Uranium in the Copper King Mine, Black Hawk No. 1 Claim, Larimer County, Colorado

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Trace Elements Memorandum Report 128-A

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

MAY 9 1951

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Raw Materials Operations
U. S. Atomic Energy Commission
P. O. Box 30, Ansonia Station
New York 23, New York

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Sincerely yours,

W. H. Bradley
Chief Geologist

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UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

URANIUM IN THE COPPER KING MINE, BLACK HAWK NO. 1 CLAIM, LARIMER COUNTY, COLORADO

by

Harry C. Granger

and

Robert U. King

April 1951

Trace Elements Memorandum Report 128-A

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By

Harry C. Granger

and

Robert U. King

ABSTRACT

Radioactive rock was discovered on the dump of the Copper King mine, sec. 8, T. 10 N., R. 72 W., Larimer County, Colo., in the summer of 1949. The mine had been prospected intermittently for copper and zinc since 1916, but there is no record that ore was produced. The country rock is pre-Cambrian granite containing many schist inclusions and narrow pegmatite dikes.

Pitchblende disseminated in chlorite and sulfides was deposited in an obscure vein system during an intermediate stage of mineralization. This stage was preceded by biotitic alteration of amphiboles and sulfide deposition. The latest stage of mineralization is represented by the limonitic dense quartz vein followed during mining. The uranium-bearing vein is about 2-3 feet wide and the dense quartz vein is less than 6 inches wide. Both veins are bordered by 1-3 feet of biotite- and sulfide-bearing granite and amphibole schist. The uranium content of 26 samples taken in the mine and on the dump ranges from 0.002 to 1.40 percent. These samples contained as much as 2.97 percent copper and 5.96 percent zinc.

The general outlook for further prospecting near the Copper King shaft is not favorable, because much of the immediately surrounding area has been thoroughly investigated without finding abnormal radioactivity. The most favorable environment for concentration of uranium minerals appears to have been in or near schist inclusions in granite, and further exploration in nearby prospects may result in the discovery of other unranium-bearing deposits. In the Copper King mine, additional exploration would aid in determining the extent of the uranium-bearing material.

INTRODUCTION

Radioactive rock was discovered on the dump of the Copper King mine (fig. 1), in the summer of 1949 by the present owners. A. H. Brown, Livermore, Colo., and H. G. Ismert, Huntington Park, Calif. The mine is on the Black Hawk No. 1 claim in sec. 8, T. 10 N., R. 72 W., 6th principal meridian, Larimer County, Colo. It may be reached by driving northward from the Cache La Poudre River to Rustic for about 12 miles to Red Feather Lakes, then 10 miles northeastward. The mine is about 75 feet northwest of the road on the southwestern edge of Prairie Divide, a high, rolling area underlain by granite. Prairie Divide is at an altitude of about 8,000 feet and probably is inaccessible during part of the winter.

At the request of Messrs. Brown and Ismert, the locality was briefly examined for uranium by the writers on August 30 and 31, 1949, as part of the Colorado Front Range project of the U. S. Geological Survey. During September 1949 the surface was mapped on a scale of

