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IN REPLY REFER TO:
G-TEPCO

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

AEC-379/6

Mr. Ernest E. Thurlow, Chief
Salt Lake Exploration Branch
Division of Raw Materials
U. S. Atomic Energy Commission
P. O. Box 2196
Salt Lake City, Utah

Dear Ernie:

Joe Hosted has asked us to send you a copy of TEI-24 and TEM-42, in response to your memorandum of November 22, 1955 (SLEB:EET:af).

I enclose a copy of TEM-42, and a quotation from TEI-24. The quoted material is the only information on the subject of dry lake beds of California in TEI-24. We do not have a copy of the map referred to in TEM-42.

Sincerely yours,

Lincoln R. Page
Assistant Chief Geologist

Enclosures

Copy to: J. O. Hosted, DRM

When separated from enclosures, handle this document as Unclassified
(Insert proper classification)

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Document(s) transmitted herewith contain(s) classified DEFENSE INFORMATION.

Excerpt from TEI-24, first paragraph, page 18. - Title: Reconnaissance Investigations for Trace Elements in Utah, Colorado, Nevada, California, and Oregon - Preliminary Report - by C. W. Chesterman and F. H. Main - June 1947

"Saline deposit at Searles Lake, California

Searles Lake, a dry desert playa made up of crystalline salts, is in the northwest corner of San Bernardino County, California (fig. 9, locality C-41). Tests made on well cores, which usually consist of a mixture of halite (NaCl), trona ($Na_2CO_3.HNaCO_3.2H_2O$), and borax ($Na_2B_4O_7.10H_2O$) indicated low radioactivity. Brines from the pumping wells were found to be only slightly radioactive, also."

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : E. E. Thurlow, Chief, Salt Lake Exploration Branch, Salt Lake City Utah

DATE: December 1, 1955

FROM : Joseph O. Hosted, DRM, Washington

SUBJECT: REQUEST FOR PUBLICATIONS

Information on uranium in dry lake beds of California requested in your memo of November 22, 1955 is being sent direct from U. S. Geological Survey to you.

RECEIVED
DEC 1955
AEC
SALT LAKE CITY, UTAH

RA NO. 63

RECLASSIFICATION AUTHORIZATION

In accordance with the authority delegated to me by memorandum from the General Manager, dated December 6, 1948, subject, "Security Procedures and Policies relating to the Domestic Raw Materials Program" and based on criteria for determining classification, as outlined in Appendix A attached thereto, the documents listed below are reclassified as indicated.

Document and Title Description	Present Classification	Revised Classification
(1) USGS - TEI Report No. 34 "Trace Elements Reconnaissance in Indiana, Illinois, Missouri, Arkansas, and Kentucky" Preliminary Report by John M. Nelson and Edward V. Stratton, dated May 1949	SECRET	UNCLASSIFIED
(2) USGS - TEI Report No. 32 "Placer Deposits of Monazite in North Carolina" Preliminary Report by K. G. Brill, Jr., and G. V. Carroll, dated September 1946	SECRET	UNCLASSIFIED
(3) USGS - TEI Report No. 20 "Trace Elements Reconnaissance in South Dakota and Wyoming" Preliminary Report by A. L. Slaughter and John M. Nelson, dated March 1946	SECRET	OFFICIAL USE ONLY
(4) USGS - TEI Report No. 43 "Radioactivity of Asphaltites, Coals, and Shales in Tennessee, Kentucky, West Virginia, and Pennsylvania" Preliminary Report by J. M. Nelson and K. G. Brill, Jr., dated October 1948	SECRET	UNCLASSIFIED

Feb. 21, 1951

Date

Jesse C. Johnson

Jesse C. Johnson
Manager
Raw Materials Operations

(200)
T67r

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[redacted]

RA No 63

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

TRACE ELEMENTS RECONNAISSANCE IN SOUTH DAKOTA AND WYOMING

PRELIMINARY REPORT

by

A. L. Slaughter and John M. Nelson

March 1946

Trace Elements Investigations - Report No. 20

RA No 63
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BY AUTHORITY OF J. C. Johnson
DATE Feb 21, 1951

