft contained 0.127 and 1.20 percent uranium. Vein material from the dumps contained from 0.005 to 0.93 percent equivalent uranium, and from 0.025 to 0.084 percent uranium. Standing water in the shafts contained 2.7 and 8.2 ppm uranium.

Lynne mine.—The Lynne mine (120) is in sec. 15, T. 3 S., R. 73 W., a quarter of a mile west of the town of Russell Gulch. The mine shaft is caved. An examination of the dump material indicated that the workings are in gneiss. Vein material consisted of silicified wall rock with abundant pyrite and minor amounts of galena and sphalerite. No abnormal radioactivity was observed on the property.

Minnesota and Hillhouse mines.—The Minnesota and Hillhouse mines (121) are in secs. 14 and 23, T. 3 S., R. 73 W., half a mile east of the town of Russell Gulch. The properties were inaccessible at the time of the visit, but are said to be developed by two shafts 200 and 600 feet deep with levels every 100 feet. Pyritic vein material was found on the dumps. No abnormal radioactivity was noted.

Mitchell mine.—The Mitchell mine (122) is in sec. 14, T. 3 S., R. 73 W., on the southeast side of Quartz Hill about a mile southwest of Central City. The property has not been worked for many years and is now inaccessible. The vein, which appears to strike nearly east and west, is developed by a shaft said to be 500 feet deep. Ore seen on the dump consisted of pyrite and chalcopyrite in granite gneiss wall rock. Some pitchblende ore is said to have been found in the western part of the vein.

Nimrod mine.—The Nimrod mine (123) is in sec. 15, T. 3 S., R. 73 W. The mine workings were inaccessible at the time of the visit. The dump consisted of silicified gneiss and quartz vein with pyrite and sparse chalcopyrite. No abnormal radioactivity was noted.

Ohio mine.—The Ohio mine (124) is in sec. 14, T. 3 S., R. 73 W. The examination of the dump disclosed no abnormal radioactivity associated with vein materials.

Onoko mine.—The Onoko mine (125) is on the south slope of Leavenworth Gulch in sec. 14, T. 3 S., R. 73 W., about 500 feet east of the Bezant mine.

The mine workings, consisting of a shaft and underground workings of unknown extent, were inaccessible at the time of the examination.

Material on the dump consists of vein quartz with pyrite and altered granite gneiss.

No abnormal radioactivity was detected on the dump.

Payoff mine.—The Payoff mine (126) is in Lake Gulch in sec. 12, T. 3 S., R. 73 W. The property is developed by a 1,500-foot adit. The wall rock is silicified granite gneiss. The vein is apparently a fault fissure filling, as slickensides and mullion structure were observed on the hanging-wall block. The vein minerals are predominantly quartz and pyrite with some chalcopyrite. A radioactivity traverse of the adit disclosed no abnormal radioactivity.

Perrin mine.—The Perrin mine (127) is in sec. 14, T. 3 S., R. 73 W. The property, consisting of a shaft of unknown depth, has not been worked for many years and is now inaccessible. Pitchblende has been reported to occur on the dump, but none was observed during the examination.

Pewabic tunnel in Russell Gulch (Golden Opportunity).—The Pewabic tunnel (Golden Opportunity)(128), in Russell Gulch, is in sec. 23, T. 3 S., R. 73 W. The adit was not examined, but dump material consisted of quartz vein fragments containing pyrite, galena, and sphalerite, silicified granite gneiss with disseminated pyrite, and schist. No abnormal radioactivity was detected.

Pewabic tunnel near Blackhawk.—The Pewabic tunnel (129) is in the NE¼ NE¼ sec. 17, T. 3 S., R. 72 W., near Blackhawk. The adit is about 1,500 to 1,800 feet long and has several branch drifts. It cuts schist, gneiss, and pegmatite of the Idaho Springs formation. The radioactivity of the country rocks ranges from 0.004 to as high as 0.039 percent equivalent uranium. Sample analyses ranged from 0.001 to 0.041 percent uranium. The presence of radon is suspected because of the erratic performance of Geiger counters after use in the adit.

Pewabic shaft.—The Pewabic shaft (130) is in sec. 23, T. 3 S., R. 73 W., in Russell Gulch. The workings consist of a shaft 1,100 feet deep and about 2,000 feet of drift. The mine was last worked in 1940 and is now inaccessible. Minerals noted on the dump include pyrite, sphalerite, galena, chalcopyrite, tennantite, and pitchblende.

Phoenix shaft.—The Phoenix shaft (131), 1,000 feet northeast of the Gold Rock mine, is in the NE¼ sec. 22, T. 3 S., R. 73 W.

The workings are inaccessible and their extent is unknown, but probably small.

Vein material on the dump consists of pyrite in quartz and altered granite gneiss and schist. A radioactivity examination of the dump showed no abnormal radioactivity.

Placer deposits in North Clear Creek.—Gold-bearing placer deposits (132) have been mined for the entire length of North Clear Creek from its junction with Clear Creek to Blackhawk and beyond for a considerable distance upstream.

A tailings pile in the bed of the creek, resulting from placer clean-up operations, 6.5 miles by road south of Blackhawk was investigated in March 1951. The placer locality is in sec. 26, T. 3 S., R. 72 W. It consisted of a sand bank five feet thick by about 50 feet in diameter. Black sand is concentrated in thin horizontal lenses in the sand bank. The black sand consisted chiefly of magnetite and garnet, but contained some monazite, quartz, feldspar, and biotite.

Only slight radioactivity was noted in the field; but a panned concentrate from the black sand contained 0.019 percent equivalent uranium and 0.003 percent uranium.

<u>Placer deposits in Leavenworth and Russell Gulches</u>.—Placer deposits in Leavenworth and Russell Gulches (133) one mile southeast of Quartz Hill in secs. 13 and 14, T. 3 S., R. 73 W.

Local miners have reported that pitchblende was concentrated in the bottom of pans during former panning operations at the junction of Leavenworth and Russell Gulches. An area 500 feet by 500 feet at the junction of the gulches was examined for radioactivity, but with negative results.

A placer area in Leavenworth Gulch about midway between its head on Alps Hill and its junction with Russell Gulch was examined for radioactivity. The radioactivity of this area was about twice background but no local concentrations of greater radioactivity were found in the placer material. It is estimated that the radioactivity is not over 0.003 percent equivalent uranium.

Prompt Pay mine.—The Prompt Pay mine (134) is in SW¼SW¼ sec. 15, T. 3 S., R. 73 W., about one-fourth mile northwest of the town of Russell Gulch. The mine is developed by a shaft 175 feet deep connecting with four short levels. The mine has been idle since 1905, therefore the workings could not be entered. Ore on the dump was predominantly pyritic but carried minor amounts of sphalerite and galena. The wall rock is mostly schist. No abnormal radioactivity was detected on the dump.

Pyrinees mine.—The Pyrinees mine (135) in sec. 15, T. 3 S., R. 73 W., is said to be developed by a shaft and four levels. These workings were all inaccessible at the time of the examination. Wall rock observed on the dump consisted of schist and gneiss of the Idaho Springs formation. Vein material consisted of pyrite, pitchblende, chalcopyrite, and sphalerite in a gangue of finely crystalline rose quartz. A selected specimen assayed 0.64 percent equivalent uranium and contained 0.44 percent uranium.

Ralls County mine.—The Ralls County mine (136) in sec. 14, T. 3 S., R. 73 W., is on the north side of Quartz Hill near its summit. The property is developed by a 700-foot shaft, now inaccessible, and seven levels. The country rock, as noted on the dump, is granite gneiss. Pyrite, galena, sphalerite, and tetrahedrite comprise the vein material on the dump. A radiometric reconnaissance of the dump disclosed no abnormal radioactivity.

Rough and Ready claim.—The Rough and Ready claim (137) is in sec. 36, T. 2 S., R. 73 W. A small adit and six prospect pits were examined for radioactivity. No abnormal radioactivity was noted.

Russell mine.—The Russell mine (138) is in sec. 23, T. 3 S., R. 73 W., in Russell Gulch. The property consists of two shafts, 200 and 500 feet deep, and five levels totaling about 1,000 feet of drift. The workings connect with the Old Town mine to the east. The mine has not been worked for many years and is inaccessible. Slight radioactivity amounting to about 0.005 percent equivalent uranium was detected on the dumps.

Russell-Pride mine.—The Russell-Pride mine (139) is in sec. 14, T. 3 S., R. 73 W., Russell Gulch. The mine workings are inaccessible and only the dump was examined. The vein material noted consisted of quartz with pyrite. Very slight radioactivity, estimated to be 0.003 percent equivalent uranium, was detected on the south side of the dump.

Scandia mine.—The Scandia mine (140) is in sec. 14, T. 3 S., R. 73 W., on the east slope of Quartz Hill a little over a mile southwest of Central City. The development consists of a shaft and an adit, but as the mine has not been worked for many years, these workings are now inaccessible. The only ore seen on the dumps consisted of pyrite in a quartz gangue.

Telegraph (?) mine.—The Telegraph (?) mine (141) is in the SE$\frac{1}{4}$ sec. 14, T. 3 S., R. 73 W. The mine workings are inaccessible, but it is thought that the mine is one of the smaller properties on Quartz Hill. Uraconite (hydrous sulfate of uranium and copper) has been reported from the property. Moderate radioactivity estimated to amount to 0.01 percent equivalent uranium was observed at the collar of the shaft.

Tom Martin lode.—The Tom Martin lode (142) is 400 yards east of the crest of Nigger Hill in sec. 11, T. 3 S., R. 73 W. The property is developed by a shaft of unknown depth. The vein material on the dump is composed largely of highly silicified gneiss with disseminated pyrite and sphalerite. No abnormal radioactivity was detected.

Topeka mine.—The Topeka mine (143) is in the SW¼ sec. 14, T. 3 S., R. 73 W., about one-fourth of a mile north of the town of Russell Gulch. The development consists of two inclined shafts with drifts on 15 levels. The workings were inaccessible at the time of the visit.

The predominant metallic minerals of the Topeka vein are pyrite and sphalerite, with subordinate amounts of chalcopyrite and galena. The gangue consists of quartz and altered wall rock with small amounts of calcite. Small amounts of native bismuth are reported from the fourteenth level. The wall rock is mostly granite gneiss.

A radioactivity reconnaissance of the dump disclosed no abnormal radioactivity.

Trail mine.—The Trail mine (144), in sec. 14, T. 3 S., R. 73 W., is about 750 feet northeast of the town of Russell Gulch. The mine workings consist of a caved shaft with presumably a small amount of drifting.

The vein explored by the Trail shaft consists largely of pyrite and quartz.

No abnormal radioactivity was noted on the mine dump.

Waterloo mine.—The Waterloo mine (145) is in sec. 23, T. 3 S., R. 73 W. The mine is inaccessible, and the extent of the workings is not known. Reconnaissance of the dump disclosed no abnormal radioactivity.

West Russell mine.—The West Russell mine (146) is in sec. 22, T. 3 S., R. 73 W., in Russell Gulch. The mine workings were inaccessible at the time of the examination. Material on the dump indicates that the host rock is granite gneiss. The vein material consists of highly silicified granite gneiss containing disseminated pyrite. The northern part of the dump was found to be abnormally radioactive. The radioactivity of two samples of material from the dump was found to be equivalent to 0.006 and 0.012 percent uranium, but chemical analysis of the samples showed a negligible uranium content.

Wyandotte mine.—The Wyandotte mine (147) is located in the NW¼SE¼ sec. 14, T. 3 S., R. 73 W. Mine workings consist of a deep shaft which is inaccessible. A series of prospect pits extends from the shaft N. 70° E. for about 150 yards. The dump material is altered and silicified granite gneiss. Two of the prospect pits show slight radioactivity amounting to about 0.005 percent equivalent uranium.

Bostonite dike.—A Tertiary bostonite dike (148) intruded into Precambrian granite gneiss is exposed in a road cut 1.6 miles north of Blackhawk on Colorado Highway 119 in sec. 1, T. 3 S., R. 73 W. The dike strikes N. 55° E. and dips 40° NW. The dike is 30 feet thick and 5,000 feet long. Fluorite, minor sulfides, and secondary iron oxides line scattered vugs near the center of the dike. Feldspar is the most abundant gangue mineral with some quartz and hornblende. Radioactivity of the dike is about twice background. One chip sample taken across the dike contained 0.005 percent equivalent uranium.

Chaffee County

Location and general features

Chaffee County is southwest of the Front Range mineral belt in central Colorado; Salida, in the southeast corner, is the county seat.

The Continental Divide is along the crest of the Sawatch Range and forms the western boundary of the county, and the southern part of the Mosquito Range forms the eastern boundary. The Arkansas River flows in a wide valley that trends southward through the middle of the county. Altitudes range from over 14,000 feet in the Sawatch Range to 7,500 feet along the Arkansas River. The western part of the county is in the Sawatch Range and is mostly inaccessible but the eastern part along the Arkansas River where there are good roads is readily accessible.

Seven pegmatite deposits and one breccia deposit in the Turret mining district and three pegmatites in the Trout Creek Pass region were examined for radioactivity. The Turret mining district is in an area of early Paleozoic sedimentary rocks that lie on Precambrian granite and are intruded by early Tertiary igneous rocks. The Trout Creek Pass region is underlain chiefly by Precambrian granite. The remainder of the eastern side of the county is similar geologically to the Turret district. The Arkansas River valley is covered by alluvium, and the western part of the county contains Precambrian granite, gneisses, and schists that have been intruded by rocks.

Mica-Beryl, Falfar, and Gray Hen claims.--The Mica-Beryl, Falfar, and Gray Hen claims (149) are located seven miles north of Salida in sec. 27, T. 51 N., R. 9 E. The deposit is an extremely coarse-grained pegmatite in medium- to coarse-grained Precambrian granite. The claims were located in 1942 and have had feldspar, mica, and beryl produced from them. Small amounts of monazite and samarskite were found by Thomas P. Anderson of the U. S. Atomic Energy Commission during a brief field examination in June 1950. A sample of selected material contained 1.10 percent uranium.

Crystal No. 8 mine.—The Crystal No. 8 mine (150) in sec. 17, T. 14 S., R. 77 W., is about 1,000 feet south of U. S. Highway 24, eight miles by road east of Buena Vista. The mine was examined by K. G. Brill, Jr., in 1947 and K. G. Bell in 1949.

The mine workings consist of a cut, 80 by 30 feet, and a short tunnel.

The country rock consists of augen gneiss. The pegmatite dike is about 300 feet long, 40 feet wide, and is exposed to a depth of 30 feet. The dike trends N. 85° E. and the dip of the south border is 70° S. The two zones of the pegmatite are core and wall zone. The core contains coarsely crystalline quartz, potash feldspar, and biotite books. Crystals of allanite are present in small quantities at the west end of the exposure. The wall zone contains the same minerals, some plagioclase, and a large quantity of garnet crystals. There are also numerous small grains of euxenite in the plagioclase-quartz intergrowth of this border zone.

Masses of allanite crystals and some books of biotite are high in radioactivity. The allanite contains 0.062 percent equivalent uranium, but only 0.006 percent uranium, indicating the presence of considerable thorium (perhaps 0.2 percent). The biotite contains 0.004 percent equivalent uranium and 0.002 percent uranium.

Lucky Break Placer claim.—The Lucky Break Placer claim (151) is 12 miles northeast of Salida in W½ sec. 2, T. 50 N., R. 9 E., in the Turret mining district. The property can be reached by graded country road. Development consists of a 75-foot adit which connects with the bottom of an open pit that is 50 feet deep by 50 feet in diameter. Two small adits extend into the walls of the pit for distances of 10 and 20 feet.

The principal rock of the area is limestone of probable Mississippian age that is cut by sills of Tertiary (?) monzonite porphyry. Precambrian granite and schist crop out within half a mile of the property. The limestone adjacent to a vertical fault is highly brecciated and cemented by hematite. Within the fault zone, hematite coatings are slickensided and chatter-marked. Two types of hematite are present: (1) a reddish-brown, earthy material that occurs as a massive filling between limestone fragments, and (2) a hard, black, massive material that occurs as nodules, reniform masses, and fracture fillings. Quartz stringers at places occur within the breccia zone. A wedge of talc-like material occurs along the fault and extends into the breccia.

Radioactivity traverses were made of the surface and mine workings. Radioactivity ranged from the normal background in the limestone to four times the background in the hard black hematite. The owners report uranium assays as high as 0.30 percent. One sample taken by K. C. Brill, Jr. of the U. S. Geological Survey assayed 0.009 percent uranium. The radioactivity of the hematite breccia ranges from 0.002 to 0.065 percent equivalent uranium. The uranium content ranges from 0.001 to 0.011 percent.

Homestake mine.—The Homestake mine (152) in sec. 34, T. 51 N., R. 9 E., Turret district, is in a pegmatite about six miles north of Salida. The mine was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of a bench cut 80 by 80 feet.

The country rock consists of biotite-augen gneiss and quartzite. The pegmatite is about 240 feet long, 80 feet wide, and is exposed to a depth of 50 feet. It trends N. 71° E. and plunges 10° to 15° NE. The pegmatite is zoned and has a core of albite and an outer zone of quartz, albite, muscovite, and microcline. An inclusion of chlorite schist is exposed in the south end of the dike.

Most of the dike is not abnormally radioactive. A sample of the chlorite schist contained 0.004 percent uranium.

Last Chance Spar-Mica Dyke prospect.—The Last Chance Spar-Mica Dyke prospect (153) now known as the Old Glory claim, in sec. 33, T. 51 N., R. 9 E., is about six miles north of Salida. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of two trenches and a pit.

The country rock is gray, coarse-grained granite. The prospect is in a branching pegmatite dike. The main branch, about 200 feet long and 40 feet wide, strikes N. 55° W., and the other about 105 feet long and 35 feet wide, strikes S. 77° W. The dike is distinctly zoned. The core consists of coarsely crystalline quartz and white potash feldspar; the intermediate zone of quartz, plagioclase, and muscovite with beryl; and the wall zone of finely crystalline quartz, potash feldspar, muscovite, and garnet.

Torbernite that coats a joint plane is highly radioactive. A sample of pegmatite with torbernite from the joint plane contained 0.034 percent equivalent uranium and 0.011 percent uranium.

Mica-Beryl pegmatite mine.—The Mica-Beryl pegmatite mine (154) in sec. 21, T. 51 N., R. 9 E., Turret district, is on a flat bench about 2.5 miles by road north of the Homestake mine. The mine was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of a cut 100 by 40 feet. The country rock is a fine-grained gray granite.

The pegmatite dike is 450 feet long, 50 feet wide, and is exposed to a depth of 30 feet. The dike strikes N. 87° E. and is vertical. The pegmatite has three district zones. The core consists of quartz and microcline; the intermediate zone of muscovite, plagioclase, and beryl; and the wall zone of quartz, microcline, muscovite, and plagioclase.

Radioactivity measurements made on the outcrop indicate that some of the books of muscovite are slightly radioactive, but the radioactivity of pegmatite is negligible.

Northern View mine.—The Northern View mine (155)(formerly the Clora May lode) in sec. 11, T. 14 S., R. 77 W., is about 1,000 feet south of U. S. Highway 24, 10 miles by road east of Buena Vista. It was examined by K. G. Brill, Jr. in 1947 and by K. G. Bell in 1949.

The country rock is granite porphyry. The pegmatite dike is about 200 feet long, about 50 feet wide, and is exposed by an open cut to a depth of about 40 feet. The pegmatite is distinctly zoned. The core consists chiefly of quartz, microcline, biotite, and a little red granite. The intermediate zone consists of finely crystalline quartz, potash feldspar, and albite. The wall zone is quartz-mica schist.

Small masses of biotite, garnet, and smoky quartz are abnormally radioactive. A sample of this material contained 0.010 percent equivalent uranium and 0.006 percent uranium. Monazite was observed in the open cut. A sample of muscovite with black tourmaline from the core zone contained 0.006 percent equivalent uranium, but only 0.001 percent uranium.

Riegel prospect.—The Riegel prospect (156) in sec. 3, T. 50 N., R. 9 E., is about six miles northeast of Salida. The prospect was examined by K. G. Brill, Jr. in 1947.

The mine workings consist of two small cuts and a room 10 by 15 feet.

The distinctly zoned pegmatite dike in gneiss has a core of quartz, potash feldspar, and relatively small books of muscovite. The wall zone consists of granite pegmatite and tarnished biotite books. The dike strikes southwest and is vertical.

Measurements made on the outcrop indicate that the radioactivity is negligible.

Rock King prospect.—The Rock King prospect (157) in sec. 34, T. 51 N., R. 9 E., is about six miles due east of U. S. Highway 285. The prospect was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of a bench, 25 feet long and 10 feet wide, at the foot of a cliff formed by pegmatite.