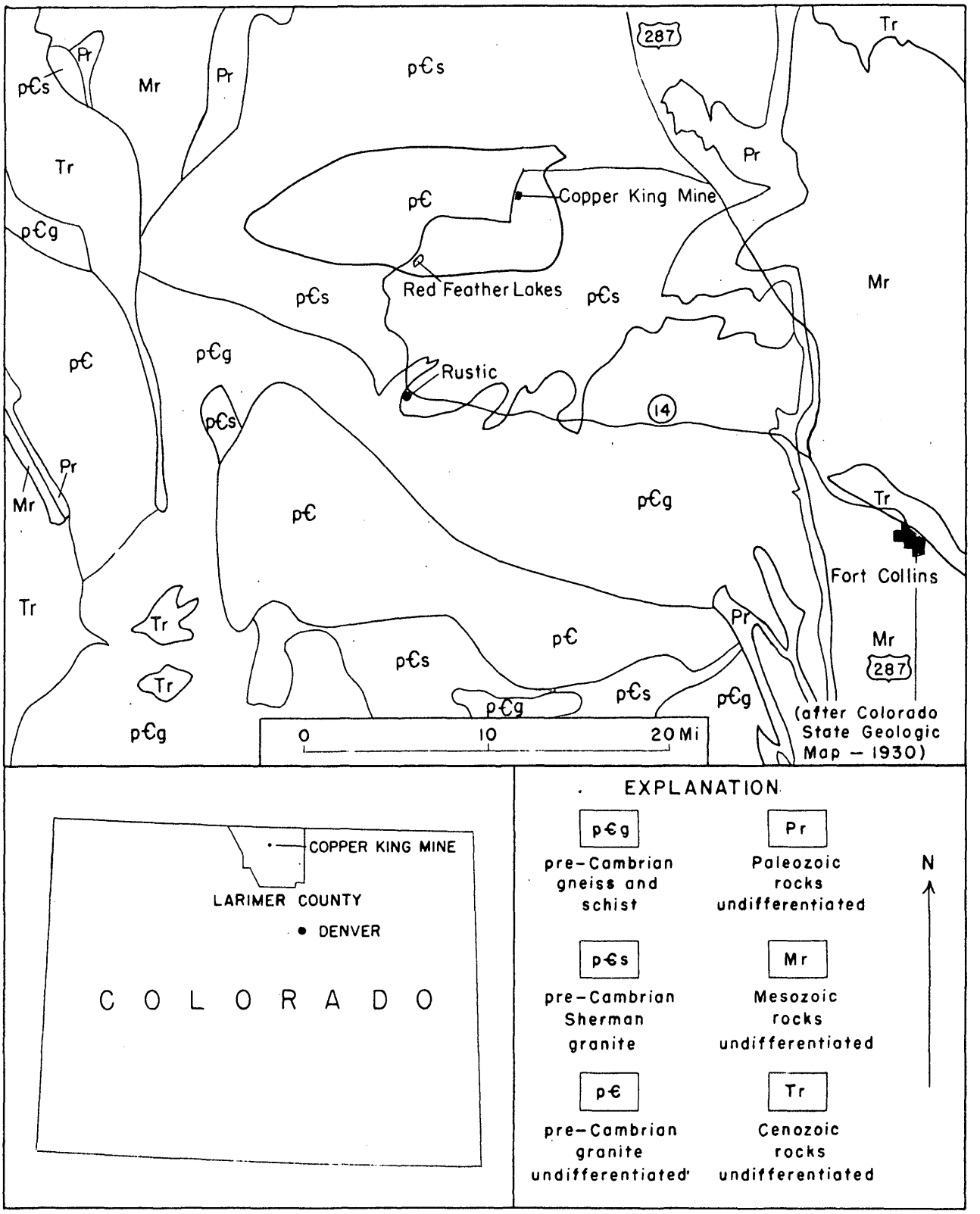


FIGURE 1. — INDEX MAP, COPPER KING MINE, LARIMER COUNTY, COLORADO.

1 inch equals 300 feet (fig. 2) and, when the shaft was subsequently dewatered, the 60-foot level was sampled and mapped on a scale of 1 inch equals 5 feet (fig. 3). Twenty-six samples _/ of rock were taken

_/ Granger, H. C., and King, R. U., Report of factual data obtained during examination of Copper King shaft, Black Hawk claim No. 1, Larimer County, Colorado: U. S. Geol. Survey Trace Elements Memorandum Rept. 128, 1950.