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Illustrations

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UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

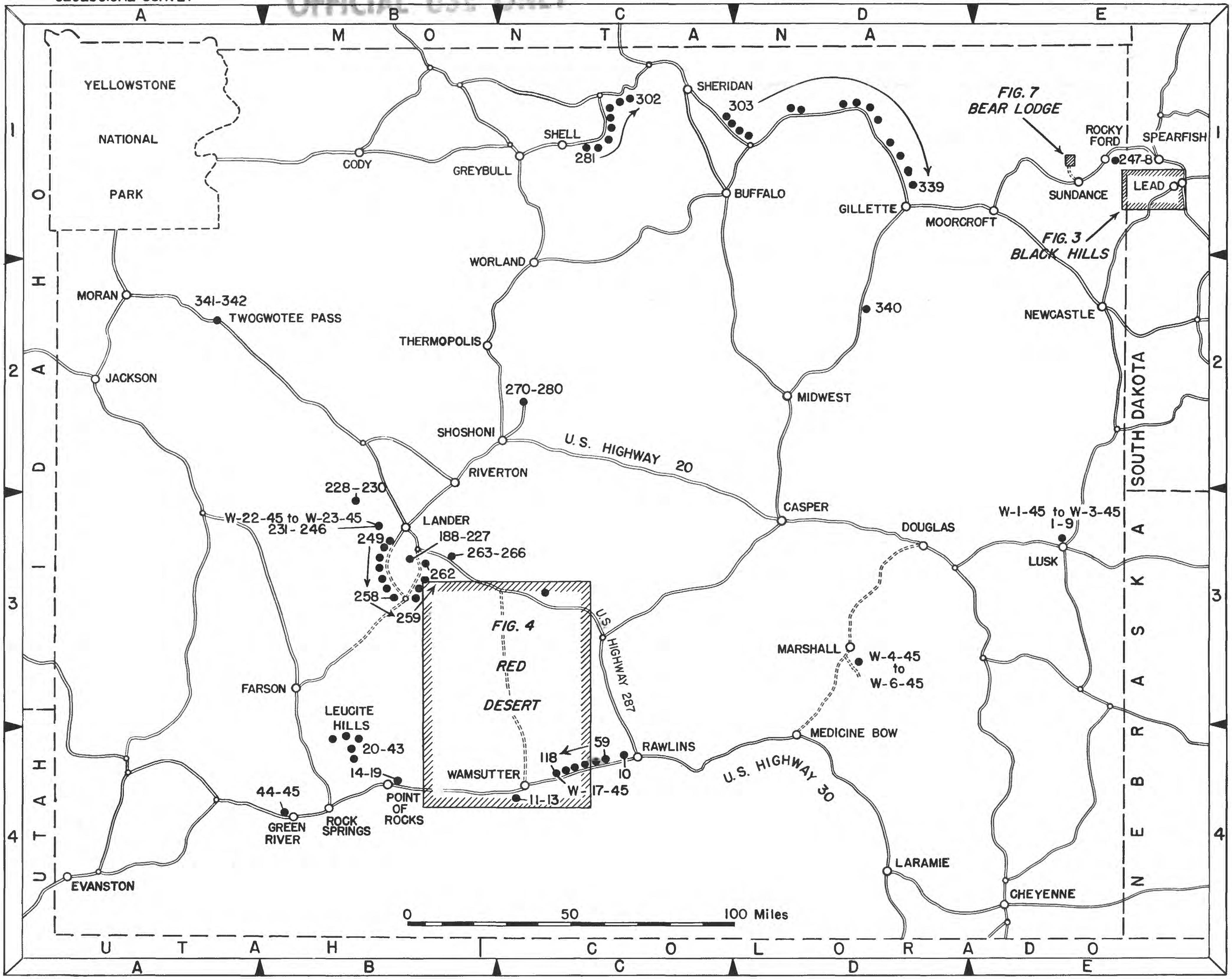

FIG. I INDEX MAP OF WYOMING AND PART OF SOUTH DAKOTA

Field work by A. L. Slaughter
John M. Nelson
June to August, 1945

FINDING LIST

SAMPLES

BH- 1-45 to BH- 6-45	FIG. 3	
BH- 7-45 to BH-16-45	FIG. 7	
BH-17-45 to BH-18-45	FIG. 3	
W- 1-45 to W - 3-45	FIG. I	E3
W- 4-45 to W - 6-45	" "	D3
W - 7-45 to W-21-45	FIG. 4	
W-22-45 to W-23-45	FIG. I	B3

OUTCROPS

1	-	9	FIG. I	E3
10	-	13	"	C4
14	-	45	"	B4
46	-	58	FIG. 4	
59	-	118	FIG. I	C4
119	-	187	FIG. 4	
188	-	246	FIG. I	B3
247	-	248	"	E1
249	-	266	"	B3
267	-	269	FIG. 4	
270	-	280	FIG. I	C2
281	-	302	"	C1
303	-	339	"	D1
340			"	D2
341	-	342	"	A2

EXPLANATION

- ● W-4-45 to W-6-45 Location of samples.
- ● 270-280 Location of outcrops.
- ● W-1-45 to W-3-45 Location of 1-9 samples and outcrops.
- 118 ←— 59 ●●●●●● Location of a series of outcrops.

[redacted]

INTRODUCTION

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The radioactivity of certain rocks in Wyoming and western South Dakota was investigated during the summer of 1945 by A. L. Slaughter and John M. Nelson. The objectives of the work were (1) to examine reported occurrences of radioactive minerals, (2) to investigate more fully the schroeckingerite (dakeite) area in the Red Desert country of south central Wyoming, (3) to test certain rocks which are commonly radioactive and which might offer possible sources of radioactive material, and (4) to test unusual rocks which might contain radioactive material.

Uranium is of principal interest in this work; thorium is of secondary interest.

All work done in South Dakota was in the Black Hills area; work in Wyoming covered much of that state.

MEASUREMENTS OF RADIOACTIVITY

The measurements of radioactivity were made with a Geiger-Mueller counter which measures the rate of gamma ray emission. The field instrument was calibrated against a standard sample containing a known amount of uranium in equilibrium. Periodic checks against the standard sample indicate that the instrument remained in control.