The country rock consists of augen gneiss and quartzite. Three parallel dikes that strike east and dip vertically are exposed on the claim. The middle dike is the largest and is about 1,000 feet long, 50 feet wide, and forms a cliff 80 feet high. The northern and southern dikes are about 500 feet long and 10 feet wide. All three dikes have cores composed of albite and quartz. The wall zones consist of granite pegmatite. The dikes contain scattered beryl and tantalite-columbite.

A sample of a brown mineral (tantalite-columbite ?) with beryl from the core of the southern dike contained 0.098 percent equivalent uranium and 0.027 percent uranium. Another sample from a pile of limonite rock on the south side of the road bridge contained 0.003 percent equivalent uranium and 0.002 percent uranium.

Seven Mile Creek pegmatite dike.—The dike (158) in sec. 25, T. 13 S., R. 78 W., is about five miles northeast of Buena Vista and five miles due west of U. S. Highways 24 and 285. It was examined in 1947 by K. G. Brill, Jr.

The dike has not been explored.

The country rock consists of granite porphyry. The pegmatite dike is about 30 feet long, about 10 feet wide, and trends slightly east of north. It consists chiefly of hornblende with stringers of finely crystalline quartz and potash feldspar.

Radioactivity measurements made on the outcrop indicate that the radioactivity of the dike is negligible.

White Swan prospect and Doyle's prospect.—These prospects (159) in sec. 33, T. 51 N., R. 9 E., are about six miles north of Salida. The prospects were examined by K. G. Brill, Jr., in 1947.

The dikes have been explored by a shallow shaft on each claim. There are at least four subparallel pegmatite dikes that extend across the two claims in quartz-mica schist and granite. On the White Swan claim the dikes consist of finely crystalline granite pegmatite that contains magnetite. On Doyle's claim, which is downhill toward the west, one of the large northern dikes has a core of coarsely crystalline quartz and green beryl, and a wall zone of quartz, potash feldspar, and blue beryl. Isolated spots have some radioactivity, but a sample taken of granite with magnetite contained only 0.002 percent equivalent uranium and 0.002 percent uranium.

Custer County

Location and general features

Custer County is a small county in central Colorado. Westcliffe in the center of the county is the county seat.

On the western side of the county are the Sangre de Cristo Mountains and on the eastern side are the Wet Mountains. Between the two mountain ranges is a wide valley that drains to the north into the Arkansas River. Elevations range from over 13,500 feet above sea level in the mountains to slightly above 7,500 feet in the valley.

The Sangre de Cristo Mountains are composed of Paleozoic sedimentary rocks; the valley is covered with Quaternary alluvium; and the Wet Mountains are composed of Precambrian igneous rocks and a few Tertiary intrusives.

Only one locality was examined for radioactivity. It consists of vein deposits in the Wet Mountains.

Haputa Ranch.—Ten and possibly 12 radioactive vein deposits were discovered (Dellwig, 1951) within an area about 15 miles long and about four miles wide in the Precambrian metamorphic and igneous complex of the Wet Mountains in south-central Colorado. The most promising of these deposits, those on the Haputa Ranch (160) in the SE¼ sec. 12, T. 22 S., R. 71 W., were mapped in August 1950 by L. F. Dellwig and C. G. Bowles (fig. 18).

The deposits on the Haputa Ranch, owned by George Haputa of Rosita, Colo., have been developed by four 15- to 20-foot shafts and several shallow pits and trenches. Thorium and rare earths are present in the veins, and assays of representative samples from these deposits are reported to indicate potentially minable deposits of gold, silver, copper, and lead (Dellwig and Gott, 1951). There are no known previous reports on this area.

The radioactive deposits are in shear zones in a Precambrian metamorphic-igneous complex that consists of quartz-hornblende schist, granite gneiss, hornblende-andesine gneiss, gabbro and peridotite, microcline granite, and pegmatite. The younger of the two granitic units, microcline granite, was emplaced in part along faults and in part along the foliation of the earlier granite gneiss. Faulting in Tertiary (?) time reopened pre-existing fault zones, sheared the microcline granite, and produced openings along which lamprophyre dikes and the radioactive veins were emplaced.

A network of closely spaced quartz-sulfide veins, stringers, and pods are present in fractured shear zones. The thickness of the veins, stringers, and pods generally ranges from less than an inch to three or four inches; the width of the shear zones ranges from half a foot to about 25 feet.

The granite gneiss country rock has a fair to excellent foliation that varies in prominence with the age and texture of the rocks. The foliation trends uniformly northeast and dips steeply northwest or vertically. Some microcline granite dikes, which are barren, and most of the pegmatites were intruded in a lit-par-lit manner along the foliation planes of the country rock.

Four shear zones that trend about N. 45°-50° W., and that dip nearly vertically were mapped (fig. 18). Shear zone 1, which has an average width of about 5½ feet, extends beyond the limits of the mapped area; it is at least two miles long. Shear zones 2, 3, and 4 are probably much shorter, and average between one and five feet in width.

The shear zones occur along dikes of microcline granite, which probably were emplaced along pre-existing faults. After the granite dikes were emplaced, they were fractured and sheared, and a porous breccia was formed through which the ore-bearing solutions later circulated. White and black quartz, barite, thorite, and sulfides were deposited in veins, stringers, and pods in the breccia zones.

The radioactive deposits occur as fracture-fillings and as replacements in shear zones. They are classed as mesothermal deposits. Metal-bearing quartz-vein material, thorium, and the rare earths were introduced into the fracture zone.

The massive quartz veins consist of vuggy quartz and visible galena, chalcopyrite, marmatite, and bornite; Mr. George Haputa has reported that assays indicate that commercial quantities of gold and silver are also present. Broken crystals of quartz and galena are veined by barite. The ore was later brecciated and cemented by hematite, thorium, and rare-earth minerals.

Four radioactive veins have been found in the area mapped by Dellwig and Gott (1951). Shear zone 1, which is more than two miles long, contains the most extensive and most radioactive deposit in the mapped area. Samples collected from vein exposures at the surface and in shallow pits along the shear zone show different degrees of radioactivity. A 20-foot shaft in the shear zone in the northwestern part of the area exposes a shear zone six feet wide. In the bottom of the shaft the microcline granite is intensely fractured and stained with thorium and secondary iron minerals. The equivalent uranium content of the six-foot zone in the bottom of the shaft ranges from 0.026 to 1.42 percent; it averages 0.15 percent. The most radioactive part, which contains 8.1 percent thorium oxide, is a six-inch fracture zone that contains numerous pods and stringers of black quartz. Specimens collected from the outcrop show much less radioactivity. It is concluded, therefore, that the radioactivity in the shear zone may increase with depth.

Barite, thorite, and a little galena are exposed in the shaft in the northwestern part of the area along shear zone 1. Galena is abundant on the southern end of this shear zone, and in the central part of the area some chalcopyrite is sparsely present.

The radioactivity of shear zones 2 and 3 is less than that of shear zone 1. Barite and quartz are the only vein minerals observed in shear zone 2. Barite and commercial quantities of gold-bearing quartz have been reported by the owner from the shaft on the northern end of shear zone 3; traces of gold also has been reported in negligible quantities from the south end of shear zone 3; copper is present and small amounts of barite and galena are present in shear zone 3. Data obtained by radioactivity travers-ing indicate that the radioactivity is highest where galena and barite are present.

Shear zone 4 is exposed in only one place, but a sample collected from this locality is more radioactive than any other sample from the mapped area. It contains 14.9 percent thorium oxide and 2.94 percent equivalent uranium.

There is some evidence that indicates that the radioactivity of the deposits increases as depth increases. This suggests that the surface rocks have been leached of some of their radioactive constituents. Analyses that range in radioactivity from 0.007 to 2.94 percent equivalent uranium, may not, therefore, adequately illustrate the radioactivity of the deposit at depth.

The results of radium and repeat thorium analyses of three of the samples show that thorium is responsible for the radioactivity in these samples. The radiometric and chemical analyses of these samples, together with the information that is known about the mineralogy, suggest that thorite and its alteration products are the only radioactive minerals that are present in these deposits.

Data obtained during this investigation indicate that the Haputa Ranch deposits contain appreciable quantities of thorium as the mineral thorite and its alteration products. In addition, it is possible that commercially significant amounts of lead, zinc, gold, silver, barite, and the rare earths may be found.

The common association of uranium with thorite suggests that this element originally may have been present in the thorite at the Haputa Ranch deposits, but that during alteration the uranium may have been removed by the acid waters derived from fluorite, barite, and associated sulfides in a manner similar to the leaching of pitchblende- and sulfide-bearing dumps from veins in the Central City district of Colorado. It is possible, therefore, that uranium-bearing thorite or other uranium minerals occur below the zone of oxidation and circulating groundwaters. The presence or absence of uranium in the unleached part of the deposits can only be determined by drill holes or underground workings that penetrate the mineralized zones at a considerable depth below the surface.

Douglas County

Location and general features

Douglas County is in central Colorado south of Denver. Castle Rock is the county seat.

The Rampart Range covers the southwest half of the county. The rest of the county is rolling hills and flat plains. East and West Plum Creeks and Cherry Creek form the drainage system of the county. Elevations range from slightly over 5,000 feet above sea level in the eastern portion to over 7,500 feet at Devil's Head in the western part of the Rampart Range. The western part of the county contains Precambrian granite and Paleozoic and Cretaceous sedimentary rocks. The eastern part of the county contains Tertiary sedimentary formations with a few basalt and rhyolite intrusions. A large fault cuts across the southwest corner of the county. The four pegmatite prospects examined are in Precambrian granite near Devil's Head.

Little Eddy prospect.—The Little Eddy prospect (161) in sec. 7, T. 10 S., R. 69 W., is 0.3 mile east of Colorado Highway 67. It is four miles north of West Creek. It was examined by K. G. Brill, Jr., in 1947. The pegmatite dike has been explored by a trench about 30 feet long.

The country rock consists of biotite granite porphyry. The dike is about 200 feet long and 50 feet wide. The zoned pegmatite has a core of coarsely crystalline quartz and pink potash feldspar. The intermediate zone is finer grained but otherwise the same as the core. The wall zone consists of granite pegmatite and biotite. A border of finely crystalline biotite granite lies between the wall zone and the country rock on the west side of the dike.

Parts of the border and intermediate zones are radioactive, but most of this activity is not due to uranium, as a sample of granite from the border zone contained 0.005 percent equivalent uranium and only 0.001 percent uranium.

Magnusson and Sons, Inc. feldspar mine.—The mine (162) in sec. 10, T. 9 S., R. 69 W., is about six miles northeast of Deckers. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of an open pit 25 by 30 feet.

The country rock consists of biotite granite porphyry. The pegmatite dike is more than 100 feet long, 35 to 45 feet wide, and trends N. 35° W. The zoned pegmatite has a core of quartz and potash feldspar and a wall zone of quartz, potash feldspar, and biotite books.

Two samples from the core and wall zone contained 0.003 and 0.006 percent equivalent uranium respectively. They each contained 0.001 percent uranium.

Skeleton No. 2 mine.—The Skeleton No. 2 mine (163) in sec. 36, T. 9 S., R. 69 W., is about six miles northeast of West Creek. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of an open cut 100 by 40 feet.

The country rock consists of pink granite. The pegmatite dike is about 400 feet long, 75 feet wide, and is exposed to a depth of 50 feet. It has a general northwest trend and dips to the southwest. The zoned dike has a core of coarsely crystalline quartz and potash feldspar and a wall zone of granite intergrowth with bronze-colored biotite. A band of altered country rock is between the wall zone and the fresh country rock.

The country rock and the altered granite have some radioactivity. A sample of altered red granite contained 0.007 percent equivalent uranium and 0.003 percent uranium. A sample of the country rock contained 0.004 percent equivalent uranium and 0.001 percent uranium.

Watson Park feldspar mine.—The Watson Park feldspar mine (164) is sec. 36, T. 9 S., R. 69 W., is one mile east of the Rampart Range highway. It was examined by K. G. Brill, Jr., in 1947. The mine workings consist of an open cut 30 by 30 feet.

The country rock consists of a granite porphyry. The pegmatite dike is about 300 feet long, 60 feet wide, and is exposed to a depth of 30 feet. It trends N. 20° W. and dips 25° E. The zoned pegmatite has a core of coarsely crystalline quartz and pink potash feldspar and a wall zone of quartz, potash feldspar, and biotite.

A sample of biotite contained 0.006 percent equivalent uranium but only 0.001 percent uranium, suggesting that most of the radioactivity is not due to uranium. Similarly two samples of the pegmatite contained 0.003 and 0.005 percent equivalent uranium and only 0.001 and 0.003 percent uranium, respectively.

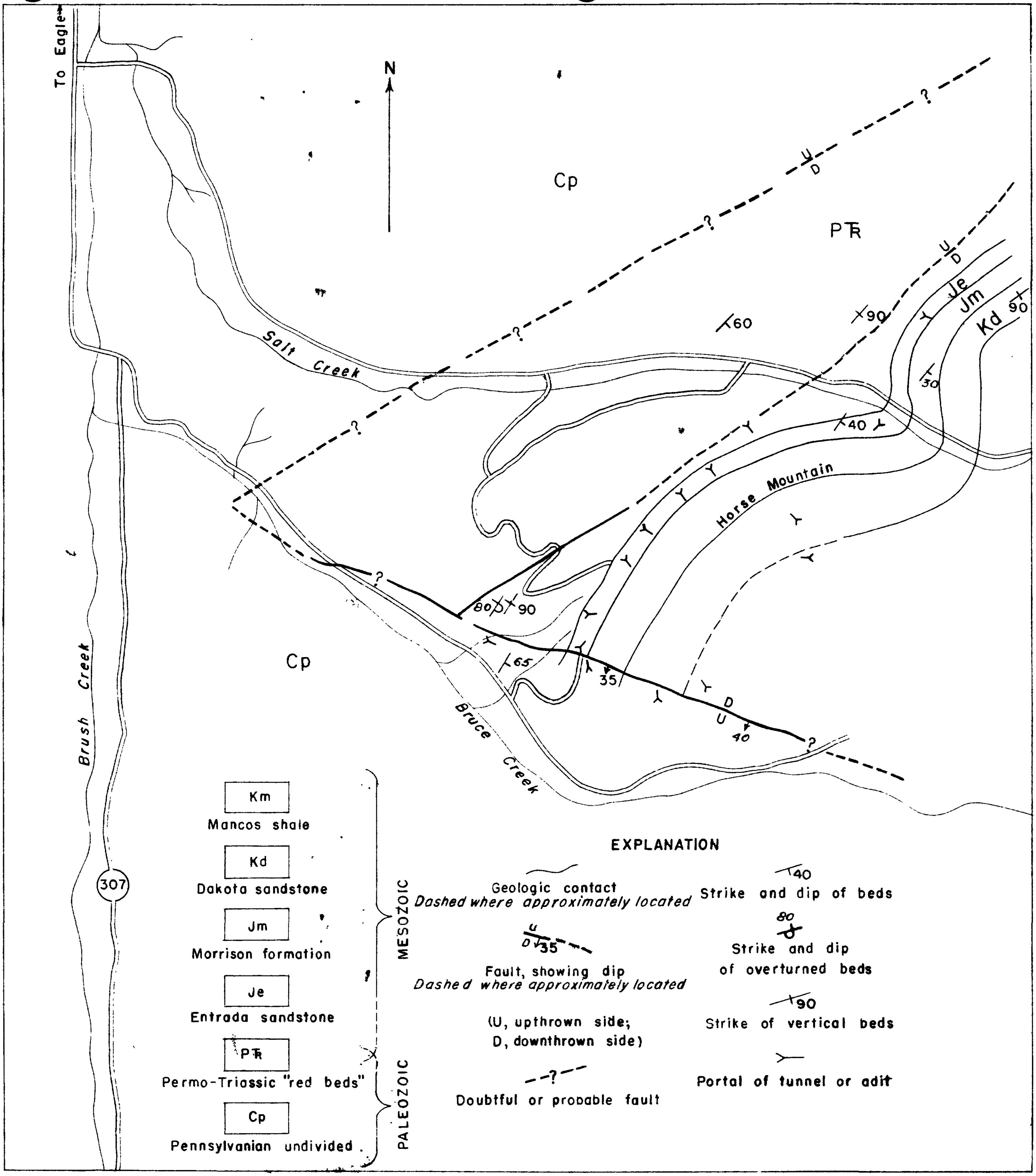
Eagle County

Brush Creek district

Location and general features.--The mines examined in the Brush Creek district are on Horse Mountain about seven miles southeast of Eagle along the Brush Creek road in sec. 30, T. 5 S., R. 83 W. The mountain is bounded on the northeast and southwest by roads along Salt Creek and Bruce Creek. Mine roads, accessible by jeep, lead to the Lady Bell mine on the south slope and the Kleckner tunnel on the north slope. The mines in the district were examined for uranium in May 1951 by F. B. Moore and R. U. King (fig. 19).

Geology.--A brief account of the geologic relations in the Brush Creek region is given by R. D. George (1913). Horse Mountain is a hogback forming the northwestern limb of a synclinal basin whose axis strikes northeast (Gabelman, 1949). The Dakota sandstone caps the hogback and the Morrison, Entrada, and Permo-Triassic "Red Bed" formations are exposed underneath. The beds strike about N. 30° E. and dip 30° SE. Near Bruce Creek, these beds terminate against a southeast striking fault which brings the lower Pennsylvania limestones and shales (Belden ?) against the Entrada sandstone (fig. 20).

The ore deposits are at the base of the Entrada sandstones which is 20 to 30 feet thick in this area. Silver is the principal ore mineral, but azurite, malachite, chalcocite (?), and pyrite are present. Secondary uranium minerals are reported to have been found in a tunnel on what is now known as the Ground Hog No. 1 claim. This mine, called the "Uranium



Revised from John W. Gabelman
unpublished doctoral thesis, map 4
Colorado School of Mines, May 1949

1500 0 1500 3000 FEET

FIGURE 20.-GEOLOGIC MAP OF BRUSH CREEK MINING DISTRICT, EAGLE COUNTY, COLORADO

Workings" by the company, was not accessible at the time of the writer's visit. Specimens of uranium-bearing ore were found on the dump and 26 sacks of uranium-vanadium ore (about one ton) are reported to have been stored at Eagle since 1926.

Lady Bell mine.—The Lady Bell mine (165), located six miles southeast of the town of Eagle in sec. 30, T. 5 S., R. 83 W., is the only mine in the district credited with significant production ($150,000). It is developed by an upper and a lower (Assay Tunnel) adit (fig. 19). The two adits are connected by an open stope. As the drifts are generally 10 degrees off from the strike of the beds, the miners had difficulty in staying on ore and even staying in the Entrada sandstone. Small quantities of carnotite (?), azurite, and malachite disseminated in sandstone were found in a pit near the upper portal. Slight radioactivity amounting to 0.01 percent equivalent uranium was detected near the hanging wall of a fault in the Assay Tunnel.

Kleckner tunnel.—The portal of the Kleckner tunnel (166) is about 1,500 feet north-northeast of the portal of the lower adit of the Lady Bell mine. The tunnel extends about 450 feet in a southeasterly direction. It penetrates about 400 feet of "red beds" before intersecting the Entrada sandstone, which is not over 20 feet thick at this point.

Samples of copper and silver ore are reported to contain from 46 to 948 ounces of silver per ton, and from 0.1 to 4.5 percent copper.

Slight radioactivity amounting to about 0.005 percent equivalent uranium was detected at two places in the tunnel in "red beds", but no uranium minerals were identified. No radioactivity above normal was detected in the Entrada sandstone.

Dakota tunnel.—The Dakota tunnel (167), above and about 300 feet east of the Kleckner tunnel (fig. 19) is 260 feet long and was driven along the base of the Entrada sandstone for most of this distance. From 200 to 230 feet the tunnel is in crushed and faulted rock. At 230 feet a prominent slickensided fault surface cuts off the Entrada sandstone and exposes sandstone and shale "red beds". The fault surface strikes N. 47° E. and dips 64° SE.

The Dakota tunnel follows a mineralized zone about one to two feet thick along the base of the Entrada. Azurite and malachite impregnating sandstone are visible in the adit. Ore from the mineralized zone is reported to contain 14.4 ounces of silver per ton, and 6.2 percent copper.

No radioactivity above normal was detected in the Dakota tunnel.

Mock tunnel.—The Mock tunnel (168) on Bruce Creek (fig. 19) is driven for 1,200 feet in lower Pennsylvanian shales and limestones. Red beds are encountered 50 feet from the face. By projecting the Entrada down dip from its exposure at the Lady Bell mine, it is estimated that 225 feet of drifting would be needed to reach the Entrada sandstone. The country rock exposed in the workings were not mineralized.