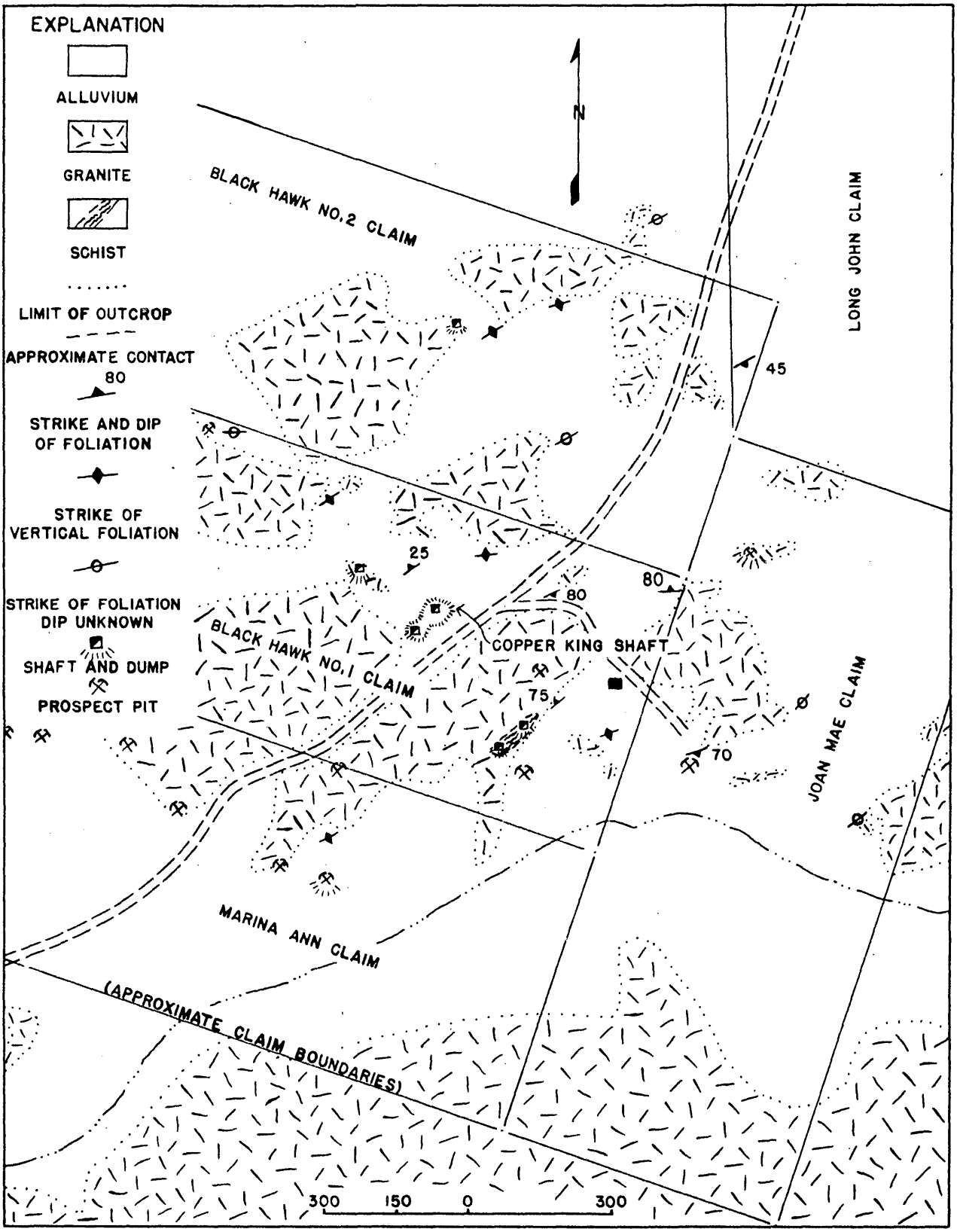
from the mine and dump, and three samples of water were collected during the dewatering of the mine.

George Phair of the Geological Survey's Washington laboratory assisted the writers in mapping on the Black Hawk No. 1 and adjoining claims and also made a mineralogical study of specimens collected from the Copper King dump. J. W. Adams of the Geological Survey made a study of the mineral assemblage in specimens collected during sampling of the mine.

HISTORY AND MINE DESCRIPTION

The Copper King mine and four nearby shafts originally were sunk in exploring for copper and zinc during World War 1. No ore is known to have been shipped prior to 1920, when a carload of low-grade ore was shipped. This carload failed to pay the cost of milling and the mines were abandoned. In 1936 Richard Kyle of Idaho Springs, Colo. worked the Copper King mine briefly for zinc but found no ore of economic grade.

In summer of 1949 Brown and Ismert prospected the Copper King mine dump and found it to be highly radioactive. They filed claim on



GEOLOGY BY H. C. GRANGER AND G. PHAIR
1949

FIGURE 2.–GEOLOGIC MAP OF BLACK HAWK CLAIMS, LARIMER COUNTY, COLORADO

the mine on July 14, 1949, naming it the Black Hawk No. 1 claim.

The Copper King mine consists of a single-compartment vertical cribbed shaft 65 feet deep, and one level. The level extends 98 feet east and 11 feet west from the shaft.

GEOLOGY

The rocks exposed near the Copper King mine are predominantly medium-grained biotite granite of pre-Cambrian age. The crushed and elongated quartz and feldspar produces an obscure foliation in the granite which, near inclusions of schist, is emphasized by the presence of biotite flakes and layers. The strike of the planar foliation ranges from N. 40° E. to N. 85° E., averages about N. 60° E. and has a nearly vertical dip. Amphibole-and biotite-schist inclusions in granite crop out in areas less than 10 feet across and 30 feet long. These inclusions have irregular contacts, some of which are parallel to the foliation. In the mine the schist is composed mainly of anthophyllite and actinolite. Near the veins much of the amphibole has been altered to biotite by hydrothermal solutions.