The technical terms used throughout the report are defined as follows:

Radioactivity.—A property of certain elements, which involves the spontaneous emission of alpha particles or of beta particles from the nucleus of the atom. Gamma rays, also of nuclear origin, may accompany or immediately follow the disintegration, but are a by-product of the process.

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Radioactive equilibrium.--A relationship between a radioactive substance and its parent substance, in which at any instant the rate of disintegration of the former is equal to its rate of formation from the latter.

Equivalent uranium or E.U.--The degree of radioactivity of a substance expressed in terms of the percent uranium, in equilibrium, which would produce the same degree of radioactivity. Thus, a rock having a radioactivity of 0.015 percent E.U. exhibits the same degree of radioactivity as a rock known to contain 0.015 percent uranium, but the radioactivity of the former may originate in any radioactive element (thorium, uranium, actinium, etc.) or in any proportion of any radioactive elements.

Four methods were used to determine the radioactivity of the rocks:

1. Car traversing.--The radioactivity of the rocks beneath and alongside of the roads was measured while driving with the Geiger-Mueller tube mounted on the side of the car about 3 feet above the road. This method is the least accurate but was selective enough to locate the more radioactive rocks in the Bear Lodge Mountains, the radioactive coals in the Red Desert, and the radioactive sediments in a small playa. It was generally used while driving over new roads as a scanning method by which any unexpected large and highly radioactive deposit adjacent to the road might be located. Geiger-Mueller counters of greater sensitivity would increase the accuracy and value of the car traverse method.