Guenon incline.—The Guenon incline (169) and drift about a quarter of a mile west of the Lady Bell mine are driven in lower Pennsylvanian shale, sandstone, and fossiliferous limestone. The incline, which is south of, and nearly parallel to the southeast-striking fault, trends about S. 60°-70° E. Azurite and malachite are disseminated in sandstone at the base of the 50-foot incline. It is estimated that, on the present trend, about 2,000 feet of additional drifting would be required to reach the Entrada sandstone.

El Paso County

Location and general features

El Paso County is in south-central Colorado. Colorado Springs is the county seat.

Except for a narrow belt on the west in the Rampart Range, the county is relatively flat. Elevations range from over 14,000 feet above sea level at Pike's Peak to below 5,500 feet on the eastern high plains.

The Rampart Range contains Precambrian granite and some Paleozoic and Cretaceous sedimentary rocks. Several large, generally north-trending, faults can be seen in and along the edge of the mountains. The southwest corner of the county contains mostly Paleozoic and Cretaceous sedimentary formations. The rest of the county contains Tertiary and Quaternary sedimentary rocks.

Two vein deposits, a tailings dump, a carnotite deposit, a syenite dike, and a pegmatite prospect were examined for radioactivity.

Colorado shaft.—The Colorado shaft (170), in the SE¼ sec. 17, T. 15 S., R. 67 W., is three miles east of Rosemont and 1,000 feet north of the Gold Camp Road, Colorado Highway 336. It was examined in October 1950 by V. R. Wilmarth and D. H. Johnson.

The mine workings consist of a caved vertical shaft. The deposit is a fluorspar-quartz vein in Pikes Peak granite. The vein strikes north, dips steeply to the west, and could be followed on the surface for about 100 feet.

The radioactivity of the vein material and the wall rocks in the vicinity of the mine is negligible.

Duffields property.—The Duffields property (171) is located in the SE¼ sec. 17, T. 15 S., R. 67 W. (unsurveyed), in the St. Peters Dome fluorspar district. The fluorspar deposit is about three miles east of Rosemont on Colorado Highway 336 (Gold Camp Road). It was examined by V. R. Wilmarth. The deposit is a fluorspar fissure vein in the Pikes Peak granite (Steven, 1949). The property which has produced about 16,000 tons of fluorspar is developed by a large open cut and two vertical shafts. The fluorite is associated with limonite, galena, and sphalerite. Three channel samples taken across the vein contained from 0.001 to 0.18 percent uranium.

Golden Cycle tailings dump.—The tailings dump (172) of the Golden Cycle cyanite plant is near the mill buildings in sec. 14, T. 14 S., R. 67 W. The tailings dump is approximately one mile west of Colorado Springs and is served by a branch line of the Denver and Rio Grande Western Railroad.

The dump, which is reported to contain approximately 16 million tons, was examined September 9 and 10, 1948, by E. S. Hanley and W. N. Sharp of the Geological Survey for the purpose of testing its radioactivity and formulating a tentative plan for a more extensive program of sampling in the future (Hanley, 1949) should appreciable quantities of uranium-bearing material be found.

The Golden Cycle Mill is a typical cyanidation plant originally designed to treat Cripple Creek gold and silver telluride ores. After crushing and grinding, selected Cripple Creek ores are, according to present practice, concentrated by flotation, roasted, and finally treated by amalgamation and cyanidation. Other miscellaneous ores are generally treated by the same method with the exception that flotation may be eliminated.

The material now being sent to the dump is much the same as that which has been sent to it in the past and consists principally of sands and slimes from the mill. The sands represent the coarser ball-mill product which has been leached with cyanide solution, whereas the slimes are composed of flotation tails and filter cake from the acid-cleaning phase of the cyanidation section.

The background, measured at five widely separated points, was fairly consistent at an average of 71.8 counts per minute.

Two straight-line traverses were surveyed across the main body of the dump approximately at right angles to each other, and Geiger counter readings were taken along them at intervals of 115 feet. Additional readings were taken elsewhere on the dump.

Traverse No. 1 included 15 stations along a course of S. 24° E. The average net count for the traverse was 79.7 counts per minute with a range in the total counts of 27.8.

Traverse No. 2 crossed the dump along a S. 55° W. course with 12 stations at 115-foot intervals. The average net count for traverse No. 2 was 91.1 per minute with a range in the total count of 28.5.

Fourteen samples were taken from trenches cut approximately four feet long and three inches deep in the surface of the dump at selected Geiger counter stations. The radioactivity of these samples ranged from 0.007 to 0.010 percent equivalent uranium. The samples contained from 0.002 to 0.003 percent uranium.

Although 13 of the 14 samples were obtained from the topmost layer only, they are considered to be representative of the dump as a whole because (1) 95 percent of the ore treated in the mill comes from one particular district, and (2) the composition of the tailings has probably remained fairly constant throughout the 40 years of operation owing to the absence of radical changes in mill practice.

Geiger counts at the field stations do not indicate the existence of high-grade concentrations in the dump and it is unlikely that the uranium content increases materially with depth. The material at and near the surface of the Golden Cycle mill dump is shown by chemical analysis to be too low in uranium content to be a commercial source of uranium.

Mike Doyle carnotite deposit.—The Mike Doyle prospect (173) is in sec. 2, T. 16 S., R. 67 W., about 10 miles south of Colorado Springs.

On February 23, 1950, E. P. Beroni and R. U. King made a radiometric and geologic examination of the property (Beroni and King, 1950).

Rocks exposed at the prospect are thought by Mr. Donald Gould (oral communication) of Colorado College to be part of the Morrison formation of Jurassic age. The visible section is about 20 feet thick and, from bottom to top, consists of (1) carbonaceous shale, (2) fractured quartzitic white sandstone containing scattered carbonized wood fragments, and (3) varicolored marls and clays.

Carnotite and abnormally radioactive rocks occur in an area about 10 feet wide and 100 feet long extending along the strike of the beds. Within this area are two prospect pits in sandstone and one pit in shale (fig. 21). Two of the pits expose sandstone containing carnotite coatings on the walls of fractures and on carbonized wood fragments. Small amounts of carnotite and uranophane are common on walls of fractures cutting wood fragments. Locally, especially where carnotite is present, the fractures have walls that are silicified and contain slickensided iron-stained gouge.

The highest radioactivity noted on the property was about six times average background and was localized at the two pits in sandstone. A grab sample was taken in each of the pits and the analyses (samples 1 and 2) are given in table 21. The shale in the third pit within the area of radioactivity does not contain visible uranium minerals but is abnormally radioactive. The analysis of a grab sample (no. 3) of the shale is given in table 21.

Syenite porphyry dike.—The syenite porphyry dike (174) in sec. 10, T. 16 S., R. 67 W., is 500 feet east of the Johnny feldspar mine. The dike was examined by K. G. Brill, Jr., in 1947.

The dike has not been prospected. The country rock consists of a granite gneiss. The syenite dike is about 900 feet long, averages 70 feet in width, and is exposed to a depth of 200 feet on the hillside. It is composed of a finely crystalline groundmass with phenocrysts of potash feldspar and fine-grained magnetite.

A sample taken from the dike indicates that the radioactivity present is not entirely due to uranium, as the sample contained 0.006 percent equivalent uranium but only 0.001 percent uranium.

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GEOLOGICAL SURVEY

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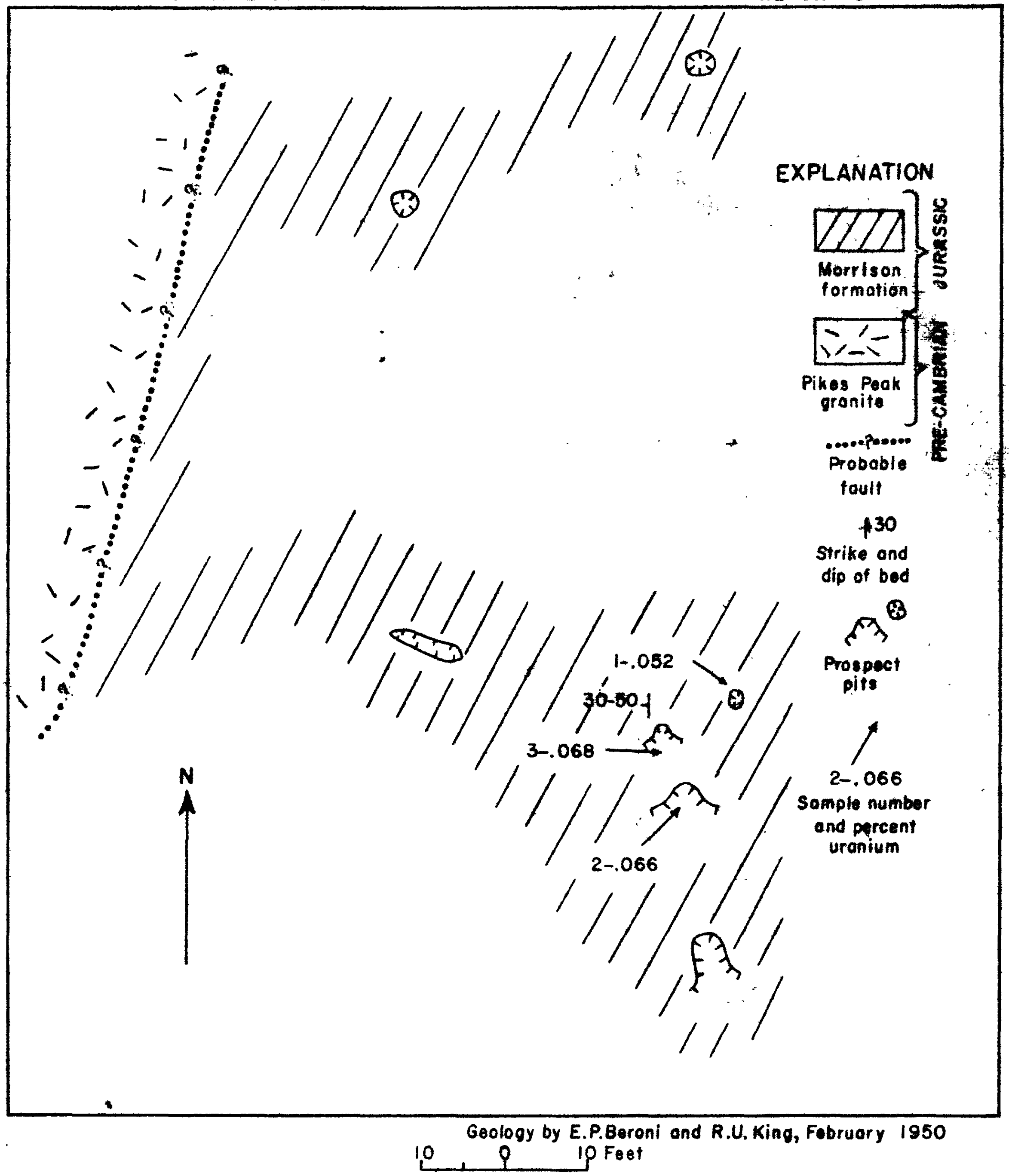


FIGURE 21.—SKETCH MAP OF THE WORKINGS OF THE MIKE DOYLE CARNOTITE DEPOSIT, EL PASO COUNTY, COLORADO

Table 21.—Analyses of samples from the Mike Doyle property.

Sample number	Material	Equivalent uranium (percent)	Uranium (percent)	V_2O_5 (percent)
1	Carnotite (?)-bearing sandstone	0.076	0.066	0.00
2	Carnotite (?)-bearing sandstone	.058	.068	.00
3	Carbonaceous shale	.055	.052	.02

Analyses by E. C. Mallory, Jr., U. S. Geological Survey, 1950.

Johnny feldspar mine.—The Johnny feldspar mine (175) in sec. 10, T. 16 S., R. 67 W., is 15 miles airline southwest of Colorado Springs. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of a large open cut 60 by 40 feet.

The country rock consists of a light-red granite with large patches of biotite schist. The pegmatite dike is about 350 feet long, 90 feet wide, and is exposed to a depth of 60 feet. The dike trends east and according to Hanley, Heinrich, and Page (1950, p. 32), the foot- and hanging-wall contacts dip inward. It is a zoned pegmatite consisting of quartz, microcline, and muscovite with a little biotite along the walls.

A sample taken in the biotite schist on the south side of the dike contained 0.006 percent equivalent uranium and 0.006 percent uranium.

Fremont County

Location and general features

Fremont County is in central Colorado, west of Pueblo. Canon City, in the central part of the county, is the county seat.

The Sangre de Cristo Mountains border the west side of the county and are cut off on the north by the Arkansas River which flows east across the length of the county. The Wet Mountains are also cut by the Arkansas River in the central part of the county. The rest of the county has a more gentle topography. Altitudes range from over 10,000 feet in the Sangre de Cristo Mountains to 5,000 feet along the Arkansas river in the southeast part of the county.

The Sangre de Cristo Mountains consist of Paleozoic sedimentary rocks. The central and northeast part of the county contains Precambrian igneous rocks and Tertiary intrusive rocks. The southeast part of the county contains Paleozoic, Cretaceous, and Tertiary sedimentary rocks.

The 21 prospects that were examined in this county consisted of four vein deposits, one coal bed, one felsite dike, one granite dike, one sedimentary deposit, and 13 pegmatites.

Coleman claims

The Coleman claims consist of three unpatented claims, the Pink Lady lode (176), the Brown Lava lode (177) and the Surprise lode (178), all located in sec. 5, T. 20 S., R. 72 W. They are accessible by $1\frac{1}{2}$ miles of trail southeast from the Copper Gulch road.

The claims are under lease to V. P. Coleman and Boyd W. Coleman of Colorado Springs, Colorado, and H. Coleman of Canon City, Colorado. The development of these three claims consists of one shallow prospect pit on both the Pink Lady and Surprise lodes and two vertical shafts, 10 and 25 feet deep, on the Brown Lava lode. These claims were examined by G. B. Gott in company with Mr. Holland Coleman of 417 Greenwood Street, Canon City, Colorado, on August 28, 1950.

A Victoreen model 263 B beta-gamma counter was used to determine relative radioactivity. The average background was between 0.02 and 0.03 mr/hr.

<u>Pink Lady lode</u>.—The Pink Lady lode (176) is the northernmost of the three claims. The only development work is a two-foot deep prospect pit which was dug several years ago into a fault zone in a reddish rhyolite.

The strike of the fault zone is N. 5° W. and the dip is vertical. The fracture zone is about two feet wide.

The radioactivity of the fracture zone is estimated to average 0.005 percent equivalent uranium.

Brown Lava lode.—The Brown Lava lode (177) is about 1,200 feet S. 30° E. of the Pink Lady lode. This locality was prospected several years ago for gold and silver by two shafts 10 and 25 feet deep. No recent exploration has been done. The shafts have been dug along fracture zones in rhyolite which has been weathered and altered to a limonite-brown earthy mass. Two sets of fracture zones are visible in the 10-foot shaft. One of these is two feet wide, strikes N. 80° W. and dips 80° S. The other is only about three inches wide, strikes N. 25° W., and dips 82° SW.

The radioactivity across the wider of these two zones averaged 5.5 divisions on the 2.0 scale and throughout the bottom of the pit averaged 9 on the 0.2 scale. A channel sample across the two-foot zone contained 0.019 percent equivalent uranium and 0.007 percent uranium. A selected sample from the same zone contained 0.045 percent equivalent uranium and 0.027 percent uranium.

Surprise lode.—The Surprise lode (178) is about half a mile south of the Brown Lava lode. A small prospect pit has been dug into the side of the mountain where a mineralized zone 44 inches wide has been exposed.

The mineralized zone is in a medium- to fine-grained, altered, and brecciated granite dike which strikes N. 87° E. and dips about vertically. Veins and disseminated crystals of barite, calcite, and siderite are present. The wall rock on either side of the mineralized zone is a gray gneissic granite.

The radioactivity of this zone is estimated to range from 0.002 to 0.004 percent equivalent uranium.

Griffin Ranch and Federal Land prospects.—The Griffin Ranch and Federal Land prospects (179) in the NE¼SW½ sec. 23, T. 20 S., R. 71 W., is in a draw that is 0.4 mile north from the junction of Colorado Highway 143 and 277, and is 0.5 mile, at approximately N. 50° W., up this draw. The prospects were examined in the summer of 1951 by L. F. Dellwig.

The mine workings consist of six prospect pits on two veins. The country rock consists of injection gneiss and lamprophyre dikes. The dumps show silicified and pyritized lamprophyre. The deposit consists of mesothermal barite veins of unknown age. The primary ore minerals are barite, galena, and a red radioactive substance. The gangue minerals are quartz, siderite, and specularite. The northern vein strikes N. 80° W., dips 75° S., and is three feet thick. The southern vein strikes N. 65° W., dips vertically, and has a maximum thickness of 28 inches.

The samples taken for analysis ranged from 0.013 percent equivalent uranium on the dump of the northern vein to 0.089 percent equivalent uranium on the dump of the southern vein. The uranium content of these samples is 0.001 percent and 0.058 percent, respectively.

Prospect near Badger Creek.—The prospect near Badger Creek (180) is in the NW¼ sec. 25, T. 51 N., R. 11 E. It was examined in June 1950 by Thomas P. Anderson of the U. S. Atomic Energy Commission.

The prospect was not developed at the time of the examination.

The prospect consists of an altered felsite dike in coarse-grained

Precambrian granite. The dike is sheared and fractured parallel to poorly defined walls. Limonite staining and some black, soft material tentatively identified as one of the manganese minerals were the only minerals observed. The radioactivity of the altered felsite dike is negigible.

Permo-Pennsylvanian coal bed prospect.—The Permo-Pennsylvanian coal bed prospect (181) in the SW¼ sec. 21, T. 49 N., R. 10 E., is along the north wall of the Arkansas River Canyon. It was examined in August 1950 by G. B. Gott and L. F. Dellwig.

The mine workings consist of an inclined adit extending about 70 feet down the dip of the coal bed.

The deposit is in a Permo-Pennsylvanian coal bed. The bed dips 35° N. 5° W. and is 16 to 20 feet thick. No radioactive minerals were identified.

Two channel samples contained 0.003 and 0.004 percent equivalent uranium and 0.002 percent uranium.

Jesus lode.—The Jesus Lode (182) in sec. 28, T. 18 S., R. 72 W., is 4½ miles by dirt road southwest from U. S. Highway 50 at Parkdale, Colo. It was examined in July 1950 by G. B. Gott and L. F. Dellwig.

The mine workings consist of two bulldozer cuts. The deposit consists of torbernite in Dakota sandstone of Cretaceous age. The torbernite is sparsely disseminated as crystal aggregates on joint planes.

Samples taken from the bulldozer cuts ranged from 0.004 to 0.037 percent equivalent uranium and from 0.002 to 0.034 percent uranium.

Willis Tuttle prospect.—The Willis Tuttle prospect (183) in sec. 26, T. 20 S., R. 71 W., is accessible by private road from Colorado Highway 277, 0.4 mile from its junction with Colorado State Highway 143. The locality was examined for radioactivity by G. B. Gott and L. F. Dellwig in September 1950.

Development of the prospect consists of four shallow pits.

A Precambrian complex is intruded by a granite dike that has been faulted, fractured, and mineralized with quartz and thorium minerals (probably thorite).

The granite dike is from two to five feet wide and is at least 300 feet long, and of unknown thickness.

Although the radioactivity of the deposit ranges from 0.007 to 0.31 percent equivalent uranium, the maximum uranium content is 0.002 percent. The deposit may contain significant quantities of thorium.

Eight Mile Park pegmatite prospect No. 1.—The prospect Eight Mile Park pegmatite prospect No. 1 (184), in sec. 22, T. 18 S., R. 71 W., Eight Mile Park district, is on the west end of a ridge, 1.0 mile by mine road west of the Royal Gorge Highway. The mine road leaves the highway 1.7 miles south of the junction of the Royal Gorge Highway and U. S. Highway 50. The prospect was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of two large cuts on opposite sides of the ridge. The country rock consists of a quartz-mica schist. The pegmatite dike is about 300 feet long, 60 feet wide and is exposed to a depth of about 30 feet. It strikes N. 60° W.; the north border dips 40° S., and the south border dips north at a high angle. It is indistinctly zoned. The pegmatite consists chiefly of quartz, potash feldspar, and large books of tarnished biotite. Some beryl is present, and torbernite is interlaminated with the biotite sheets.

A sample of eight biotite books contained 0.13 percent equivalent uranium and 0.10 percent uranium.

Eight Mile Park pegmatite prospect No. 2.—The Eight Mile Park pegmatite prospect No. 2 (185), in the NE¼ sec. 23, T. 18 S., R. 71 W., Eight Mile Park district, is on the east end of a ridge about 400 feet west of U. S. Highway 50. It was examined by K. G. Brill, Jr., in 1947.