Irregular pegmatite dikes, less than 6 inches thick, cut the schist and granite parallel to the foliation. The pegmatites observed at the surface are composed predominately of quartz and pink feldspar but in the mine several 4-inch dikes contain a greenish feldspar, quartz, and biotite.

MINERAL DEPOSITS

The 60-foot level of the Copper King mine follows a well-defined fissure vein, as much as 6 inches wide, filled with hydrous iron oxides, clay minerals, and in places, dense quartz. This vein trends about N. 80° W. and has a steep dip, generally to the south. Locally the strike ranges from nearly due west to N. 65° W. At 28 feet east of the shaft a branch vein strikes N. 75° E. and at 92 feet east of the shaft another vein branches N. 75° E.

The wall rock bordering the vein is composed of granite and amphibole schist largely altered and replaced by biotite, pyrite, sphalerite, and chalcopyrite. Apparently the initial stage of mineral deposition was characterized by biotitic alteration of the amphibole schist. The biotite fills fractures in the granite and locally has completely replaced the amphiboles in a zone as much as 8 feet wide. Pyrite is commonly disseminated throughout the biotite, and some is pseudomorphous after anthophyllite.

An intermediate stage of mineralization is represented by minor fracturing, alteration of biotite to chlorite, and deposition of pitchblende, carbonates, and pyrite. Obscure, highly radioactive fracture surfaces, which strike N. 70° W. to N. 87° E. and dip nearly vertically along the north wall about 70 to 78 feet east of the shaft, show no apparent relationship to the vein followed during mining.

The vein extending the full length of the drift represents the last period of mineralization, and may be a recent re-opening along

the original structure that allowed introduction of the biotite and sulfides. Pitchblende is the last mineral to have been deposited during the second stage and is later than the chlorite, carbonates, and pyrite. Under the microscope it appears to be a very fine-grained opaque black substance, partly disseminated in black gouge, and distributed throughout the chlorite or coating angular grains of pyrite and sphalerite. One thin section, reproduced in figure 4, shows the uranium mineral finely disseminated in chlorite stringers cutting sulfides. The chlorite was probably derived from altered biotite and redeposited as fine veinlets. The black uranium mineral has been definitely identified as pitchblende by George Phair _/ of the Geolo-

_/ Phair, George, Personal communication.

gical Survey, who reports:

"X-ray diffraction powder patterns have been obtained with ignited material which are similar to those given by an ignited standard uraninite having an initial excess of UO_3 over UO_2. The difficulty of obtaining an unambiguous pattern was the only obstacle standing in the way of the positive identification.

"Previously the presence of major amounts of uranium in the black opaque had been confirmed spectrographically. A chemical analysis on the purest material obtainable reported 57.0 percent U_3O_8 and 14.2 percent Fe_2O_3. After due allowance for the 14.2 percent Fe_2O_3, most of which was known to be present in the sample