2. Outcrop tests.--The radioactivity of outcrops was measured by placing the Geiger-Mueller tube on the outcrop for a three-minute interval. The short outcrop tests indicate the number of gamma rays per unit time which pass through

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the space occupied by the sensitive portions of the Geiger-Mueller tube and have the following probable errors: for a measured outcrop radioactivity of 0.005 percent E.U. the probable error is ± 0.002 percent E.U.; for 0.010 the probable error is ± 0.003 percent E.U.; for 0.020 the probable error is ± 0.003; for 0.040 the probable error is ± 0.004. Although the measurements are fairly accurate, they need not indicate with accuracy the radioactivity of the rocks in the outcrop. The following factors influence the ratio of radioactivity of the rocks to the number of gamma rays, per unit time, which pass through the space occupied by the Geiger-Mueller tube;

(a). Size and shape of the radioactive outcrop.— Within limits, more gamma rays per unit time are recorded if the radioactive part of the outcrop is large and fewer if the radioactive part of the outcrop is small. Likewise, more gamma rays are recorded if the tube is located in a reentrant in the outcrop than if it is located on a point of rocks.

(b). Distribution of radioactive minerals within the outcrop. The gamma rays passing through the Geiger-Mueller tube originate, in large part, in the rock immediately adjacent to the tube, and, in smaller part, in the rocks further away from the tube. Thus, a radioactive mineral adjacent to the Geiger-Mueller tube on the outcrop might indicate a high degree of radioactivity for the outcrop, whereas a channel sample of the rock nearby and not including any radioactive minerals would show no radioactivity. Conversely, the tube might be placed on a barren spot of the outcrop and indicate a lower radioactivity than a sample from the same outcrop which, by chance, contains one or more radioactive minerals.

Each of the above errors may be reduced by measuring the radioactivity of the outcrop in a sufficient number of places.

On an outcrop, the Geiger-Mueller tube records gamma rays at about 6 times the rate at which the tube records gamma rays from a sample of the outcrop. This is because the source of gamma rays is larger in the outcrop than in the sample. By a direct comparison in many places of outcrop radioactivity and the equivalent uranium content of samples collected from the outcrop, a variation diagram may be constructed which will permit outcrop radioactivity to be expressed as equivalent uranium without sampling.

The variation diagrams in figure 2 were constructed by plotting the number of gamma rays recorded by the Geiger-Mueller tube on the outcrop against the equivalent uranium content of samples collected from the outcrop. The counter records as gamma rays an average of 8 cosmic rays per minute. The cosmic rays originate out of this world and are not attributable to the outcrop. Thus, an outcrop test showing an apparent gamma ray count of 8 per minute indicates an equivalent uranium content of 0.000 percent. The straight line extending from the 0.000 percent E.U. and 8 gamma rays per minute is pivoted at this point so that it indicates the approximate E.U. content of the outcrop for any gamma ray count per minute. The large deviations of the points from the diagonal line are attributable in large part to sampling errors, i.e. the chance inclusion or exclusion of more or less radioactive parts of the outcrop in the sample.

3. Sample tests in the field.--In the field, the radioactivity of coarsely-crushed and volumetrically-measured samples was determined with a portable Geiger-Mueller counter.

4. Sample tests in the laboratory.--In the Survey laboratory in Washington, D. C. the radioactivity of crushed and weighed samples was measured with the laboratory Geiger-Mueller counter.

In practice the above methods were used as follows: If the outcrop test was high, or if more information was desired, the rock was sampled, and crushed