The pegmatite dike has been explored by a cut 30 by 25 feet. The country rock consists of granite gneiss. The dike is about 350 feet long, about 40 feet wide, and is exposed to a depth of 20 feet. The dike strikes east and probably dips 90 degrees. It is indistinctly zoned and appears to consist predominantly of coarsely crystalline quartz, microcline, and black tourmaline.

A small fragment of tantalite (?) showed some radioactivity. A sample of muscovite contains 0.012 percent equivalent uranium and 0.004 percent uranium, indicating the presence of thorium or other radioactive elements.

Eight Mile Park pegmatite prospect No. 3.—The Eight Mile Park pegmatite prospect No. 3 (186), in sec. 15, T. 18 S., R. 71 W., Eight Mile Park district, is on a small knoll 300 feet north of the Royal Gorge Highway at a point 1.5 miles by road south of the junction of the Royal Gorge Highway and U.S. Highway 50. It was examined in 1947 by K. G. Brill, Jr.

The pegmatite dike has been explored by two deep trenches and several shallow pits.

The country rock is a biotite granite gneiss. The dike is about 400 feet long, about 30 feet wide, and is exposed to a depth of 50 feet. It is a very irregular, zoned pegmatite. The core consists of coarsely crystalline quartz, microcline, biotite, and muscovite. The wall zone consists of granite pegmatite.

The radioactivity of the mica books is estimated to be about 0.004 percent equivalent uranium.

Lower South mine.—The Lower South mine (187), in sec. 1, T. 16 S., R. 73 W., Micanite district, is on the east side of Mac Gulch, 0.3 mile north of Dane Johnson ranch and 250 feet east of Colorado Highway 9. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of a cut 50 by 40 feet and by two adits.

The country rock consists of biotite granite gneiss. The pegmatite dike trends northeast and dips 20° NW. on the east side. It is exposed for 200 feet and is as much as 100 feet wide at the south end and tapers to the north. The core consists of quartz and microcline. The wall zone consists of quartz, microcline, biotite, and muscovite with small amounts of garnet and beryl.

From radioactivity measurements made on the outcrop the radioactivity of small quantities of a yellow mineral (autunite ?) associated with hematite and mica is estimated to be 0.003 percent equivalent uranium.

Mica Lode mine.—The Mica Lode mine (188), in sec. 14, T. 18 S., R. 71 W., Eight Mile Park district, is at the end of the east fork of the mine road that leaves U. S. Highway 50, 8.0 miles west of Canon City and 1.5 miles by road east of the Royal Gorge airport. The mine is about 1.5 miles by road south of the highway. The mine was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of a cut 150 by 60 feet, an adit, and several trenches.

The country rock consists of red granite gneiss and quartz-mica schist. The pegmatite is a tadpole-shaped body trending east. The pegmatite core consists of microcline and quartz with a pod of mica and beryl pegmatite on the south side. The wall zone consists of quartz, potash feldspar, and muscovite.

Radioactivity measurements made on the outcrop indicate that the radioactivity is about 0.003 percent equivalent uranium.

Meyers' mine.—The Meyers' mine (189), in sec. 14, T. 18 S., R. 71 W., Eight Mile Park district, is at the end of the east fork of the mine road that leaves the U. S. Highway 50, 8.0 miles west of Canon City, and 1.5 miles east of the Royal Gorge Airport. The mine is about 1.5 miles by road south of the highway. The mine was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of two large open cuts and numerous small trenches.

The country rock consists of red granite. The pegmatite dike is poorly zoned. It has a core of quartz and potash feldspar; an intermediate zone of quartz, muscovite, potash feldspar, and small amounts of beryl, and a wall zone of granite pegmatite. The pegmatite dike is from 200 to 500 feet wide and about 1,500 feet long.

Radioactivity measurements made on the outcrop indicate that the radioactivity is equivalent to about 0.003 percent equivalent uranium.

Climax mica mine.—The Climax mica mine (190), in sec. 6, T. 16 S., R. 72 W., Micanite district, is at the forks of a mine road that leads up the east side of Mac Gulch. The mine road leaves the Mac Gulch road about

1.0 mile north of its junction with Colorado Route 9. It was examined by K. G. Brill, Jr., in 1947. The mine workings consist of three adits and several open-cuts.

The country rock is quartz-sillimanite schist and granite gneiss. The pegmatite dike has an irregular outcrop pattern. The three zones in the pegmatite consist of a core of coarse quartz, an intermediate zone of quartz, albite, and muscovite, and a wall zone of granite pegmatite.

The radioactivity of the pegmatite is negligible.

Devil's Hole beryl mine.—The Devil's Hole beryl mine (191), in the SE$\frac{1}{4}$NW$\frac{1}{4}$ sec. 20, T. 18 S., R. 73 W., is on the north wall of Bull Gulch about 6.0 miles by road north of Texas Creek station on the Denver and Rio Grande Western Railroad. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of three large cuts and two adits. The country rock consists of dark schist and gneiss. The pegmatite is a northwest-trending body with two branches. The main body consists of a core of microcline and quartz, an intermediate zone of quartz, muscovite, and albite with some beryl, and a wall zone of the same minerals except for beryl.

The radioactivity of the pegmatite is negligible.

Rowe's North mine.—Rowe's North mine (192), in sec. 1, T. 16 S., R. 73 W., Micanite district, is on the east wall of Mac Gulch about 200 feet above the floor of the valley. The mine is 500 feet northwest of the Dane Johnson ranch house. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of a crescent-shaped tunnel.

The country rock consists of biotite-granite gneiss. A pegmatite dike trends N. 45° E., and the west border dips 60° SW. The pegmatite has a coarse-grained core of quartz, microcline, muscovite, and biotite, and a wall zone of finer crystals of these minerals.

Radioactivity measurements made on the outcrop indicate that the radioactivity of books of muscovite with red hematite coatings is equivalent to 0.004 percent uranium.

Rose Dawn mica mine.—The Rose Dawn mica mine (193), in sec. 32, T. 15 S., R. 72 W., Micanite district, is near the top of the ridge on the east side of Mac Gulch, about 0.2 mile by road northwest of the Climax mica mine. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of two open-cuts and two tunnels.

The country rock consists of sillimanite schist and gneiss. The pegmatite dike is distinctly zoned and has a core of quartz and a wall zone of quartz, microcline, albite, and muscovite. There is a narrow border zone of albite-muscovite.

Radioactivity measurements made on the outcrop indicate that the radioactivity of the dike is negligible. Two samples of sillimanite schist and gneiss taken next to the dike contained 0.003 percent equivalent uranium and 0.001 percent uranium.

Star Girl mine.—The Star Girl mine (194), in sec. 32, T. 15 S., R. 72 W., Micanite district, is on the top of the ridge on the east side of Mac Gulch 0.7 mile by road north of the Climax Mica mine. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of an open cut and some underground workings that have been destroyed by later work.

The country rock consists of coarsely crystalline granite gneiss. The pegmatite dike is about 200 feet long, about 20 feet wide, and is exposed to a depth of 30 feet. The trend of the dike is north and the dip is vertical. The pegmatite is distinctly zoned and has a core of quartz and microcline and a wall zone of quartz, microcline, plagioclase, and muscovite with accessory garnet. A thin border zone is also present.

The radioactivity of the dike is negligible. The radioactivity of the country rock near the dike is equivalent to about 0.002 percent uranium.

School Section mine.—The School Section mine (195), in sec. 16, T. 18 S., R. 71 W., Eight Mile Park district, is on a low hill 0.25 mile southwest of the Royal Gorge Highway. An access road leaves the highway 1.3 miles south of its junction with U. S. Highway 50. The mine was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of seven open cuts, of which two are very large, and three prospect pits.

The country rock consists of granite gneiss. The pegmatite dike is an irregular, pipe-like intrusive that is indistinctly zoned. The dike consists of quartz, microcline, muscovite, biotite, and small amounts of beryl. No radioactive minerals were observed at the time of Brill's visit although thorite has been reported to be associated with fine-grained mica in the dike.

Radioactivity measurements made on the outcrop indicate that the radioactivity is negligible.

Upper South mine.—The Upper South mine (196), in sec. 1, T. 16 S., R. 73 W., Micanite district, is on the east side of Mac Gulch about 750 feet east-southeast of the Lower South mine and 200 feet higher. It was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of an open-cut, 60 by 20 feet, and an adit.

The country rock consists of biotite granite gneiss. The pegmatite dike is 150 feet long, 30 feet wide, and is exposed to a depth of 30 feet. It trends northeast and dips steeply to the east on the east side. The pegmatite is indistinctly zoned and consists of potash feldspar, muscovite, and biotite with magnetite and hematite.

Some of the biotite and weathered magnetite is radioactive, but the radioactivity is largely derived from elements other than uranium. A sample contained 0.033 percent equivalent uranium but only 0.007 percent uranium.

Grand County

Location and general features

Grand County is in the north-central part of the state. Hot Sulphur Springs in the center of the county is the county seat.

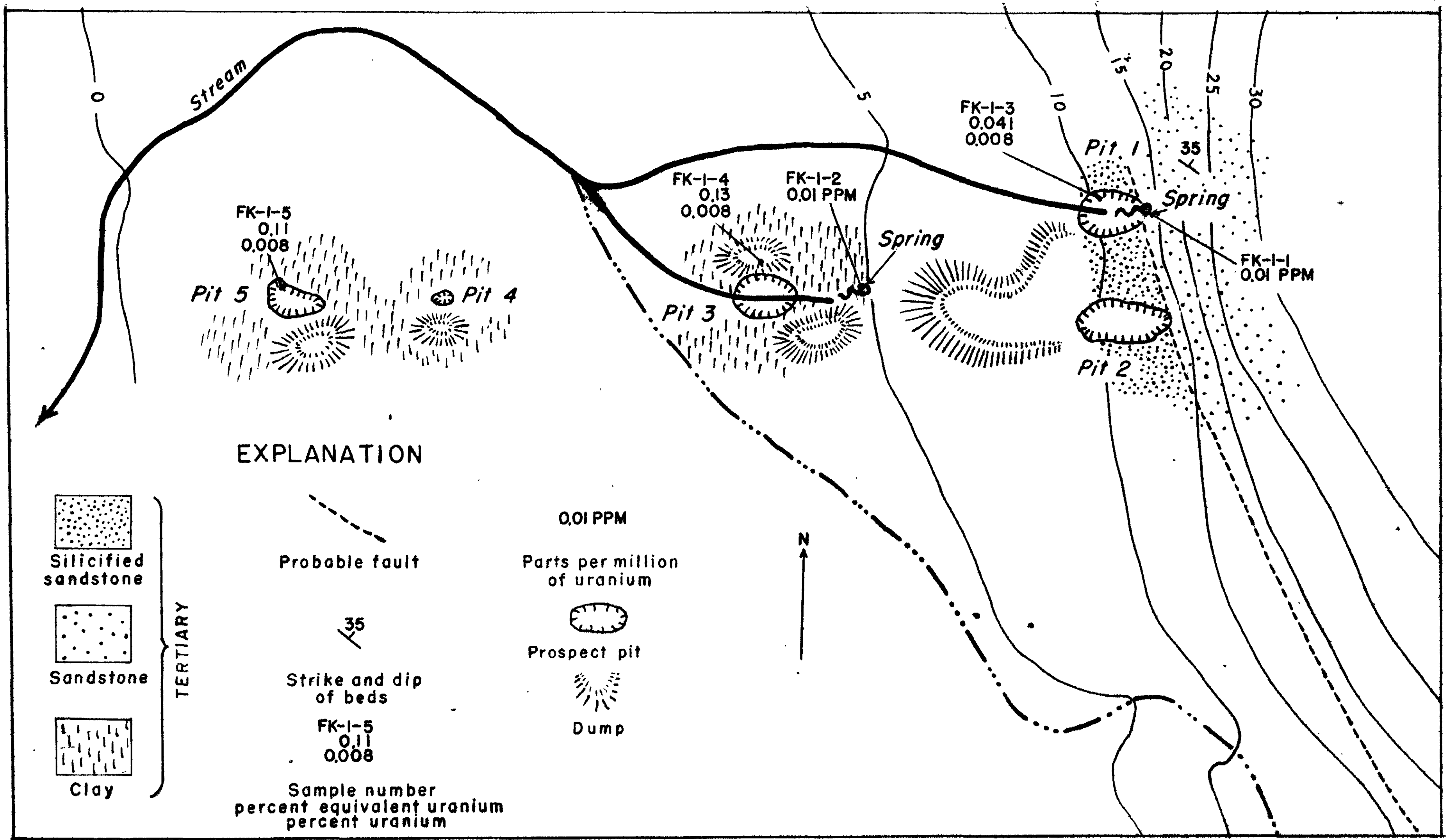
The east and north boundary of the county is the Continental Divide. The Williams River Mountains form the southern boundary. The central part of the county is a relatively flat area known as Middle Park. The Colorado River has its source in the northeast corner and flows southwest across the county. Elevations range from over 14,000 feet above sea level along the Continental Divide to less than 7,500 feet along the Colorado River in Middle Park.

The one locality examined for radioactivity is in Middle Park.

Lucky Strike claims.—The Lucky Strike claims (197), in secs. 31 and 32, T. 2 N., R. 79 W., eight miles northeast of Kremmling, can be reached by a dirt road north leaving U. S. Highway 40 at the schoolhouse at Troublesome. The claims are part of a group of 28 unpatented claims that were located on July 11, 1950. The Lucky Strike claim is owned by Dale Tucker and other members of his family, and the Lucky Strike No. 1 claim is owned jointly by the Dale Tucker family and Walt E. Magill, of Kremmling, Colo. Both claims are developed by small prospect pits (fig. 22).

The claims are underlain by the North Park formation of Miocene (?) age, and are near the contact with Precambrian hornblende gneiss and granite. The North Park formation consists of fluviatile and lacustrine white, yellow, buff, and reddish interbedded clays, shales, sands, and sandstones, or any combination of these units. Thin carbonaceous and iron-stained clay lenses are common throughout the formation. The North Park formation is nearly flat-lying, except near the flanks of the granitic intrusives where it has a primary dip of 35 degrees. Springs that issue from a fractured and silicified sandstone suggest the presence of a fault. The fault probably is the cause of the steeper dips in this area.

The radioactive deposits are in iron and manganese-stained clay and sandstone (Beroni and McKeown, 1952). They appear to have been deposited from cold water springs. The only uranium mineral noted was a yellow-green coating along bedding laminae of a half inch, iron-stained, carbonaceous clay lens on the Lucky Strike No. 1 claim. Samples from the Lucky Strike claim and the Lucky Strike No. 1 claim contained from 0.041 to 0.13 percent equivalent uranium, but contained only 0.008 percent uranium. Water from two springs in the area contained 0.01 parts per million uranium.



Mapped by E.P. Beroni and F.A. McKeown, 1950.

FIGURE 22.-GEOLOGIC SKETCH MAP OF LUCKY STRIKE CLAIM, GRAND COUNTY, COLORADO

10 5 0 10 20 FEET

Gunnison County

Location and general features

Gunnison County is in the west-central part of the state; Gunnison, the county seat, is in the southeastern part of the county. Altitudes range from more than 14,000 feet at the crest of the Sawatch Range that marks the Continental Divide and the eastern boundary of the county, to 7,000 feet at the bottom of the Black Canyon of the Gunnison River that flows westward across the center of the county. The crest of the Elk Mountains marks the northern boundary of the county.

Tertiary volcanic rocks and Precambrian igneous and metamorphic rocks underlie most of the southwestern part of the county; Precambrian igneous and metamorphic rocks underlie the eastern part, and Paleozoic and Cretaceous sedimentary rocks and Tertiary intrusive rocks occupy most of the central and northern parts.

Ten localities in Gunnison County were examined for radioactivity by J. W. Adams and F. B. Moore in September 1950. The thorium-bearing vein deposit on the Little Johnnie claims near Powderhorn in the White Earth mining district is the only deposit that appears to have commercial possibilities. Base- and precious-metal veins in the Irwin and White Earth districts contained no radioactive deposits.

Forest Queen mine.—The Forest Queen mine (198) is an inactive silver mine in sec. 15 (?), T. 13 S., R. 87 W., Irwin district, 12 miles west-northwest of Crested Butte.

The mine workings consist of two shafts and one adit. A flotation mill is on the property. The country rock consists of Eocene (?) volcanic rocks. The deposit is a fissure vein in a silicified breccia zone that contains small quantities of galena in a gangue of quartz, rhodonite, and barite.

No radioactivity above normal was detected in the vicinity of the mine or mill.

Gunnison mine.—The Gunnison mine (199), in the SE¼ sec. 4, T. 47 N., R. 2 W., Cebolla (White Earth) district, is five miles north of Powderhorn on Colorado Highway 149.

The mine workings consist of a shaft, an adit, and several shallow cuts.

The country rock is Precambrian schist, gneiss, and quartzite. The deposit is a fissure vein that has been worked for gold. Pyrite, chalcopyrite, native gold, and limonite are present in the deposit.

The radioactivity of the deposit is negligible.

Anaconda mine.—The Anaconda mine (200) is in sec. 9, T. 47 N., R. 2 W., White Earth district; extent of the mine workings is unknown.

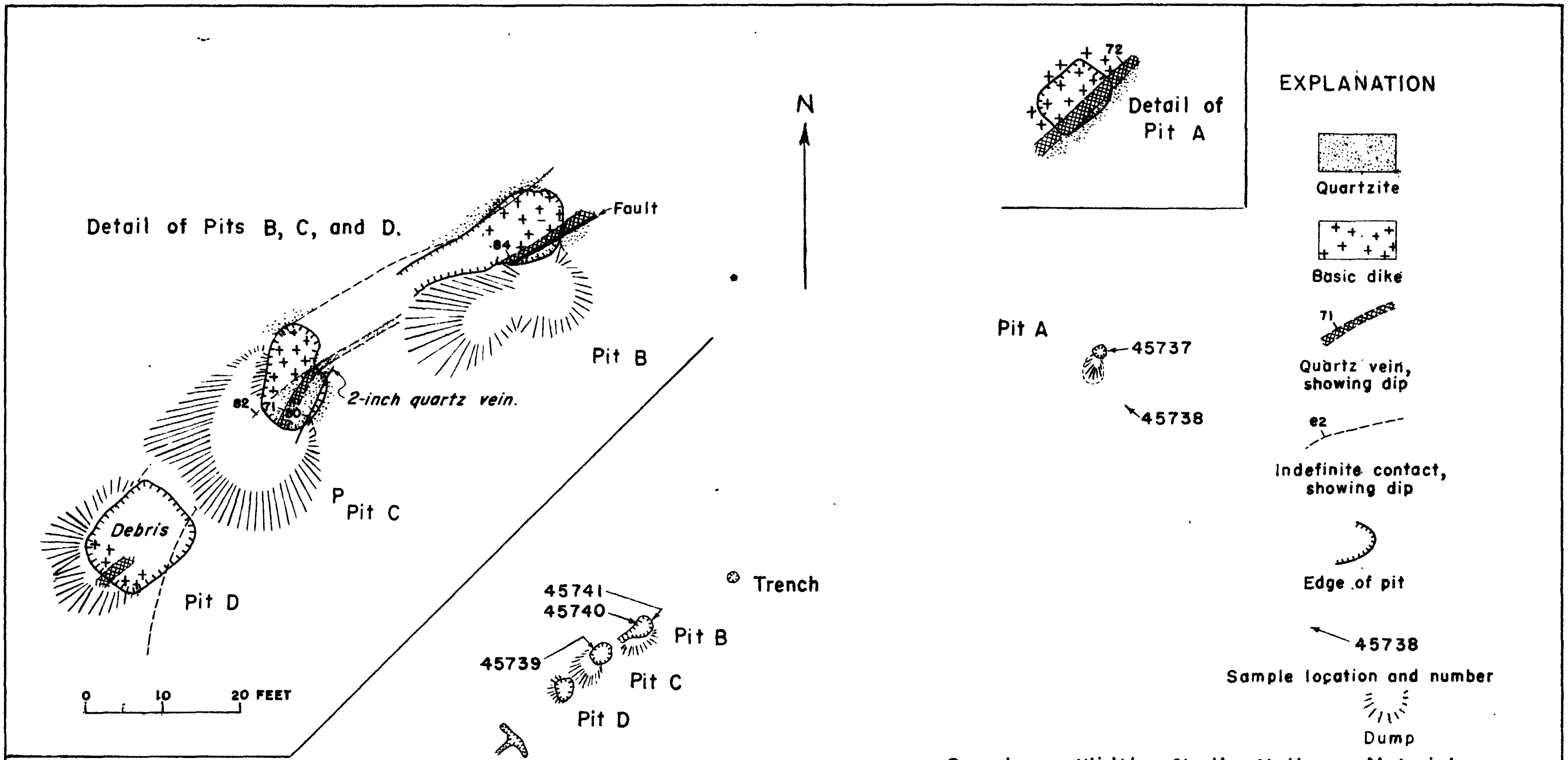
The deposit consists of veins in fractured Precambrian metasedimentary rocks. The mine explores a copper deposit in a quartz vein that contains pyrite, chalcopyrite, and copper carbonates.