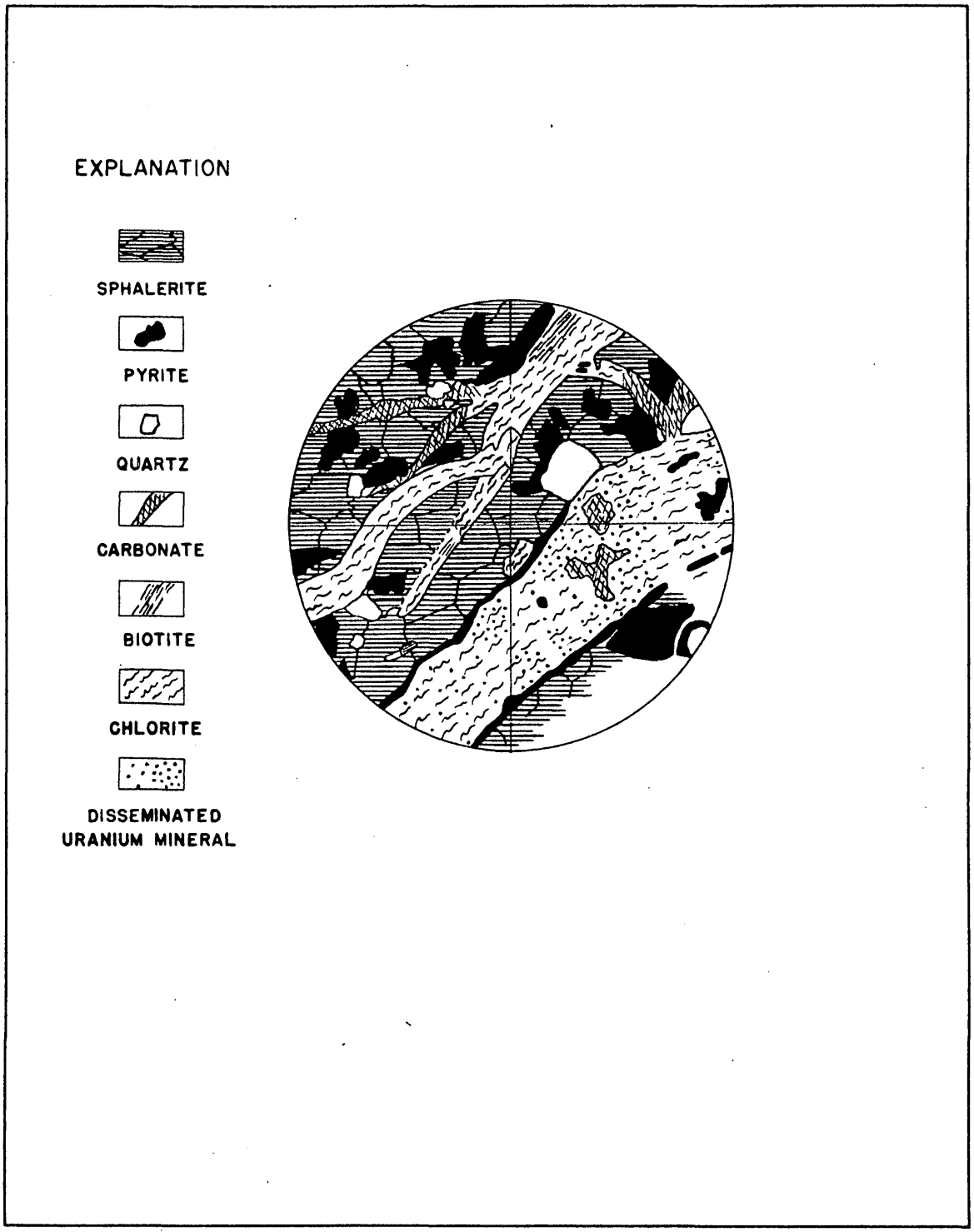


FIGURE 4.—CAMERA LUCIDA DRAWING OF A THIN SECTION OF URANIUM-BEARING ROCK, COPPER KING MINE, LARIMER COUNTY, COLORADO. 20X

as hydrated iron oxides, the U_3O_8 content recalculated to 100 percent is 66.6 percent a figure well within the range of U_3O_8 contents shown by pitchblendes from different areas.

"A study of six thin sections including two polished thin sections, and 10 polished sections showed that the pitchblende formed, (1) minute disseminations in "gouge" (2) veinlets cutting other ore minerals, and (3) colloform coatings on brecciated pyrite and chalcopyrite. Further details on the paragenesis of the ore minerals and on the identification of the pitchblende will be given in a forthcoming report."

The uranium-bearing zone at 70 to 78 feet east of the shaft is probably about 3 to 4 feet wide and diverges from the 1st level with a strike of N. 75° W. and a nearly vertical dip.

Rock at 54 feet east of the shaft also has a relatively high uranium content (table 1), but no abnormal radioactivity was recorded at the time of the examination so the trend and size of this deposit is not known.

SAMPLING AND GRADE

Radioactivity measurements were made on the dump of the Copper King mine with a Beckman MX-5 beta-gamma counter. Average radioactivity one foot above the surface of the dump registered about 4 divisions on the 2.0 scale compared to a normal background reading of 5 divisions on the 0.2 scale. Locally the radioactivity was greater and

selected specimens registered as much as 20 divisions on the 20 scale when held in contact with the probe.