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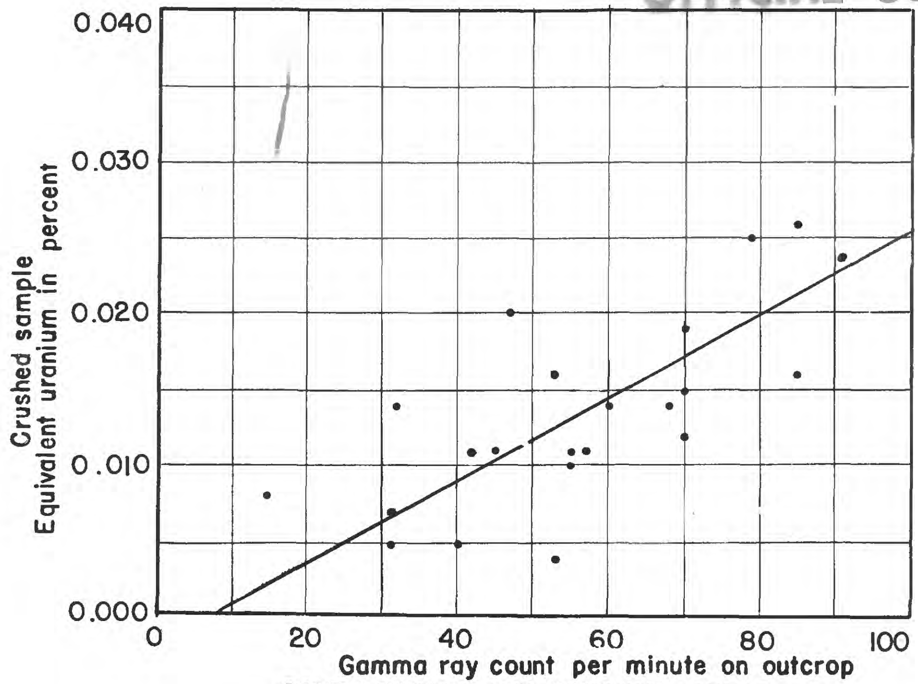
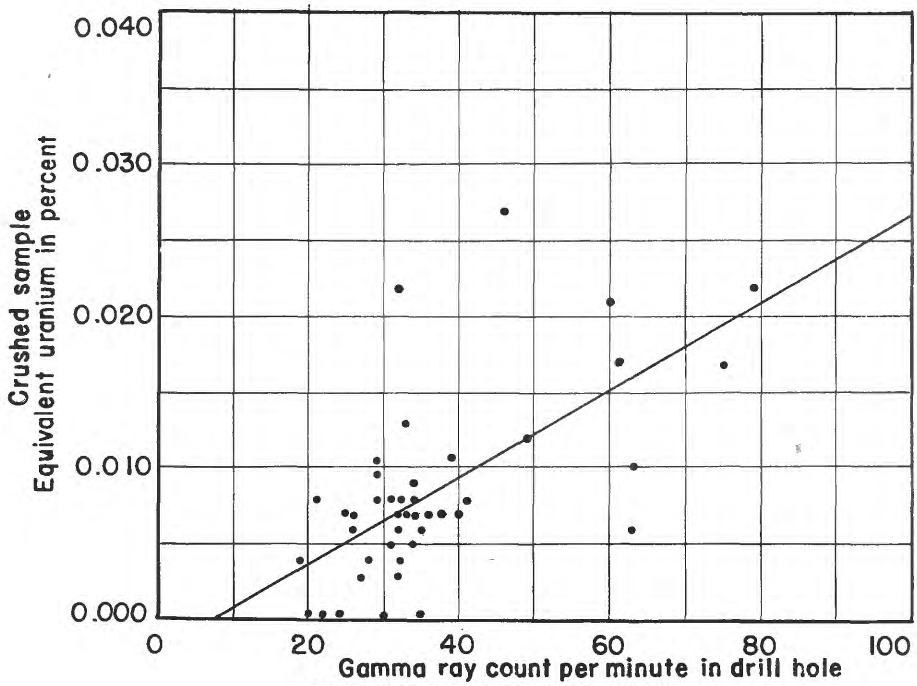


SOUTH DAKOTA AND WYOMING AREAS
EXCLUDING SHROECKINGERITE AREA



THE SHROECKINGERITE AREA

FIG. 2 VARIATION DIAGRAMS SHOWING RELATION OF OUTCROP RADIOACTIVITY TO EQUIVALENT URANIUM

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and the radioactivity of the sample was determined in the field. If still more information was desired, the sample was sent to Washington, D. C. and the radioactivity of the sample was measured again in the laboratory. Samples of further interest were chemically analyzed by the Survey to determine how much of the radioactivity was due to uranium.