No radioactivity was detected in the immediate area.

Jeanie No. 6 claim.—The Jeanie No. 6 claim (201), in sec. 16, T. 47 N., R. 2 W., White Earth district, is four miles north of Powderhorn.

The mine workings consist of seven prospect pits (fig. 23).

The deposit consists of a vein, one to three feet wide, in pink quartzite. A basic dike lies along one side of the vein for 400 feet. The identified vein minerals are quartz and limonite.



Sample	Width	% eU	% U	Material
45737	2.0 ft.	0.007	0.001	Vein
45738	Grab	.001	.001	Quartzite
45739	2.5 ft.	.014	.001	Vein
45740	Grab	.002	.001	Basic dike
45741	0.9 ft.	.018	.001	Vein

Mapped by J. W. Adams and F. B. Moore, September 1950

Radioactive material was found in four of the pits and contained from 0.001 to 0.018 percent equivalent uranium. The uranium content of the material was 0.001 percent.

Little Johnnie Nos. 1 and 2 claims.—The Little Johnnie Nos. 1 and 2 claims (202) are in sec. 15, T. 47 N., R. 2 W., White Earth district, three miles north of Powderhorn.

The development consists of a 28-foot adit and eight small prospect pits (fig. 24). The deposit is a vein in schist. The minerals identified are quartz and limonite. The vein is probably 3,000 feet long and shows radioactivity from two to five times background at most exposures.

A sample (no. 45749) of the vein material contained the following:

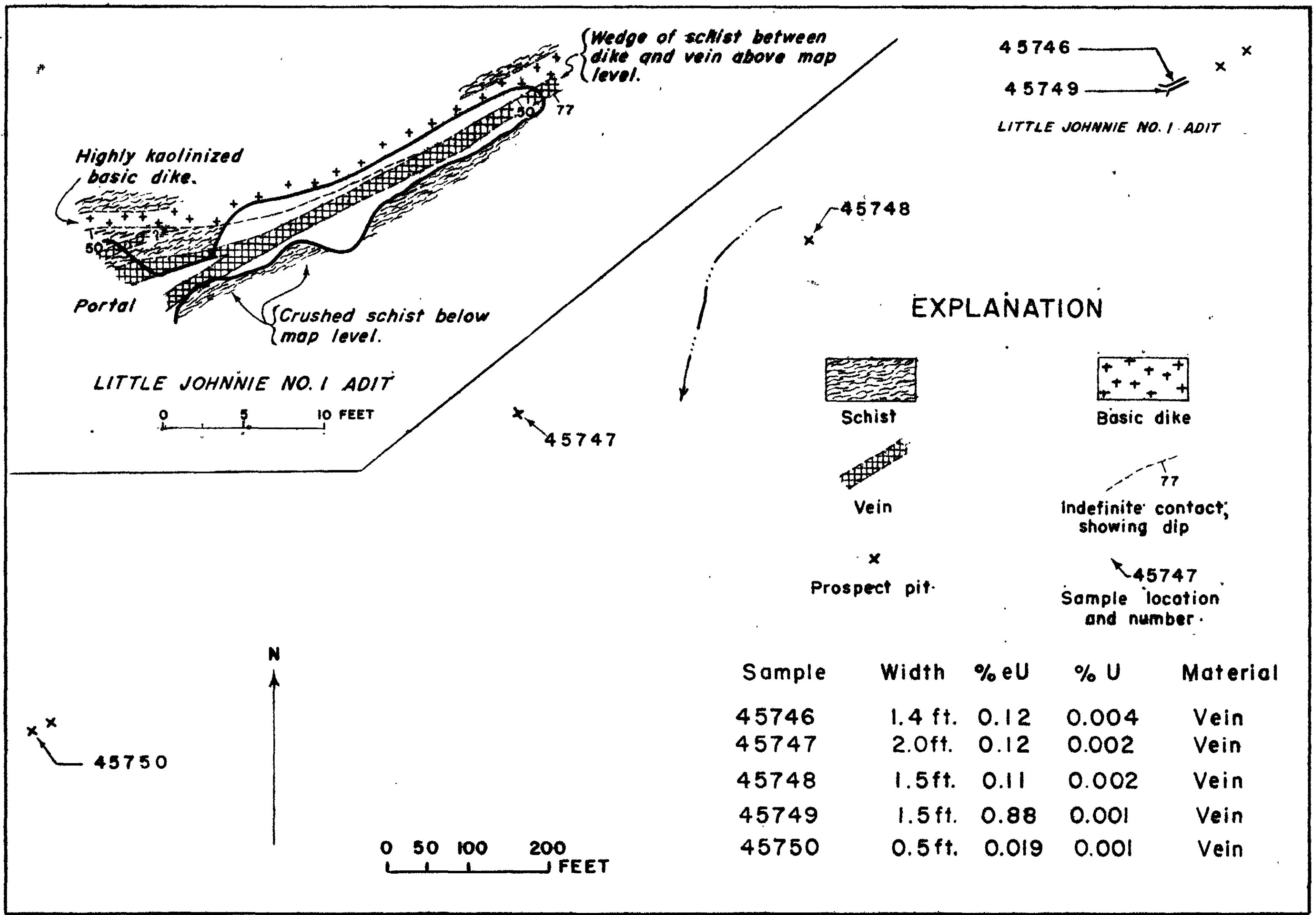
Equivalent uranium	0.88 percent
Uranium	0.001 percent
Thorium oxide	4.4 percent
Rare-earth oxides	0.50 percent

Mickey group (?) of claims.—The Mickey group (?) of claims (203) are in the NW¼ sec. 18, T. 46 N., R. 1 W., White Earth district.

The mine workings consist of a bulldozer trench and two open cuts. The deposit consists of vermiculite and garnet (?) in an alkalic igneous rock. No radioactivity was detected in any of the workings.

Loading dump for Augusta (?) mine.—The loading dump for the Augusta (?) mine (204) in sec. 1, T. 13 S., R. 87 W., Irwin district, is 10 miles northwest of Crested Butte.

The dump is at the lower end of an aerial tram believed to have been used to haul ore down from the Augusta mine. The country rock consists of diorite porphyry of possible Eocene age. The vein material on the dump contains galena, sphalerite, pyrite, and possibly silver minerals.



Sample	Width	% eU	% U	Material
45746	1.4 ft.	0.12	0.004	Vein
45747	2.0ft.	0.12	0.002	Vein
45748	1.5ft.	0.11	0.002	Vein
45749	1.5ft.	0.88	0.001	Vein
45750	0.5ft.	0.019	0.001	Vein

Mapped by J. W. Adams and F. B. Moore, September 1950

FIGURE 24. — LITTLE JOHNNIE CLAIMS, GUNNISON COUNTY, COLORADO

No radioactive material was found on the dump.

Black Mica Company properties.—Two properties (205) reported to be owned by the Black Mica Company are in secs. 7 and 12, T. 46 N., Rs. 1 and 2 W.

The development on the properties consists of several open pits and trenches.

The country rock of both properties consists of pyroxenite. The veins on both properties are composed of carbonates (?) in pyroxenite. The four veins on the property in sec. 7 and the vein in sec. 12 contain small quantities of radioactive material. Measurements made on the outcrop indicate the radioactivity is equivalent to a content of from 0.005 to 0.007 percent uranium.

Unnamed prospect near Lot mine.—An unnamed prospect (206), in the NE¼ sec. 21, T. 47 N., R. 2 W., White Earth district, is half a mile S. 43° W. from the Lot mine. The Lot mine is three miles north of Powderhorn.

The mine workings consist of an adit 300 to 400 feet long trending N. 37° W.

The country rocks are of Precambrian metamorphic rocks and strongly sheared basic dikes. The deposit consists of carbonate-barite veins containing calcite and barite. No radioactivity was detected in the mine workings or in the surrounding area.

Ute Trail mine.—The Ute Trail mine (207) is in the NE¼ sec. 12, T. 47 N., R. 2 W., White Earth district, five miles northeast of Powderhorn.

Mine workings consist of a caved shaft and dump and a 20-foot shaft to the northeast of these.

The mine is reported to be a gold property. The deposit consists of quartz veinlets in Precambrian pyroxenite and metasedimentary rocks. No radioactivity was found on the dumps of the mine workings.

Huerfano County

Location and general features

Huerfano County is in the south-central part of Colorado southwest of Pueblo. Walsenburg in the southeastern part of the county is the county seat.

The Sangre de Cristo Mountains cover the western side of the county. The southern tip of the Wet Mountains extends into the central part. The Huerfano and the Cucharas rivers flow northeastward across the county and join north of the northeast boundary of the county. Altitudes range from over 10,000 feet in the mountains to a little above 5,000 feet in the eastern part of the county.

One locality in the Sangre de Cristo mountains was examined for radioactivity.

McIntire claims.—The A. S. McIntire uranium and vanadium claims (208) are in sec. 19, T. 27 S., R. 70 W., at an altitude of 8,800 feet on the north slope of Iron Mountain in the Sangre de Cristo Range. The property consists of three unpatented claims—Sam Jack's No. 1 and No. 2, and Silver Streak No. 4. The claims are seven miles southwest of Gardner and two miles west of the Pass Creek School. They are accessible by seven miles of dirt road from Malachite.

The uranium-vanadium deposits, in red beds of Permian (?) age, are near the contact between Precambrian granite and Eocene intrusive rocks. Secondary copper, uranium, and vanadium mineral coatings and manganese stains occur in a brownish red, micaceous sandstone and mudstone and are associated with carbonized wood fragments. In places the beds appear to be slightly crumpled, probably due to faulting and folding along individual bedding planes. The coatings on the sandstone and mudstone are bright blue, green, and yellow and are composed chiefly of azurite, malachite, carnotite, and volborthite (?). A sample of the mineralized sandstone contained 0.008 percent equivalent uranium; 0.007 percent uranium; and 0.50 percent vanadium oxide.

Jefferson County

Location and general features

Jefferson County is in the central part of Colorado west of Denver. Golden, the county seat, is 13 miles west of Denver.

The western half and southern neck of the county is in the Front Range. The northwest and generally eastern part contains the relatively flat land of the high plains. The South Platte River forms a part of the eastern boundary of the county. North Fork, Bear Creek, and Clear Creek form the main drainage from the west side into the South Platte River. Altitudes range from over 10,000 feet in the Front Range to 5,500 feet on the plains.

The Front Range is composed of granite, gneiss, and schist of Precambrian age and associated pegmatite. The foothills are composed of Paleozoic, Jurassic, and Cretaceous sedimentary rocks. The plains area is composed of

Tertiary sediments. A few Tertiary intrusive and extrusive igneous rocks can be seen in the county.

Five veins, a coal bed, nine pegmatites, a syenite dike, and the sedimentary rocks of the Morrison-Golden area were examined for radioactivity.

Brereton mine.—The Brereton mine (209) in the NW¼ sec. 17, T. 2 S., R. 71 W., lies on a hill that can be reached by a road to the southwest from the Coal Creek store. The property was examined in the summer of 1951 by F. A. McKeown and A. J. Gude.

The mine workings consist of one caved adit, one adit 45 feet in length, and one small prospect pit.

The country rock consists of fine-grained biotite granite. The deposit is a quartz-rich breccia reef that contains fluorite, feldspar, and minute amounts of a secondary uranium mineral, probably torbernite, all intergrown with quartz. The deposit is very near the Hurricane Hill dike.

The radioactivity of the deposit is negligible. The maximum uranium content of three grab samples was 0.005 percent.

Cook property.—The Cook property (210), about 18 miles southwest of Denver, is about two miles north of Foxton. The workings are about a quarter of a mile east of Kennedy Gulch (Casto Creek) in sec. 10, T. 7 S., R. 70 W.

The property consists of three unpatented claims owned by H. E. Cook and his son of Denver, Colorado. H. C. Granger and E. P. Beroni spent approximately three-fourths of a day on the property on June 1, 1949. On June 19, 1949, R. U. King spent part of a day at the property.

The Cook property mine workings consist of a shaft, three short adits, and three prospect pits (fig. 25) (Granger and Beroni, 1950).

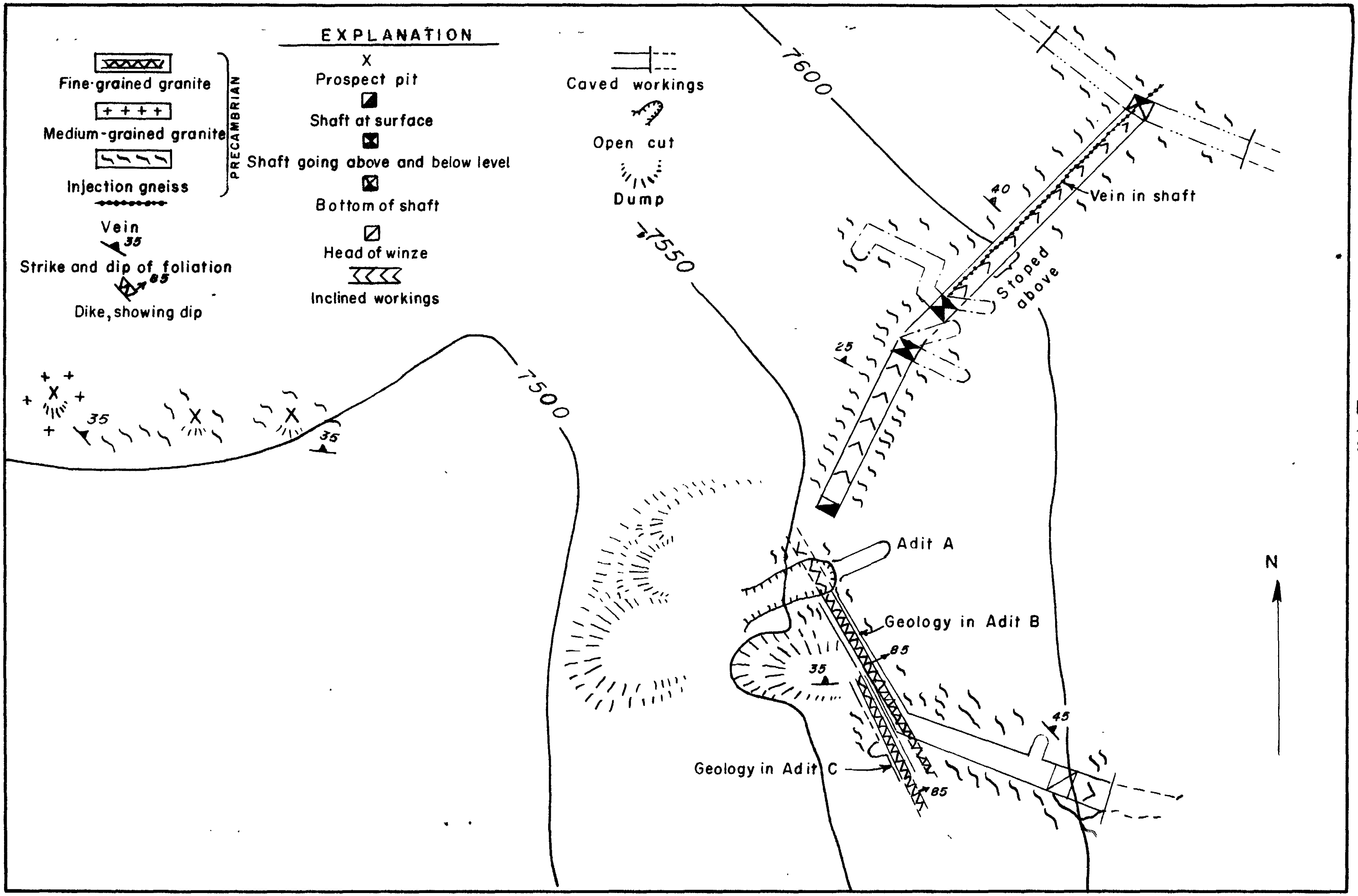
The Cook property is probably near the contact between Precambrian Idaho Springs schist and Pikes Peak granite. The granitic rock was intruded, lit-par-lit, as thin layers or lenses along and across the schistosity to form an injection gneiss. This injection gneiss forms the wall rock of the mineral deposit.

Sulfide minerals are most abundant in lenses of schist containing biotite and amphibole. Pyrite and chalcopyrite, stained by covellite, are the most common sulfides. Sphalerite and galena were seen in several places in Adit B (fig. 25).

The injection gneiss strikes about N. 65° W. and dips 25°–45° NE. The inclined shaft follows the dip of the gneiss and, from a depth of 75 feet to the bottom, follows a vertical vein that strikes N. 45° E. The vein has a maximum thickness of six inches, but in places between pegmatitic lenses, is only a fracture. It contains a soft, moist, iron-stained mass of quartz grains and clay minerals.

The granite dike followed by two of the adits (fig. 25) is from six inches to six feet thick and consists mainly of iron-stained pink potash feldspar and quartz. It strikes N. 30° W., dips 80° NE., and has been minutely fractured and later healed with iron oxides. Malachite and azurite occur in small quantities in and near this dike.

Malachite and azurite are exposed in the three prospect pits in the west part of the property. The east pit is 10 feet deep and exposes a flat-dipping vein which ranges in thickness from half-an-inch to two inches, and strikes northwest parallel to the schistosity. The vein filling consists



By E.P. Beroni and H.C. Granger, 1949

FIGURE 25.—SKETCH MAP OF MINE WORKINGS, COOK PROPERTY, JEFFERSON COUNTY, COLORADO

40 0 40 Feet

Contour interval 50 feet
Datum is assumed

of a soft iron-stained mass of quartz grains, clay minerals, and altered biotite. Some pyrite was seen in the widest part of the vein. Efflorescent brochantite is present on the walls. The other two prospects display fractures in the granite that are stained by azurite and malachite.

It is probable that supergene enrichment from primary copper minerals has resulted in the development of malachite, azurite, and brochantite in the near surface deposit.

Without further study it is impossible to state whether these sulfides are of Precambrian age or of more recent origin.

The mine workings on the Cook property were carefully tested for radioactivity with an El-Tronics Geiger counter, but the rate meter readings did not exceed twice the average background. This difference is no greater than might normally be expected within rocks of the type found in this area.

Fluorite mine.—The Fluorite mine (211), in sec. 15, T. 5 S., R. 71 W., Evergreen district, is one mile south of Evergreen on Colorado Highway 73. The collar of the shaft is 50 feet south of the bend in the road.

The mine workings consist of a shaft of unknown depth, possibly 100 feet. The country rock consists of Precambrian granite gneiss and schist. The deposit consists of a steeply dipping quartz vein possibly 100 feet long and less than one foot thick along a fault zone. Fluorite and some galena and sphalerite are the primary ore minerals. The gangue minerals are quartz, pyrite, and sericite.

A sample of dump material contained 0.005 percent equivalent uranium.

Radioactivity of rocks in the Morrison-Golden area.—The Morrison-Golden area (212) is in the north-central part of Jefferson County in

Tps. 2, 3, 4, and 5 S., R. 70 W. Rocks exposed in the area include the Precambrian Idaho Springs formation and sedimentary rocks that range in age from Pennsylvanian through Tertiary. The Paleozoic and Mesozoic sedimentary rocks dip approximately 30 degrees eastward away from the Precambrian core of the Front Range. The area was examined by Beroni, Granger, and Sharp in August 1948.

The radioactivity of the Precambrian Idaho Springs formation was measured at six places along a half-mile interval in Bear Creek Canyon, but no abnormal radioactivity was observed.

The Ralston basalt dike of Tertiary age, four miles north of Golden, was tested for radioactivity at numerous places. The two samples that were taken for analyses contained 0.001 and 0.002 percent uranium.

The Fountain formation of Pennsylvanian age, about 1,200 feet thick at Red Rocks Park, was examined for radioactivity at twenty different localities. The whole formation proved to be slightly radioactive. Mudstone lenses in the argillaceous sandstone are estimated from field measurements to contain 0.007 percent equivalent uranium.

The Permian Lyons sandstone was examined at three points, and the Triassic Lykins formation—including gypsum beds, "Crinkled limestone", and shale beds—was examined at ten points on Turkey Creek Canyon. The radioactivity of these formations was not higher than background.