A radiometric traverse was made of the mine. The probe was swept slowly across the back and down each wall at intervals in the east drift. The average readings are shown in table 2. The relatively high readings recorded at 5 and 15 feet east of the shaft are caused partly by a pile of waste rock containing radioactive material. Readings taken at 70 to 78 feet east of the shaft seemingly are low compared to the high uranium content of samples RUK-14-199 and RUK-14-201. This is because the uranium distribution is spotty and the readings are averages for several feet of surface. Readings as high as 20 divisions on the 20 scale were recorded locally. No abnormal radioactivity was noted at 54 feet east of the shaft although a sample containing 0.18 percent uranium was collected there.

The dump, underground workings, and standing water in the Copper King shaft were sampled and assayed at the Denver laboratory of the Geological Survey.

Twenty-three channel samples were cut along the east drift on the 60-foot level of the mine (table 1). All samples were cut either across the back or down the walls of the drift, except samples RUK-14-210 and RUK-14-211 which were cut horizontally at knee height across the east face of the drift.

Nearly all the samples contain an abnormal amount of uranium, probably because of soluble uranium absorbed on, or replacing, hydrous

Table 1.--Results of sampling, Copper King mine, Larimer County, Colorado.

Sample number	Distance east of shaft (feet)	Location 1/	Length of sample (feet)	Material	Equivalent uranium (percent)	uranium (percent)	copper (percent)	zinc (percent)
RUK-14-117	---	Dump of Copper King shaft.	---	Grab sample of fines.	0.044	0.006	---	---
-178	---	Dump of Copper King shaft.	---	Selected high-grade sample.	1.39	1.23	---	---
-189	14	Back.	8	Biotite, amphibole pyrite, granite.	0.044	0.017	1.13	0.70
-190	24	Back.	3.5	Amphibole, biotite, pyrite.	0.022	0.025	0.60	0.50
-191	34	Back.	3.5	Granite, biotite, pyrite.	0.047	0.031	0.66	0.50
-192	44	Back.	3	Granite, biotite, pyrite.	0.021	0.007	0.05	0.80
-193	54	Back.	3	Quartz, pyrite.	0.18	0.18	0.42	0.65
-194	64	Back.	3	Quartz, sphalerite, pyrite, biotite.	0.011	0.008	1.43	5.76

Table 1.--Results of sampling, Copper King mine, Larimer County, Colorado--Continued.

Sample number	Distance east of shaft (feet)	Location1/	Length of sample (feet	Material	Equivalent uranium (percent)	Uranium (percent)	Copper (percent)	Zinc (percent)
RUK-14-195	69	North wall.	4.5	Pyrite, sphalerite, biotite, quartz.	0.006	0.003	1.34	5.96
-196	69	Back.	3	Pyrite, biotite, sphalerite.	0.036	0.021	0.27	1.60
-197	69	South wall.	4.5	Granite, sphalerite, pyrite.	0.006	0.004	0.47	4.89
-198	71.5	North wall.	4.5	Granite, sphalerite, biotite, pyrite.	0.012	0.005	0.10	1.15
-199	71.5	Back.	3	Granite, pyrite, sphalerite.	0.16	0.16	0.94	1.30
-200	71.5	South wall.	4.5	Granite, biotite, sphalerite.	0.006	0.004	0.39	1.25
-201	74	North wall.	4.5	Pyrite, biotite, sphalerite.	0.45	0.50	0.79	0.81
-202	74	Back.	3	Pyrite, quartz, sphalerite.	0.015	0.005	0.88	1.20

Table 1.--Results of sampling, Copper King mine, Larimer County, Colorado--Continued.

Sample number	Distance east of shaft (feet)	Location 1/	Length of sample (feet)	Material	Equivalent uranium (percent)	Uranium (percent)	Copper (percent)	Zinc (percent)
RUK-14-203	74	South wall.	4.5	Granite, biotite, pyrite.	0.020	0.007	1.72	0.98
-204	76.5	North wall.	4.5	Biotite, quartz, pyrite, amphibole.	0.007	0.005	2.97	1.05
-205	76.5	Back.	3.	Granite, pyrite, sphalerite.	0.005	0.008	0.77	1.12
-206	76.5	South wall.	4.5	Granite, quartz.	0.004	0.002	0.55	0.35
-207	79	Back.	3.5	Granite, biotite, quartz.	0.004	0.004	0.41	0.55
-208	84	Back.	4	Garnite, biotite, pyrite.	0.008	0.005	0.86	0.70
-209	92	Back.	4	Granite, pyrite, biotite.	0.014	0.008	0.33	0.60
-210	98	Face.	5	Pegmatite, granite, biotite, pyrite.	0.006	0.003	2.31	0.85
-211	98	Face.	2.5	Amphibole, granite, pyrite, biotite.	0.003	0.002	1.14	0.45

Table 1.--Results of sampling, Copper King mine, Larimer County, Colorado--Continued.