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ROCKS AND MINERAL DEPOSITS TESTED

Tertiary igneous rocks of the northern Black Hills

More than 80 percent of the Tertiary igneous rocks of the Black Hills are, according to Darton and Paige[1], rhyolites, rhyolite porphyries, monzonite and

[1] Darton, N. H. and Paige, Sidney, Central Black Hills, S. Dak: U. S. Geol. Survey Geologic Folio No. 219, 1925, p. 16.

monzonite porphyries, and quartz monzonite. True phonolites and grorudites each form about 6 percent.

Only eight samples were taken but many outcrop tests were made on different types of the Tertiary igneous rocks. Samples were taken from the more radioactive outcrops. Sample locations are shown on the index map, fig. 3. Sample descriptions and data are given below.

Sample No.	Thick. ft.	Description	Percent E.U. field	Percent E.U. lab.	Percent uranium
BH-1-45		Chip sample, phonolite, Annie Creek	0.008	0.008	
BH-2-45	5	same	0.011	0.011	
BH-3-45	10	same	0.011	0.011	
BH-4-45	2.7	Chip sample, grorudite(?) dike in pre-Cambrian	0.016	0.014	0.005
BH-5-45		Grab sample from surface of dump., monzonite(?)por.	0.014	0.013	
BH-6-45		Chip sample, phonolite at Victoria, Spearfish Cr.	0.013	0.009	
BH-17-45	2.5	Chip sample, rhyolite por. dike, Deadwood Creek	0.005	0.008	
BH-18-45	12	Chip sample, rhyolite por. & schist bx, Deadwood Cr.	0.008	0.014	0.002

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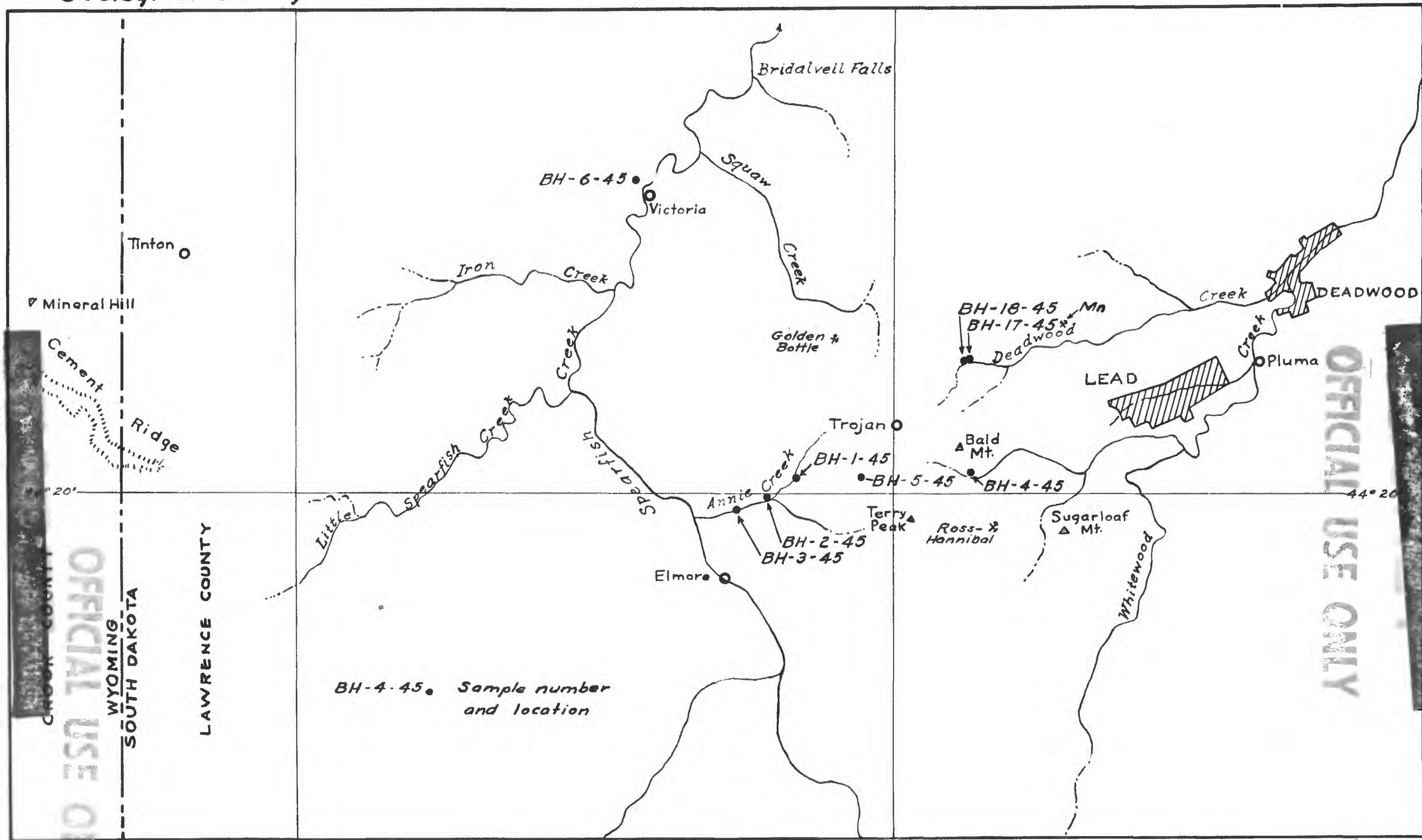
Geo[illegible]gical Survey