The Jurassic Morrison formation was examined at two different localities in Turkey Creek Canyon. Although a few of the shale members were slightly higher than background, outcrop counts indicate that the whole formation contained not more than 0.002 percent equivalent uranium.

The Upper Cretaceous Dakota formation was examined at five localities in Bear Creek and Turkey Creek canyons. Small ferruginous shale lenses in the upper 110 feet of massive sandstone were noticeably radioactive. Along the contact zone of the massive sandstone and a 20-foot bed of dark-gray shale in Bear Creek Canyon, there is a considerable incrustation of radioactive hydrous aluminum sulfate. No abnormal radioactivity was discovered in the dark-gray shale.

A shale member of the upper Cretaceous Benton group along Turkey Creek Canyon was found to be weakly radioactive.

No abnormal radioactivity was detected in the upper Cretaceous Pierre shale, in the Laramie formation, or in the Tertiary Denver-Arapahoe formation.

Analyses of samples collected in the Morrison-Golden area are shown on table 22.

Noack pegmatite prospect.—The Noack pegmatite prospect (213), in secs. 7 and 8, T. 4 S., R. 71 W., is on ranchland owned by Fred D. Blackmer of Bergen Park, Colorado. The property is developed by three open cuts and one small pit put down on pegmatite outcrops. The prospect is accessible by the Idaho Springs-Evergreen road. It is near the summit of a low rounded hill a quarter of a mile west of the road.

The rock in the vicinity of the prospect is a medium to coarsely crystalline hornblende schist. The prospect is in an unzoned pegmatite composed of massive quartz, pink feldspar, and scattered mica. The pegmatite is not abnormally radioactive.

Table 22.--Radioactivity data on samples collected from the Morrison-Golden area.

Sample number	Formation	Equivalent uranium (percent)	Uranium (percent)	Description
PB-4-1	Lower Benton	0.003	0.002	Black shale
PB-5-2	Upper Dakota	.018	.008	Ferruginous sandy clay
PB-5-3	Upper Dakota	.039	.002	Gray organic shale
PB-5-5	Upper Dakota	.009	.002	Gray organic shale and sandstone
PB-10-6	Middle upper Fountain	.006	.001	Red, argillaceous sandstone
PB-11-7	Lower Fountain	.005	.002	Red, reworked silt-stone
PB-11-8	Lower Fountain	.007	.001	Red, micaceous shale
PB-13-9	Lower Denver	.003	.002	Massive clay
PB-15-10	Tertiary intrusive	.004	.001	Basalt
PB-15-11	Tertiary intrusive	.003	.002	Basalt
PB-16-12	Upper Dakota	.004	.007	Efflorescent incrus-tation
PB-16-13	Upper Dakota	.021	.010	Gray shaly sandstone
PB-19-14	Lower Fountain	.004	----	Red arkose

Analyses by L. F. Rader, Jr., U. S. Geological Survey, 1949.

Old Leyden coal mine.--The Leyden uranium prospect (214) is in sec. 28, T. 2 S., R. 70 W., in the northern part of Jefferson County. The property is along Colorado Highway 93 about one mile south of the Denver and Salt Lake Railroad and is owned by Mrs. Susan M. Lindsay of Denver, Colorado. The Moreno-Cripple Creek Corporation of Colorado holds an option to lease the Leyden property and in August 1950 was doing development work to determine the value of the deposit.

Uranium was first reported in this locality by Captain E. L. Berthoud (1875). The deposit has been mentioned in subsequent articles by Fleck (1916) and Wilson (1923). The property was re-examined briefly in February 1950 by G. B. Gott and J. W. Adams of the U. S. Geological Survey as part of a general investigation of lignites and coals (Gott, 1950).

Mapping, sampling, and radiometric reconnaissance of the uranium-bearing deposits in the vicinity of the Old Leyden coal mine were completed by F. A. McKeown and A. J. Gude, 3d (1951) of the U. S. Geological Survey August 10, 1951 (fig. 26).

No uranium was produced until 1950 when the owners reopened the mine, which had long been abandoned and caved, and stockpiled a few tons of ore. The new development work consisted of reopening the old adit (approximately 288 feet in length) and driving it 50 feet farther to the east. The owners core-drilled holes from the adit; opened several small pits; and by bulldozing exposed uraniferous rock 1,300 feet north of the Old Leyden mine.

Several new occurrences of uraniferous rocks were discovered during the reconnaissance for radioactivity. Most of the occurrences are in clay, lignite, and sandstone within the mapped area.

The Leyden uranium prospect is in the foothills region of the Colorado Front Range. Sedimentary formations of pre-Tertiary and early Tertiary age are exposed along the eastern flank of the range.

The prospect is in the Upper Cretaceous Laramie formation, which crops out about three miles east of the contact between the sedimentary rocks and the Precambrian igneous rock of the Front Range. The formation consists of about 600 feet of interbedded sandstones, clays, carbonaceous claystones, and thin lenticular lignite coal beds. Dips of the basal sandstones of the Laramie formation range from 45° E. to vertical. Near the Leyden prospect, the basal sandstones are vertical or slightly overturned, and form a conspicuous, elongate topographic feature known as Leyden Ridge.

Butler (1950) made a detailed structural study of the Leyden Ridge area and concluded that a north-trending fault, probably associated with the Golden thrust fault to the south, was present along the ridge.

All of the observed occurrences of uraniferous rock in the mapped area are in the lower part of the Laramie formation. Although the basal sandstones of the Laramie formation are silicified wherever they were examined, the silicification apparently was greater along Leyden Ridge in the vicinity of the Old Leyden coal mine. Shear fractures and slips in clay and coal seams are commonly seen in the underground workings of the clay beds. Bedding-plane slips are also common.

The uranium at the Leyden mine is in the form of carnotite and possibly other minerals, as yet unidentified, that are associated with quartz and pyrite in a sheared, partly silicified, tongue-shaped zone in a coal bed. The maximum known concentration of uranium, as much as 3.89 percent, is in unsilicified (?) coal. Within the Old Leyden mine, the coal bed is 3.5 to 4 feet thick and dips 77° E. The average uranium content of three channel samples weighted against their length across the bed is 0.19 percent. Diamond drilling by the lessee, Mr. Ray A. Bennett of the Moreno-Cripple Creek Corporation, has proved that the coal bed extends 112 feet down dip from the adit level, where it is approximately eight feet thick and contains 0.14 percent uranium (Ray Bennett, mining engineer, oral communication).

Three of the other occurrences of uraniferous rock in the area appear to be similar to the uranium-bearing rock at the Old Leyden mine. One is the carnotite that forms a thin coating on sandstone near the top of the ridge, 120 feet south of the mine (fig. 26). A second, radioactive silicified sandstone float that is admixed in the soil for a distance of approximately 50 feet, is 1,300 feet north of the mine near the top of the ridge. A grab sample of the float contained 0.041 percent uranium. The third, an irregular patch, two to three feet across, of sandstone containing minute but megascopic amounts of carnotite (?), is approximately 2,100 feet north of the mine, along the east side of the ridge.

Several occurrences of slightly uraniferous rock that are structurally, mineralogically, and lithologically dissimilar to those just described are found in thin clay beds and lignite seams. These deposits contain from 0.003 to 0.030 percent uranium. The most radioactive material is highly carbonaceous clay, which has been found at different places along the strike from the Old Leyden mine in the Laramie formation for a distance of approximately $1\frac{1}{2}$ miles within a stratigraphic interval of about 100 feet.

The coal from the mineralized zone has been slightly brecciated and pulverized. The brecciation was probably contemporaneous with the upturning and faulting of the enclosing sediments during the Laramie revolution. The coal fragments were cemented by a network of thin quartz stringers, and the walls of the larger openings were coated by drusy quartz crystals. In the specimens examined by Butler (1950) from 10 to 90 percent of the rock mass was silicified. The sharp boundaries between the coal fragments and the siliceous material indicates that the silica and associated minerals were added after the organic material had been deposited and carbonized.

The following hypotheses should be considered in any attempt to determine the source of the uranium.

(1) Uranium salts were deposited in the Laramie sandstone at the time of sedimentation (Wilson, 1923). Later the uranium was dissolved in the ground water and concentrated in the underlying coal.

(2) The mineral solutions containing uranium had a deep-seated igneous source and moved upward along faults. The basaltic dikes and sills in the vicinity of the Leyden property may have a genetic connection with the deposits.

(3) Uranium was deposited in a formation older than the Laramie, such as the Morrison sandstone, Dakota sandstone, or Pierre shale, and was transferred to the coal of the Laramie formation by solution and redeposition from ground waters.

Union Pacific prospect.—The Union Pacific prospect (215), in the SE¼ sec. 19, T. 3 S., R. 70 W., is approximately 700 feet up a draw northwest of the road in Golden Gate Canyon, 2.3 miles west of the junction of Colorado Highways 58 and 175. The prospect was examined by J. W. Adams and M. H. Staatz in 1951.

The mine workings consist of a shaft, partly filled with debris and water and probably not over 50 feet deep.

The country rock consists of metamorphic rock of Idaho Springs formation. The deposit is a vein in a shear zone. The primary ore minerals are primary copper mineral and pitchblende. The secondary ore minerals are azurite, malachite, and iron oxides. The gangue minerals are quartz and carbonates. The highly oxidized outcrop contains narrow veinlets cutting siliceous gangue.

The analyses of samples of vein material ranged from 0.003 to 5.84 percent uranium.

Nigger shaft.--The Nigger shaft (216), in the SE¼ sec. 23, T. 2 S., R. 71 W., Ralston Creek area, is three miles north of Ralston Reservoir. The property was examined in the summer of 1950 by T. P. Anderson of the U. S. Atomic Energy Commission. The property had been previously examined by C. C. Towle. The mine workings consisted of a 20-foot shaft and a short adit (caved).

The country rock consists of schist and gneiss of the Precambrian Idaho Springs formation. The pitchblende deposit is in a brecciated shear zone four to eight feet thick that consists of quartz, limonite, pyrite, chalcopyrite, bornite, and pitchblende in small, thin fracture fillings.

Biggar mica mine.--The Biggar mica mine (217), in sec. 3, T. 6 S., R. 70 W., is on a north-facing spur of Bald Mountain 1,000 feet west of the junction of Colorado Route 124 and U. S. Highway 285. The mine was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of an open cut about 150 by 25 feet which is partly filled with water.

The country rock consists of decomposed hornblende-diorite gneiss. The pegmatite dike is about 300 feet long, about 400 feet wide, and is exposed to a depth of 30 feet. It strikes approximately N. 45° W. and dips steeply to the southwest. The dike is cut by two faults. It is distinctly zoned and has a core of quartz and microcline; an intermediate zone of quartz, albite, beryl, and muscovite; and a wall zone of medium-grained quartz, muscovite, microcline, albite, and biotite with black tourmaline.

Radioactivity measurements made on the outcrop indicate that, except for a small crystal of torbernite (?), the radioactivity is negligible. A sample containing torbernite (?) contained 5.1 percent uranium, and 5.0 percent equivalent uranium.

Centennial Cone prospect.—The Centennial Cone prospect (218), in sec. 32, T. 3 S., R. 71 W., is on a spur on the northeast side of Centennial Cone, 200 feet southwest of an abandoned cabin, 15 miles by road west of Golden. It was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of a few shallow pits dug by mineral collectors.

The country rock is biotite granite gneiss. The pegmatite dike is about 400 feet long and 10 feet wide. It strikes about N. 65° E. and dips about 45° SE. The distinctly zoned pegmatite has a core of white quartz, potash feldspar, biotite, and muscovite with green beryl and a wall zone of fine-grained granite pegmatite. Samarskite has been reported, but none was seen by Brill.

The radioactivity of a mica book was about 0.002 percent equivalent uranium.

Cresman Gulch mine.—The Cresman Gulch mine (219), in secs. 17 and 18, T. 3 S., R. 70 W., is on the north side of Cresman Gulch, which is the first gulch north of Golden Gate Canyon. The mine road leaves the country road on the west side of the Dakota hogback. It was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of two open cuts near the eastern end of the dike.

The country rock consists of gneiss and schist. The pegmatite dike trends northwest and dips 90 degrees. The dike is distinctly zoned and contains a core of quartz and microcline and a wall zone of potash feldspar, quartz, tourmaline, biotite, and beryl.

Radioactivity measurements made on the outcrops show that, with the exception of some biotite books, the radioactivity is negligible.

Four pegmatites in Swede Gulch.—Pegmatites 1 and 2 (220)(probably part of Burrough's property), in sec. 27, T. 4 S., R. 71 W., are on the east and northwest sides of a knoll, approximately 500 and 1,000 feet, respectively, west of the Swede Gulch road. Pegmatites 3 and 4, in sec. 26, T. 4 S., R. 71 W., are on the east and west sides of Swede Gulch. They were examined in 1947 by K. G. Brill, Jr.

The mine workings consist of four small open cuts and a shallow pit in pegmatite 3.

The country rock in the vicinity of the pegmatites consists of biotite granite gneiss. Pegmatites 1 and 2 have a northeast trend and nearly vertical dips. Pegmatites 3 and 4 have a northwest trend and nearly vertical dips. The pegmatites are zoned and consist of quartz, microcline, muscovite, and biotite.

The radioactivity of pegmatites 1, 2, and 3 is negligible. Granite pegmatite in the west wall zone of pegmatite 4 shows some radioactivity. A sample of the granite pegmatite contained 0.012 percent equivalent uranium and 0.006 percent uranium.

Ramstetter Ranch pegmatites.—Two pegmatites on the Ramstetter Ranch (221) are in sec. 15, T. 3 S., R. 71 W. One dike is directly across the creek from the Ramstetter ranch house which is on Colorado Route 58 near the head of Golden Gate Canyon; the other is 0.25 mile southeast of the Ramstetter ranch house. They were examined by K. G. Brill, Jr., in 1947.

The mine workings consist of a cut 100 by 40 feet and a water-filled shaft in the northwest dike; the southeast dike is explored by a shallow trench.

The country rock consists of schist and gneiss. Both pegmatites trend northeast and are distinctly zoned. They contain quartz, potash feldspar, muscovite, and black tourmaline.

Measurements made on the outcrops indicate that the radioactivity is negligible.

Robinson Gulch prospect.—The Robinson Gulch prospect (222), in sec. 16, T. 3 S., R. 71 W., crosses the Robinson Gulch road 100 feet south of its junction with Colorado Route 58. It was examined by K. G. Brill, Jr., in 1947.

A pegmatite dike is exposed in a road cut.

The country rock consists of muscovite schist injected by quartz veins. The pegmatite dike is very irregular and contains numerous schist inclusions. The dike consists mainly of a core of quartz, potash feldspar, muscovite, and tourmaline.

The radioactivity of the pegmatite is negligible.

Roscoe beryl prospect.—The Roscoe beryl prospect (223), in sec. 5, T. 4 S., R. 71 W., is on the north wall of Clear Creek Canyon at the old railroad grade level, 0.8 mile by road east of the former station of Roscoe. The prospect was examined by K. G. Brill, Jr., in 1947.

A pegmatite dike has been explored by a small prospect pit.

The country rock is a strongly-folded biotite granite gneiss. The dike, which is irregular in shape, is about 800 feet long and is 120 feet wide at the widest part. It is exposed to a depth of 150 feet. It has an east-west trend and dips about 75 degrees to the south. The dike is distinctly zoned. The core consists of quartz, pink microcline, muscovite, and small crystals of beryl; the intermediate zone of granite pegmatite and books of biotite, red garnet, and a little magnetite; and the wall zone of quartz, feldspar, granite pegmatite, and scattered large crystals of magnetite.

Radiometric measurements made on the outcrop indicate that the magnetite-bearing wall zone is radioactive. A sample of a granite pegmatite and magnetite in contact with a highly micaceous dark zone contained 0.008 percent equivalent uranium and 0.003 percent uranium. A sample of granite with crystals of magnetite contained 0.017 percent equivalent uranium and 0.012 percent uranium.

Syenite dike.—A dike of red syenite (224), in the SW$\frac{1}{4}$ sec. 16, T. 3 S., R. 71 W., is exposed in a cut on the north side of Colorado Route 58, 0.7 mile west of the divide between Guy Gulch and Golden Gate Canyon. It was examined in 1947 by K. G. Brill, Jr.

The country rock consists of muscovite schist. The dike is 2,000 feet long and about 20 feet wide. It trends northeast and dips 18° to 20° to the southeast. It is composed of finely-textured red potash feldspar and minute crystals of a black metallic mineral.

A sample of the syenite dike contained 0.002 percent equivalent uranium and 0.001 percent uranium.

Wasson beryl prospect.—The Wasson beryl prospect (225), in the SW$\frac{1}{4}$SW$\frac{1}{4}$ sec. 10, T. 4 S., R. 71 W., crosses the top of a 8,000-foot hill about 1,000 feet north of U. S. Highway 40. The prospect, in a pegmatite dike, was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of a caved adit at the east end of the dike and several shallow pits at the west end.

The country rock consists of biotite granite gneiss. The dike is about 1,000 feet long, 30 feet wide, and is exposed to a depth of 40 feet. It trends northeast and dips 90 degrees. The core consists of coarsely crystalline quartz, microcline, and biotite. The wall zone consists of quartz and microcline with little or no biotite.

Radioactivity measurements indicate that books of biotite are radioactive. A chip sample contained 0.023 percent equivalent uranium, but the uranium content of the same sample is only 0.003 percent.

Lake County

Location and general features

Lake County is a small county in central Colorado. Leadville, the county seat, is slightly northwest of the center of the county.

The Arkansas River flows southward through the county dividing it into two almost equal parts; the western part contains the Sawatch Range and the eastern part the Mosquito Range. Altitudes range from over 14,000 feet in the ranges to a little less than 10,000 feet along the river. Because of the rugged topography most of the county is not readily accessible although four main highways do cross it.

The Leadville drainage tunnel, a mile north of the city of Leadville, was the only locality examined for radioactivity.

Leadville tunnel.--The portal of the Leadville tunnel (226), in sec. 13, T. 9 S., R. 80 W. (unsurveyed), is about one mile north of the city of Leadville and 300 feet west of the road leading to Climax. The tunnel is 6,600 feet long and is driven on a bearing of S. 29° E. The tunnel was driven to drain the mines of the east Leadville district. It was examined by F. B. Moore in 1950.

The tunnel cuts most of the rock types exposed in the Leadville district. These rocks include the Precambrian Silver Plume granite, a series of nearly flat-lying sedimentary beds ranging in age from Cambrian to Pennsylvanian, and Tertiary porphyry sills. The surface along the tunnel is mostly covered by glacial moraine. The tunnel is driven in glacial moraine for 430 feet where it passes into flat-lying Weber grits of Pennsylvanian age. At 2,100 feet the Cambrian Sawatch quartzite is faulted up to tunnel level. Between 2,100 feet and 4,080 feet, the tunnel cuts Sawatch quartzite, Peerless shale, Dyer dolomite, Gilman sandstone, Parting quartzite, and Gray porphyry. At 4,080 feet, the tunnel crosses the Penery fault into Silver Plume granite which makes up the wall rock to 6,300 feet. The last 300 feet of tunnel is in Sawatch quartzite. The two faults intersected by the tunnel trend in a northerly direction. The west side of each fault has moved down with respect to the east side. No ore deposits are cut by the tunnel. No radioactivity anomalies were detected during the traverse of the tunnel.

Larimer County

Location and general features

Larimer County is in north-central Colorado between the Wyoming State line and Boulder County. The Rocky Mountain National Park occupies the southwestern part of the county. Fort Collins, the county seat, is near the eastern edge of the county and is about 70 miles north of Denver.

The greater part of the county is within the mountains of the Front Range. Elevations range from 5,000 feet above sea level at the plains along the eastern edge of the county to over 14,000 feet along the Continental Divide at the western boundary of the county.

The Cache La Poudre, Big Thompson, and Little Thompson rivers flow eastward and form the drainage system of Larimer County.

With the exception of the northwestern part, the county is generally accessible by roads.

Rocks exposed within the county include Precambrian granite, schist, pegmatite, and small intrusive bodies of Tertiary andesite and basalt in the western part of the county, and sedimentary rocks of from Pennsylvanian to Cretaceous age along the eastern edge of the county.

The deposits examined for radioactivity are all in Precambrian rocks and consist of a sulfide vein in skarn, two disseminated deposits in Precambrian granite and schist, and 12 pegmatite deposits.

Copper King mine.--The Copper King mine (227) is on the Black Hawk No. 1 claim in sec. 8, T. 10 N., R. 72 W. It is 28 miles northwest of Fort Collins and may be reached by road via Livermore and Log Cabin. The mine is about 75 feet northwest of the road on the southwestern edge of Prairie Divide, a high, rolling area underlain by granite. The property is owned by A. H. Brown, Livermore, Colorado, and H. G. Ismert, Huntington Park, California.