Sample number	Distance east of shaft (feet)	Location 1/	Length of sample (feet)	Material	Equivalent Uranium (percent)	Uranium (percent)	Copper (percent)	Zinc (percent)
RUK-14-212	---	Dump of Copper King shaft.	---	Composite sample.	0.15	0.009	0.27	0.90

1/ Figures indicate distance in feet east of shaft in the 60-foot level drift.

Note: No silver or gold was detected by fire assay.

No lead was found by the usual chemical analysis.

Table 2.--Radioactivity in the Copper King mine, Larimer County, Colorado.

Distance east from shaft (ft.)	Location in drift	Average reading 1/	Distance east from shaft (ft.)	Location in drift	Average reading 1/
5	North wall.	10	40	North wall.	8
	Back.	11		Back.	5
	South wall.	14		South wall.	5
15	North wall.	6	45	North wall.	4
	Back.	7		Back.	4
	South wall.	7.5		South wall.	3
25	North wall.	3	50	North wall.	4
	Back.	3		Back.	4
	South wall.	3.5		South wall.	4
30	North wall.	7	55	North wall.	4
	Back.	2.5		Back.	4
	South wall.	4.5		South wall.	4
35	North wall.	5.5	60	North wall.	3.5
	Back.	4.5		Back.	3
	South wall.	4.5		South wall.	3

Table 2.--Radioactivity in the Copper King mine, Larimer County, Colorado--Continued.

Distance east from shaft (ft.)	Location in drift	Average reading 1/	Distance east from shaft (ft.)	Location in drift	Average reading 1/
65	North wall.	3	80	North wall.	4
	Back.	3		Back.	5
	South wall.	2.5		South wall.	3
70	North wall.	3.5	85	North wall.	3
	Back.	6		Back.	2.5
	South wall.	6		South wall.	3
72.5	North wall.	10	90	North wall.	2.5
	Back.	8		Back.	2.5
	South wall.	8		South wall.	3
75	North wall.	5			
	Back.	12			
	South wall.	7			
77.5	North wall.	5			
	Back.	7			
	South wall.	5			

1/ Scale divisions on the 2.0 scale of a Beckman Mx-5 beta-gamma counter with probe 1 inch from surface.

iron oxides. Three samples contain over 0.10 percent uranium. Two of these, RUK-14-199 and RUK-14-201, were taken in the zone between 70 and 78 feet east of the shaft. The other, taken at 54 feet east of the shaft, may represent an extension of this zone or may be a small isolated deposit not directly connected with the larger more definite radioactive vein. Assays of other samples were as low as 0.002 percent uranium. Copper content ranged from 0.05 to 2.97 percent and zinc from 0.35 to 5.96 percent.

Two selected samples from the dump, submitted to the U. S. Atomic Energy Commission by the mine owners, assayed 0.30 and 1.40 percent uranium. Three samples were collected on the dump by the writers. A selected sample contained 1.23 percent uranium; a sample of fine sandy material contained 0.006 percent uranium, and a composite sample from 9 places on the dump contained 0.009 percent uranium.

Three samples of water were taken during the dewatering of the mine. Samples taken when the water stood 39 and 50 feet from the collar of the shaft assayed 390 and 230 ppm uranium oxide in the sediment, respectively, and 0.9 and 1.44 ppm uranium oxide in the filtrate, respectively. A sample of fresh water accumulating in the sump at the bottom of the shaft shortly after dewatering contained 0.8 ppm uranium.

SUGGESTIONS FOR PROSPECTING

The general outlook for further prospecting near the Copper King shaft is not favorable, because much of the immediately surrounding area has been thoroughly investigated without finding abnormal radioactivity. It is believed, however, that the most favorable environment for concentration of uranium minerals was in or near schist inclusions in the granite country rock, and further exploration in nearby prospects may result in the discovery of other uranium-bearing deposits.

Although the size of the uranium ore body cannot be predicted it is possible that additional uranium-bearing material may occur along a vein extending S. 75° E. from a point on the north wall about 74 feet east of the shaft on the 60-foot level. Exploration both above and below the level on this vein might discover ore. A small stope opened at 54 feet east of the shaft, would aid in determining the extent of the uranium-bearing material represented by sample RUK-14-193.