The Copper King mine and four nearby shafts were originally driven to prospect for copper and zinc during World War I. No ore is known to have been shipped prior to 1920, when a carload of low-grade ore was shipped. The shipment failed to pay the cost of milling, and the mine was closed. The property was worked briefly for zinc in 1936, but no material of economic grade was found. Messrs. Brown and Ismert found the mine dump to be highly radioactive, and filed claim on the mine in July 1949. The workings of the mine consist of a single compartment, vertical, cribbed shaft 65 feet deep, and drifts on one level that extend 98 feet to the east and 11 feet to the west of the shaft (fig. 27)(Granger and King, 1951).

The rocks exposed near the mine are predominantly medium-grained biotite granite of Precambrian age; an obscure foliation is produced in the granite by crushed and elongated quartz and feldspar. Near schist inclusions, the parallelism is emphasized by flakes and layers of biotite. The strike of the foliation ranges from N. 40° E. to N. 85° E.; the dip is nearly vertical. Inclusions of amphibolite and biotite schist crop out in areas less than 10 feet across and 30 feet long. Irregular pegmatite dikes, less than six inches thick, cut the schist and granite parallel to the foliation. The pegmatites are predominantly quartz and pink feldspar, but several contain greenish feldspar, quartz, and biotite.

The drifts follow a well-defined fissure, as much as six inches wide, filled with hydrous iron oxides, clay minerals, and scattered dense quartz. The vein trends about S. 80° E. and dips steeply to the south. Locally the strike ranges from nearly due east to S. 65° E.

The wall rock is granite and amphibole schist largely altered and replaced by biotite, pyrite, sphalerite, and chalcopyrite. The initial stage of mineralization apparently was characterized by biotitic alteration of the amphibole schist. The resultant biotite fills fractures in the granite and locally has completely replaced the amphibole in a zone as much as eight feet wide. Pyrite is commonly disseminated throughout the biotite and several specimens show pseudomorphs of pyrite after anthophyllite. An intermediate stage of mineralization is represented by minor fracturing, alteration of biotite to chlorite, and deposition of a uranium mineral, carbonates, and pyrite. Obscure, highly radioactive fracture surfaces, which strike N. 70° W. to N. 87° E. and dip nearly vertically, are along the north wall about 70-78 feet east of the shaft but show no apparent relationship to the vein. The vein represents the last period of mineralization, and may be a recent re-opening along the original fissure through which the biotite and sulfides were introduced.

The uranium mineral is tentatively identified as pitchblende. Under the microscope it appears to be a very fine-grained, opaque black substance, perhaps partly disseminated in black gouge, and distributed throughout chlorite or coating angular grains of pyrite and sphalerite.

The uranium-bearing zone at 70-78 feet east of the shaft is about 3-4 feet wide and diverges from the first level at S. 75° E. with a nearly vertical dip. Rock at 54 feet east of the shaft has a relatively high uranium content, but the trend and size of the deposit is not known.

Samples from the dump showed radioactivity as high as 1.39 percent equivalent uranium. Analyses of dump samples ranged from 0.006 to 1.23 percent uranium. Radioactivity of the mine workings ranged from 0.004 percent equivalent uranium on the south wall of the drift to 0.45 percent equivalent uranium on the north wall; analyses of samples from the same locations gave 0.002 percent uranium and 0.50 percent uranium respectively.

Spaulding-Woodhams scheelite prospects.--The Spaulding-Woodhams scheelite prospects (228), in sec. 23, T. 9 N., R. 71 W., are in Hewlett Gulch, 16 miles northwest of Fort Collins. They were examined in June 1947 by D. G. Wyant.

The development consists of several short adits and a 30-foot shaft.

The country rock consists of schist, quartzite, and lime silicate gneiss probably of the Precambrian Idaho Springs formation. The scheelite occurs in a green lime silicate rock interbedded with the other types of country rock. The scheelite-bearing bed strikes generally N. 75° W., dips approximately vertically, and is probably continuous for one-quarter mile (Wyant, 1949c).

The radioactivity of the prospects is negligible. The three samples taken ranged from 0.000 to 0.002 percent equivalent uranium.

Treasure Hill area.—The Treasure Hill area (229) is about 20 miles northwest of Fort Collins (fig. 1) in secs. 10 and 15, T. 9 N., R. 70 W. The property consists of seven lode-mining claims owned jointly by Mrs. Mildred Davis, 345 Milwaukee Street, Denver, Colorado, and by the Woodhams brothers, Orville and Clifford, of Bellvue, Colorado, and one claim leased from Mrs. Ruth Casey, address unknown. The mining claims are known as the West Point, the Treasure Hill numbers 1, 2, 3, 4, 5, and 6 claims, and the Casey lease. They have been explored by three short shafts, one trench, seven pits, and one cut. The locality was examined for uranium by D. G. Wyant (1949b) in October 1949.

The country rock of the area is granite, presumably Precambrian in age, that megascopically resembles the Silver Plume granite. Enclosed in the granite are isolated blocks or pendants of schist, gneiss, and quartzite that are also presumably Precambrian in age, possibly Idaho Springs schist or its equivalent. The average surface dimensions of these schist pendants are about 50 by 100 feet and their average depth beneath the present land surface is probably of the same order of magnitude.

The pendants consist predominantly of quartz-chlorite to biotite schist, with subordinate amounts of impure quartzite and gneiss. Some of the schist contains as an important constituent small red garnets (?). Pyrrhotite, marcasite (?), and secondary iron oxides were observed in the dump of the shaft on the Treasure Hill No. 2 claim. The schist, quartzite, and gneiss blocks have been intersected by numerous quartz-feldspar pegmatites, and by hornblende (?) dikes.

Observations with a Geiger-Mueller counter were made at all development workings in the area. The average of the readings taken with the counter was approximately the normal background established by observation at many places near Denver and in the Treasure Hill area. The average equivalent uranium content of 15 samples collected in the area is 0.001 percent, and the uranium content ranges from 0.000 to 0.003 percent.

Big Beryl mine.--The Big Beryl mine (Hyatt Beryl Lode pegmatite)(230), in the NE$\frac{1}{4}$NW$\frac{1}{4}$ sec. 28, T. 6 N., R. 71 W., Crystal Mountain district, is on the south slope of the mountain that is north of the Fred Hyatt ranch house, about 5.5 miles by road northwest of Drake on the Big Thompson River. The pegmatite was examined in 1947 by K. G. Brill, Jr.

The dike has been explored by a wide bench and several trenches.

The country rock consists of mica schist, the foliation of which trends N. 20° E. The pegmatite dike is about 275 feet long, 50 feet wide, and is exposed to a depth of 50 feet. The general trend of the dike is N. 50° E., and the dips of the contacts range from 30° N. to 45° S. The pegmatite is distinctly zoned and has a core of coarsely crystalline microperthite; an intermediate zone that is discontinuous and consists of quartz, albite, muscovite, and some beryl, and a wall zone of finely crystalline microcline, quartz, beryl. Some tantalite, autunite, and torbernite also occur in the intermediate zone. Hanley, Heinrich, and Page (1950, p. 101) report uraninite in the intermediate zone.

Radioactivity measurements made on the outcrop indicate that radioactivity is present in the torbernite coatings in the north wall zone and in the tantalite stockpile at the east end of the bench. A sample of pegmatite with torbernite contained 0.24 percent equivalent uranium and 0.26 percent uranium. The tantalite contained 0.004 percent equivalent uranium and 0.003 percent uranium.

Big Boulder beryl prospect.—The Big Boulder beryl prospect (231), in the SE$\frac{1}{4}$ sec. 36, T. 7 N., R. 72 W., Crystal Mountain district, is on the divide between Sheep Creek and the headwaters of Fish Creek. The prospect was examined by K. G. Brill, Jr., in 1947.

The dike has been explored by two trenches, four pits, and a shallow shaft.

The country rock consists of quartz-mica schist. The dike is 260 feet long, about 100 feet wide, and is exposed to a depth of 30 feet. It strikes N. 15° E., dips 68° SE. on the west border, and plunges 60° S. The pegmatite dike has two zones. The core consists of coarse-grained quartz-microcline pegmatite. The wall zone consists of quartz-microcline-albite-muscovite pegmatite. Both zones contain beryl.

Radioactivity measurements made on the outcrop indicate that a streak of torbernite in the shaft is highly radioactive, and a pit 30 feet west of the shaft has some radioactivity. Four samples were taken. The first one, a large fragment containing a dark-brown to black tantalite in the southernmost pit, contained 0.007 percent equivalent uranium and 0.003 percent uranium. The second, consisting of garnet, sericite, and an orange coating on a joint plane, contained 0.004 percent equivalent uranium and 0.001 percent uranium. The third, including torbernite and gummite coatings on quartz and feldspar in the shaft, contained 2.70 percent equivalent uranium and 2.96 percent uranium. The fourth, consisting of yellowish coatings on quartz, muscovite, and tantalite (?) in the pit west of the shaft, contained 0.016 percent equivalent and 0.010 percent uranium.

Beryl No. 5 prospect.—The Beryl No. 5 prospect (232), in sec. 25, T. 7 N., R. 72 W., Crystal Mountain district, is on the east side of the Humphrey Ranch road at the branch just north of a large meadow, about 3.5 miles south of the Buckhorn road. It was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of a pit 17 by 9 feet.

The country rock consists of quartz-biotite schist. The dip trends northeast and dips from 55° SE. to vertical. The core consists of quartz and perthite. The wall zone consists of quartz, potash feldspar, and muscovite.

The radioactivity of the dike is negligible.

Buckhorn mica mine.—The Buckhorn mica mine (233), in the SW¼ sec. 29, T. 7 N., R. 71 W., Crystal Mountain district, is on the center of a hill 0.25 mile south of the abandoned Reynolds ranch house near the top of the divide between Sheep Creek and Fish Creek. It is reached by a mine road from the Humphrey (Brown) ranch. It was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of three shafts, several pits, and an open cut. The country rock consists of a quartz-biotite schist. The pegmatite strikes N. 65° E. and dips about 90 degrees. The core of the pegmatite consists of quartz, cleavelandite, and spodumene. The discontinuous intermediate zone consists of quartz, albite, and muscovite. A narrow border zone consists of granite pegmatite.

Radioactivity measurements made on the outcrop indicate that, in general, the country rock is more radioactive than the dike. A sample of the schist contained 0.004 percent equivalent uranium, but only 0.001 percent uranium.

Crystal Silica mine.—The Crystal Silica mine (234), in sec. 26, T. 7 N., R. 72 W., Crystal Mountain district, is on a ridge on the south side of Crystal Mountain. The mine can be reached from Fort Collins via the Buckhorn Creek road, and the Humphrey ranch road to Sheep Creek. From Sheep Creek the trail leads up the first gulch to the north. The mine was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of a 40-foot shaft, two adits, four large open cuts, and 19 small cuts.

The country rock consists of biotite schist. The pegmatite is distinctly zoned and nearly a mile long. The core consists chiefly of coarsely crystalline quartz. The intermediate zone, which is very discontinuous, contains muscovite, beryl, and plagioclase. The wall zone consists of finely-textured quartz, microcline, muscovite, and plagioclase.

Radioactivity measurements made on the outcrop indicate that the radioactivity of the dike is negligible. A sample of the country rock contained 0.003 percent equivalent uranium and 0.001 percent uranium.

Crystal Snow (?) claim.—The Crystal Snow (?) claim (235) is in the SW¼ sec. 31, T. 7 N., R. 71 W., Crystal Mountain district. It was examined in 1947 by K. G. Brill, Jr.

The pegmatite dike has not been explored.

The country rock consists of mica schist. The pegmatite is distinctly zoned. It has a core of white quartz, an intermediate zone of potash feldspar, quartz, muscovite, and tourmaline; and a wall zone of granite pegmatite.

Radioactivity measurements made on the outcrop indicate that the radioactivity of the dike is negligible.

Double Opening mine.—The Double Opening mine (236), in secs. 30 and 31, T. 7 N., R. 71 W., exploits a pegmatite in the Crystal Mountain district between the watersheds of Sheep Creek and Fish Creek. It is reached by the Buckhorn Creek road and a ranch road through the Humphrey ranch (formerly Reynolds ranch). The mine was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of two open cuts. The country rock consists of quartz-biotite schist. The poorly zoned pegmatite dike is 250 feet long and 30 feet wide. It strikes N. 40° E. and dips 60° NW. The core consists of smoky quartz, beryl, and microcline. The intermediate zone consists of quartz and albite with small quantities of muscovite, phosphate minerals, and uranium minerals. Other zones were not exposed in the workings.

Several small areas in the core are radioactive. Two samples from these areas averaged 0.004 percent uranium. Hanley, Heinrich, and Page (1950, p. 92) report the occurrence of small quantities of uraninite, autunite, torbernite, and gummite adjacent to the pegmatite core.

Humphrey beryl prospect.—The Humphrey beryl prospect (237), in sec. 25, T. 7 N., R. 72 W., Crystal Mountain district, is in the yard of the Humphrey ranch (formerly the Reynolds ranch) about 4.5 miles by road south of the Buckhorn Creek road. It was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of a small pit.

The country rock consists of quartz-biotite schist. The main pegmatite dike is 210 feet long, 10 feet wide, and strikes N. 40° E. The core consists of coarsely crystalline quartz and beryl. The wall zone consists of quartz, potash feldspar, muscovite, and beryl.

The radioactivity of the dike is negligible.

Mica-Beryl prospect.—The Mica-Beryl prospect (238), in the SW¼ sec. 30, T. 7 N., R. 71 W., Crystal Mountain district, is on the north side of a ridge, 200 feet south of the road from the Reynolds ranch to the Buckhorn mica mine. It was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of a shallow shaft. The country rock consists of quartz-biotite schist and granite gneiss. The dike consists of quartz, plagioclase, muscovite, and some beryl.

The radioactivity of the dike is negligible.

Neville (?) Ranch pegmatite prospect.—Neville (?) Ranch pegmatite prospect (239), in the southwest corner of sec. 32, T. 7 N., R. 71 W., Crystal Mountain district, is in the ranch yard which is one mile by road east of the Mary Oliver (Smith) ranch, and 10 miles by road west of the Buckhorn Creek road. It was examined in 1947 by K. G. Brill, Jr.

The pegmatite dike has not been opened by exploration cuts.

The country rock consists of mica schist. The pegmatite consists of quartz, potash feldspar, some muscovite, and black tourmaline.

The radioactivity of the dike is negligible.

White Rock prospect.—The White Rock prospect (240), in the SE$\frac{1}{4}$ sec. 29, T. 7 N., R. 71 W., Crystal Mountain district, is on the south side of a small park about half-way between the Buckhorn mica mine and the Double Opening mine. It was examined in 1947 by K. G. Brill, Jr.

The pegmatite dike has been opened by a 10-foot exploratory cut. The country rock consists of mica schist. The pegmatite is distinctly zoned and consists of quartz and potash feldspar.

The radioactivity of the dike is negligible.

Wisdom Ranch mine.—The Wisdom Ranch mine (241), in the SE$\frac{1}{4}$ sec. 5, T. 7 N., R. 71 W., Crystal Mountain district, is on the north side of a knoll about 0.75 mile by road northeast of the Wisdom ranch house. It is reached by an unimproved road which leaves the west side of the Stove Prairie road 1.5 miles north of the junction of the Stove Prairie road and the Buckhorn Creek road. It was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of an adit, a large open cut, and several small pits and trenches. The country rock consists of biotite-sillimanite schist and gneiss. The pegmatite dike is very irregularly shaped and is about a mile long. The pegmatite consists of quartz, albite, muscovite, microcline, beryl, and chrysoberyl.

With the exception of an inclusion of schist that contained 0.003 percent uranium, the radioactivity of the pegmatite dike is negligible.

Moffat County

Location and general features

Moffat County is a large county in the northwest corner of Colorado. Craig, on the eastern edge of the county, is the county seat. The Yampa River flows westward across the middle of the country and joins the Green River at the western edge of the state. The Little Snake River is the only other river of any size in the county. Altitudes range from over 7,500 feet on the plateaus to less than 5,500 feet along the Green River.

One carnotite locality was examined for radioactivity. It is in the Yampa Plateau in Paleozoic sedimentary rocks.

Skull Creek carnotite deposit.—Secondary uranium and copper minerals occur in the upper part of the Entrada sandstone approximately two miles northwest of Skull Creek. Two claims, Bozo No. 1 and Dorothy No. 2 (242), in sec. 35, T. 4 N., R. 101 W., are owned by Ben and Rebecca Morris of Skull Creek. Bozo No. 1 claim is developed by seven prospect pits and a 25-foot inclined adit. Dorothy No. 2 claim has two prospect pits.

The uranium deposits occur as lenses, up to three feet thick, parallel to the bedding in a massive, cross-bedded white to buff sandstone (Beroni and McKeown, 1952). The sandstone is part of the south limb of an anticline, and locally forms a hogback. The beds strike N. 80° W. and dip about 20 degrees to the south.

Carnotite was the only uranium mineral observed. It is most abundant around carbonized wood fragments and in thin beds of carbonaceous shale. Malachite, azurite, brochantite, and a vanadium mineral (volborthite ?) are associated with the carnotite.

Six samples were taken across the mineralized sandstone in the inclined adit and the open cut extending north from the adit. The weighted average uranium content of these samples was 0.038 percent uranium, for an average thickness of two feet. A grab sample taken from a small pit 140 feet east of the adit contained 0.16 percent uranium.

Park County

Location and general features

Park County is in central Colorado between the Mosquito Range and the Front Range. Fairplay, the county seat, is 90 miles by road southwest of Denver.

The Mosquito Range forms the west boundary of the county. The Tarryall Mountains, Kenosha Mountains, and the Platte River Mountains of the Front Range occupy the southeast part of the county. South Park, a flat basinlike physiographic feature, occupies the central part of Park County. The South Platte River and its tributaries form the drainage system of South Park. Altitudes range from over 14,000 feet in the Mosquito Range to less than 9,000 feet in the eastern part of the county along the South Platte River.

In the western part of the county Paleozoic sedimentary formations are intruded by Tertiary igneous rocks. The central part of the county contains Cretaceous and Tertiary sedimentary rocks, and Quaternary morainal deposits. The eastern part of the county contains Precambrian igneous and metamorphic rocks.

In South Park faulted and steeply tilted Paleozoic, Mesozoic, and Tertiary sedimentary rocks make up a large part of the terrane between the Mosquito Range on the west and the Front Range on the east. Large areas, particularly in the southern part of the park, are covered by Tertiary volcanic rocks.

One carnotite deposit, one vein, and two pegmatites were examined for radioactivity in this county.

Garo uranium deposits.--The Garo uranium deposits (243) are three-fourths of a mile south of Garo, in the NE¼ sec. 16, T. 11 S., R. 76 W. The carnotite deposit was mined more than 30 years ago, and Riley (1946) has reported that at least one shipment of radium ore was made at that time. The old workings are now inaccessible. Carnotite and secondary copper minerals disseminated through sandstone fragments can still be found on the old dumps. The position of the abandoned shafts suggests that there are two mineralized sandstone beds. A uraniferous chert bed closely overlies the lower of these sandstone beds.

The deposits were examined by R. U. King on June 6, 1949, and later mapped by G. B. Gott and L. F. Dellwig in July 1950 (Gott, 1951). The deposits in 1950 were under lease to Mr. W. H. Gaddis of Hartsel, Colo., who had started some small operations to reopen some of the old workings.

The Maroon formation of Permian age underlies the area in the vicinity of the uranium deposits. This formation consists of maroon to bright-red sandstone, conglomerate, shale, and a few thin limestone beds. Several beds of sandstone, shale, and limestone crop out in places, but the rest of the formation is covered by residual soil. The whole series of beds strikes N. 40°-50° W. and dips 50°-60° NE. Three northeast-trending faults were observed in the immediate vicinity of the known mineralized area. The westernmost fault has an apparent stratigraphic displacement of about 400 feet and the other two each have apparent displacements of 25 to 30 feet.

One bed of limestone, about one foot thick, is characterized by abundant radioactive chert. The chert constitutes as much as 95 percent of the bed; in this report, therefore, the limestone bed is referred to as the chert bed.

Because of the resistance of the chert to weathering, a low ridge has formed along the strike of the bed. In three places, this chert bed and other limestone beds, which also form strike ridges, are intersected by faults. The abrupt terminations of these ridges clearly show the strike of the faults.

The carnotite deposits have been explored by five shafts between 12 and 30 feet deep and dozens of shallow prospect pits. Drifts are reported to have been driven in ore-bearing sandstone beds from two of the shafts. Riley (1946) has reported that the deposits were first prospected about 1917 and that two years later a 40-ton shipment of one percent U_3O_8 ore was made. During the prospecting of this deposit dozens of shallow pits were dug indiscriminately over the area, but most of these appear to have penetrated only the surface mantle. None of the mineralized rock could be seen in place, but carnotite- and copper carbonate-bearing sandstone fragments are scattered through an estimated 150 to 200 tons of dump material, near the shafts.

Judging from the position of the shafts, the mineralized sandstone fragments were mined from two light-gray, non-carbonaceous, micaceous sandstone beds in the Maroon formation. These beds are about 100 feet apart stratigraphically.

Riley (1946) examined the dump material and identified carnotite, malachite, azurite, calciovolborthite, and volborthite. Inasmuch as several uranium analyses already have been made of specimens from the dump material, no additional sampling was done. The analytical data reported by Riley are reproduced in table 23.

Carnotite and dark vanadium minerals are disseminated in the sandstone samples obtained from the dumps. These specimens suggest that there was little or no fracture control during mineralization. They also suggest that there is no association between the uranium-vanadium minerals and carbonaceous material.

The uraniferous chert bed stratigraphically overlies the lower carnotite-bearing sandstone and is separated from it by about five feet of red shale, red sandy shale, and thin limestone beds.

The radioactivity of the chert ranges from 0.005 to 0.011 percent equivalent uranium. The uranium content is nearly the same as that indicated by the radiometric analyses, and small amounts of vanadium and copper are also present. The radioactivity data and chemical analyses of five chert samples are tabulated in table 24.

Copper King prospect.—The Copper King prospect (244) is in a pegmatite dike, in sec. 21, T. 15 S., R. 73 W., on the north side of Thirty-one Mile Creek. The prospect may be reached by following an unimproved road that leaves the Black Mountain road at a fence corner about 2.0 miles west of Gene Rowe ranch. The prospect pits lie 500 feet east of the sawmillsite. K. G. Brill, Jr., examined the pegmatite in 1947.

Table 23.—Sample and assay data for Garo uranium deposits _/.

Field number	Office number	Equivalent uranium (percent)	Uranium (percent)	V_2O_5 (percent)	Copper (percent)	Notes
4023	3718	0.27	0.31	1.38	1.90	Grab sample of stock-pile of upper or eastern horizon.
4024	3719	0.03	0.042	0.40	0.17	Grab sample of piled ore of lower or western horizon.
4025	3717	1.81	2.45	3.07	1.60	Grab sample of stock-pile of upper or eastern horizon. Selected for high-grade carnotite.
4026	3714	0.28	0.30	1.31	8.40	Grab sample of stock-pile of upper or eastern horizon. Darker sandstone with abundant copper minerals.
4027	3715	0.009	0.017	4.88	7.20	Grab sample of probable stockpile of relatively high-grade green vanadium-copper ore associated with 30-ton dump on upper or eastern horizon.
4028	3716	0.36	0.36	1.51	0.80	Selected grab sample of largest workings on lower or western horizon. Visible carnotite, but minor copper. Probably richest material available in this horizon.

_/ Analyses from Riley, L. B. (1946).

Table 24.--Radioactivity data and chemical analyses of the chert bed, Garo uranium deposits. _/

Serial number	Field number	Equivalent uranium (percent)	Uranium (percent)	Copper (percent)	Vanadium oxide (percent)
39552	GG-6	0.011	0.008	---	0.04
39553	GG-7	.010	.007	---	.05
42714	GG-10	.005	.004	0.02	.03
42716	GG-14	.009	.010	.04	---

_/ Analyses by J. N. Rosholt, Jr., E. C. Mallory, Jr., R. G. Havens, A. C. Horr, D. L. Skinner, and A. T. Myers, U. S. Geological Survey.

Mine workings consist of a horseshoe-shaped open cut and two large caved adits which were dug in search of copper.

The country rock in the immediate vicinity of the dike consists of biotite and amphibole schist. The pegmatite dike is about 350 feet long, about 300 feet wide, and is exposed to a depth of 30 feet. It trends N. 15° W. and appears to dip 90 degrees. The pegmatite is obscurely zoned with a core of white quartz, potash feldspar, and muscovite, and a wall zone of finely crystalline quartz, potash feldspar, muscovite, and biotite.

Radioactivity measurements made on the outcrop indicate that the minerals associated with some of the books of muscovite are radioactive, but they form a very small fraction of the dike. The radioactivity of the rest of the dike is negligible. A sample of muscovite books contained a weathered, dark brown, heavy mineral that assayed 0.29 percent equivalent uranium and 0.11 percent uranium.

Lone Pole copper mine.—The Lone Pole copper mine (245), in sec. 21, T. 15 S., R. 73 W., is located high on the north wall of Thirty-one-mile Creek. The mine road leaves the Black Mountain road at the top of a hill 1.0 mile west of the Gene Rowe ranch. It was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of three shafts. The country rock consists of granite, anthophyllite schist, rhyolite porphyry, volcanic breccia, and siliceous limestone. The mine was flooded at the time of Brill's visit but according to the owner, Mr. Dean, the ore consists of chalcopyrite, sphalerite, galena, silver, and gold in veins near the junction of the anthophyllite schist and rhyolite dike.

The radioactivity of the rhyolite dike is equivalent to 0.003 percent uranium.

Meyers' Ranch mine.—The Meyers' Ranch mine (246), in sec. 31, T. 14 S., R. 73 W., is on a knoll 1,000 feet west of Colorado Highway 9 near the fence between the Meyers and Rathburn ranches, about six miles by road north of Guffey. The mine was examined by K. G. Brill, Jr., in 1947.

The mine workings consist of five irregular cuts and two drifts.

The country rock is a red granite gneiss. The pegmatite dike is about 300 feet long, about 70 feet wide, and is exposed to a depth of 50 feet. Near the center, the dike is shattered and fissured in a shear zone. It is distinctly zoned having a core of white and rose quartz and microcline; an intermediate zone of quartz, muscovite, albite, beryl, garnet, and columbite; and a wall zone of quartz, microcline, muscovite, and plagioclase.

Radioactivity measurements made on the outcrop indicate that the radioactivity of the pegmatite is negligible. A sample of muscovite, however, contains 0.033 percent equivalent uranium and 0.012 percent uranium.

Routt County

Location and general features

Routt County is in the northwest part of Colorado. Steamboat Springs, on the eastern side of the county, is the county seat.

The Park Range covers the eastern section of the county, the Elkhead Mountains trend east-west across the northern part, and the Williams Fork

Mountains project into the southeast corner. The Yampa River starts in the southern neck of the county, flows northward and then westward into Moffat County.

The radioactive deposits of Routt County are in pegmatites and in disseminations in contact zones between granite gneiss and schist. None of the deposits are, however, believed to be of commercial importance at the present time.

Fair-U claims.—The Fair-U claims Nos. 1 and 2 (247) are in sec. 12, T. 6 N., R. 84 W., about five road miles from Steamboat Springs. The property can be reached by road and trail along Fish Creek and North Fork of Fish Creek. The claims are owned jointly by Jack Hoskinson of Steamboat Springs, Colorado, and Norman A. Hoskinson of Oak Creek, Colorado. The claims were examined by E. P. Beroni and F. A. McKeown in August 1950. At the time of the examination, the claims were developed by two prospect pits (Beroni and McKeown, 1952).

The claims are situated in an alpine-glaciated area of Precambrian migmatite. The rocks in the vicinity consist of hornblende and biotite schists interlayered with and crosscut by granitic bodies. In general, the contacts between the schist and granitic rocks are gradational. The granitic rocks are commonly in the shape of elongated pods, up to 100 feet in length, and are conformable with the foliation of the schist. The foliation of the schist and alinement of the bodies of granitic rocks trends northeasterly and dips 50°-75° NW. Drag folds, fracture and flow cleavage, and slickensides are common, but the relationships of these structural features to uranium occurrence is not apparent.

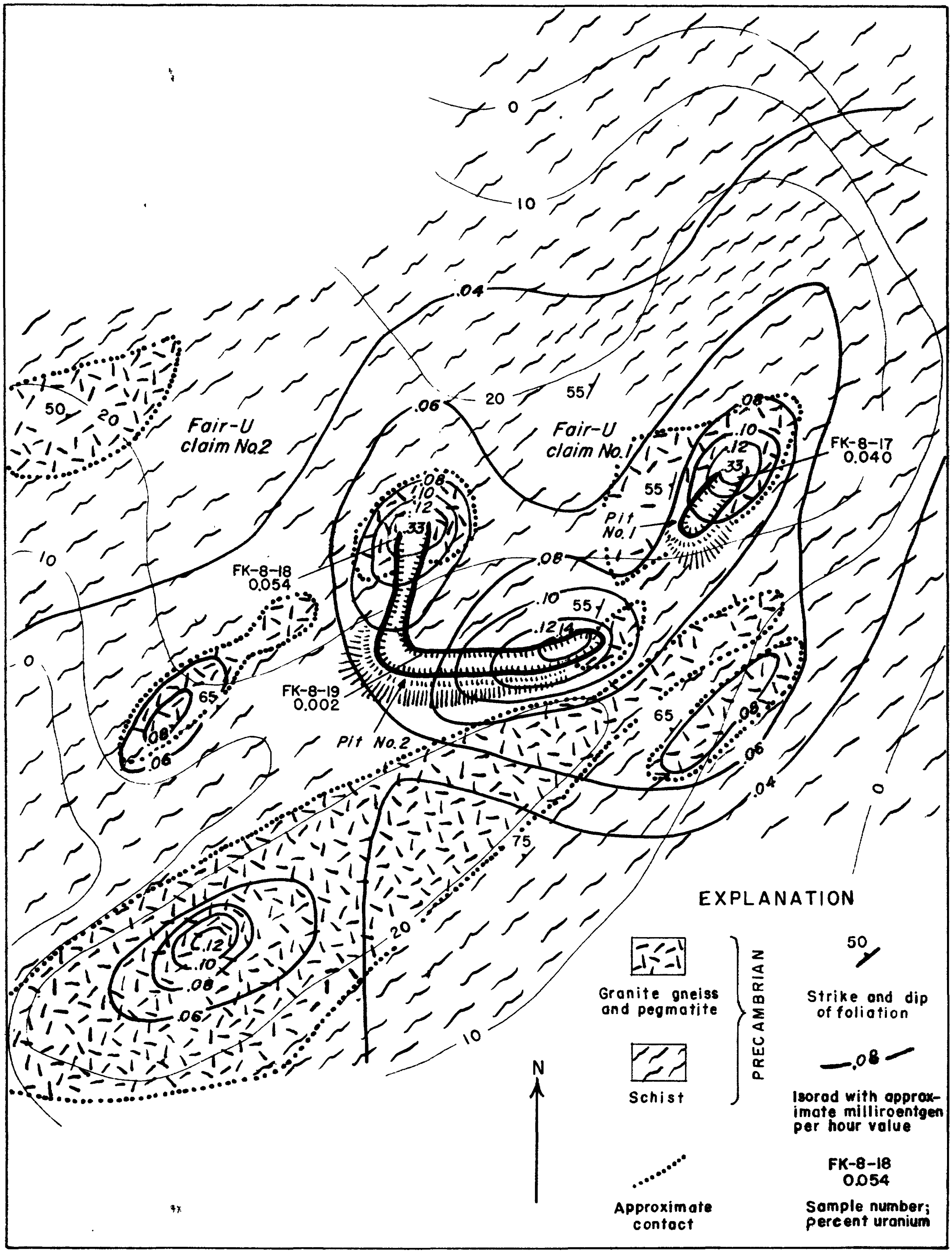
The uranium mineral autunite and an unidentified yellow-green to yellow-orange mineral are sparsely disseminated in the granitic rocks near the contacts with schist. The radioactive zones are pod-shaped, from one to 20 feet in length, and generally occur along the gradational contacts between the granitic rocks and schist (fig. 28). Abnormal radioactivity and secondary uranium minerals are also localized on biotite folia and in minute fractures in feldspar. Three samples of the most radioactive rock contained 0.04 percent, 0.054 percent, and 0.002 percent uranium.

E. C. Ellis property.—The E. C. Ellis property (248), in T. 10 N., R. 83 W., Slavonia district, is three miles northeast of Slavonia. It was examined by E. P. Beroni and F. A. McKeown in September 1950 (Beroni and McKeown, 1952).

The mine workings on the property consist of four prospect pits. The radioactive deposits consist of uranium-bearing quartz-feldspar-mica pegmatites in Precambrian granite gneiss and hornblende and biotite schist. The pegmatites cut and follow the banding of Precambrian granite gneiss. Allanite or euxenite with yellow and orange secondary gummite minerals, hematite, and magnetite were identified in the pegmatites. Large crystals of uraninite have been reported from the pegmatites on the Ellis prospect. Small quantities of scrap mica are reported to have been produced from this property.

New Greenville mine.—The New Greenville mine (249), in sec. 35, T. 9 N., R. 85 W., is two miles by road southeast of Clark, Colorado. The mine was examined by F. A. McKeown and E. P. Beroni in September 1950.

The mine workings consist of an adit approximately 500 feet long.



Mapped by E.P. Beroni and F.A. McKeown, 1950

FIGURE 28 — GEOLOGIC SKETCH AND ISORAD MAP OF THE FAIR-U CLAIMS, ROUTT COUNTY, COLORADO

10 5 0 20 FEET

Contour interval 10 feet

The mine exploits a quartz vein containing chalcopyrite and sphalerite with small quantities of pyrite. The country rock in the vicinity of the New Greenville mine is Precambrian gneiss and pegmatite.

Radioactivity amounting to about twice background was noted along iron-stained fractures in the wall rocks of the vein. The radioactivity of the fracture zone is estimated to be about 0.002 percent equivalent uranium.

Elkhorn mine.—The Elkhorn mine (250), in sec. 20, T. 12 N., R. 85 W., is in the extreme northern part of Routt County about one mile south of the Colorado-Wyoming line. The locality was examined for radioactivity by F. A. McKeown and E. P. Beroni in September 1950.

The extent of the workings are unknown, as the adit is caved at the portal, but presumably some sulfide ore has been mined from this vein deposit as an ore bin remains on the property.

The country rock in the vicinity of the Elkhorn mine is Precambrian hornblende gneiss and greenstone, and Tertiary (?) diabase. Ore minerals identified from material in the ore bin include galena, sphalerite, chalcopyrite, pyrite, and bismuthinite (?).

No radioactivity above background was observed at the Elkhorn mine.

Tom Thumb mine.—The Tom Thumb mine (251), in sec. 9, T. 10 N., R. 85 W., is on the southwestern slope of Hahns Peak, about two miles southeast of Columbine Post Office. The dumps at the mine were examined for radioactivity by F. A. McKeown and E. P. Beroni in September 1950. Mine workings consist of two tunnels (caved) each about 200 feet long, and short winzes and stopes.

The wall rocks at the mine are white and gray weathered rhyolite porphyry of probable Tertiary age. The deposit consists of a mineralized breccia zone in the rhyolite porphyry. Rhyolite breccia containing galena that fills fractures and coats fragments of porphyry comprises the ore material on the dumps.

No abnormal radioactivity was detected on the dumps.

Royal Flush mine.--The Royal Flush mine (252), in the NE¼ sec. 8, T. 10 N., R. 85 W., is three-fourths of a mile west of Hahns Peak, and 1½ miles southeast of Columbine.

The mine dumps were examined for radioactivity by E. P. Beroni and F. A. McKeown on September 2, 1950. The mine workings, inaccessible at the time of the examination, consist of an adit about 1,000 feet long with a 100-foot long drift at the bottom of a 60-foot winze.

The country rocks consist chiefly of silicified Dakota sandstone, and rhyolite porphyry dikes. Pyrite and chalcopyrite in fault gouge were observed on the dumps.

No abnormal radioactivity was detected in the country rock or vein material on the dumps.

San Miguel County

Location and general features

San Miguel County is in southwest Colorado. Telluride, on the eastern edge of the county, is the county seat.

The San Juan, the Uncompahgre, and the San Miguel Mountains cover the east and southeast part of the county. The rest of the county contains the Uncompahgre Plateau. Altitudes range from over 14,000 feet in the mountains to less than 6,000 feet along the Dolores River in the western part of the county. The Dolores River in the west and the San Miguel River in the east flow northward across the county. Most of the county is inaccessible.

One deposit near Placerville was examined for radioactivity.

Weatherly prospect (Evans claims).—The Weatherly prospect (253), also known as the Evans claims, in sec. 27 ?, T. 44 N., R. 11 W., is about one mile northwest of Placerville. The prospect was examined by J. W. Adams on August 31, 1950. Mine workings at the prospect consist of a 40-foot inclined shaft, 150 feet of adit, and several small pits.

The country rocks are limestone, shale, and sandstone of the Triassic Dolores and Cutler formations. The radioactive deposit consists of a Tertiary carbonate vein occupying a fault zone, and replacement pockets in metamorphosed limestone adjacent to the fault zone.

Minerals identified in the deposit include: uranium (pitchblende ?) in hydrocarbon, chalcocite, pyrite, tetrahedrite, galena, sphalerite, autunite, malachite, azurite, and erythrite, in a gangue of calcite, dolomite, and barite.

Samples of the uraniferous hydrocarbon contain as much as 0.71 percent uranium.

Summit County

Location and general features

Summit County is in central Colorado northwest of Park County. Breckenridge, in the southeast corner, is the county seat.

The county is generally mountainous; the Blue River flows northeast for the length of the county. Altitudes range from over 14,000 feet in the mountains to less than 8,000 feet on the Blue River. Most of the county is inaccessible by road.

One vein deposit was examined for radioactivity in this county.

<u>King Solomon mine</u>.--The King Solomon mine (254), in sec. 4, T. 6 S., R. 78 W., is on the east side of Ten Mile creek two miles southwest of Frisco. The first 600 or 700 feet of the mine was examined for radioactivity by R. U. King in company with D. F. Kent on January 10, 1950. Later, during September 1950 when the entire mine was made accessible by complete ventilation, samples of vein material were collected by D. F. Kent for radiometric analysis.

The mine consists of an adit bearing S. 10° E. for 5,728 feet, nine cross cuts totaling about 2,500 feet at intervals along the adit, and a moderate amount of stoping above the adit level.

The country rocks consist of Precambrian monzonite gneiss, hornblende-biotite gneiss, pegmatite, and chlorite schist. Gold- and silver-bearing quartz-pyrite veins that contain copper, lead, and zinc sulfides are exploited by the King Solomon mine.

A pegmatite dike in one place contained 0.03 to 0.04 percent beryllium oxide. Analysis of 50 samples of vein material collected in the adit and crosscuts, indicate the radioactivity of the veins is equal to a content of from 0.001 to 0.005 percent equivalent uranium.

A radiometric traverse of the first several hundred feet of the adit indicates that the wall rocks are not abnormally radioactive.

Teller County

Location and general features

Teller County is directly west of Colorado Springs in south-central Colorado. The famous gold mining town of Cripple Creek is the county seat and is about 35 miles west of Colorado Springs.

Altitudes range from about 7,000 feet in the northern part of the county to more than 12,000 feet on the shoulders of Pikes Peak. Tributaries of the Arkansas and South Platte rivers drain the area.

Most of Teller County is occupied by the Pikes Peak granite batholith of Precambrian age. In and around the Cripple Creek mining district in the southern part of the county Tertiary volcanic rocks are abundant.

A vein deposit in the Cripple Creek district and a pegmatite near Lake George were examined for radioactivity. The phonolite of the Cripple Creek district is the most radioactive rock in the area; the radioactivity ranges from 0.007 to 0.011 percent equivalent uranium. The uranium content of phonolite ranges from about 0.002 to 0.003 percent.

<u>Fluorine mine</u>.—The Fluorine mine (255) is in sec. 1, T. 15 S., R. 70 W., Cripple Creek district. It was examined by V. R. Wilmarth and D. H. Johnson in October 1950.

The mine workings consist of a large open cut and several shafts.

The deposit is of the replacement type at the contact between phonolite and breccia. This gold-silver mine also contains abundant manganese and iron staining. A sample of altered phonolite contained 0.007 percent equivalent uranium and 0.003 percent uranium. Manganese-bearing rock from the open cut contained 0.009 percent equivalent uranium and 0.005 percent uranium.

Gem mine (formerly Crystal Peaks). --The Gem mine (256), in sec. 12, T. 12 S., R. 71 W., is reached by a gravel road which leaves U. S. Highway 24 to the north, 0.3 mile west of Lake George. It was examined in 1947 by K. G. Brill, Jr.

The mine workings consist of an open cut about 60 by 60 feet.

The country rock consists of granite gneiss. The pegmatite dike trends northwest and is not clearly zoned. It consists chiefly of quartz, potash feldspar, amazonstone, and biotite.

The radioactivity of the dike near the center is equivalent to about 0.004 percent uranium.

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