Field work by A.L. Slaughter, John M. Nelson June-July, 1945

Fig. 3 - Index Map, Part of the Northern Black Hills, S. Dak. and Wyo.

Scale — 1 inch = 2 miles

October 1945

[redacted]

Phonolites:--Zeigler[1] has listed a reported occurrence of autunite

[1] Zeigler, Victor, Minerals of the Black Hills: S. Dak. School of Mines, Bull. 10, pp. 205-207, 1914.

($Ca(UO_2)_2P_2O_8 + 8H_2O$) in phonolite at Annie Creek (fig. 3). No autunite was found in the phonolite here but outcrop tests were made in a number of places and three samples of the phonolite were taken. BH-1,2 and 3-45 contain 0.008, 0.011, 0.011 percent equivalent uranium respectively. These samples are probably all from the same large phonolite sill. Outcrop tests at several intermediate places along Annie Creek indicate about the same radioactivity. An outcrop of the same sill at Elmore also has about the same radioactivity.

BH-6-45, which contains 0.009 percent equivalent uranium is from a 75-foot thick sill at Victoria. The rock contains abundant sodalite. Outcrop tests on other masses of phonolite farther down Spearfish Creek, at the mouth of Squaw Creek and at Bridalveil Falls, indicate radioactivities of less than 0.005 percent equivalent uranium.

Phonolite, probably part of the large mass that makes up Sugar Loaf Mountain, was tested at several outcrops west and south of the summit. It contains about 0.005 percent equivalent uranium. A greenish phonolite dike cutting pre-Cambrian schist at Whitetail Creek just north of Sugar Loaf Mountain contains about 0.010 percent equivalent uranium by outcrop test, but near the margins where the rock is lighter in color it contains about 0.005 percent. The schist on both sides contains too little radioactive material to be detected.

Soft and altered phonolitic rock in an open cut near Mineral Hill contains about 0.005 percent equivalent uranium by outcrop test. Nepheline syenite, rather pegmatitic in texture, is non-radioactive.

In the Bear Lodge Mountains, Crook Co., Wyoming, which are part of the Black Hills uplift, phonolite was tested two miles south of Warren Peaks and found to

[redacted]

contain about 0.005 percent equivalent uranium (fig. 7).

Grorudite:--The grorudites are closely related to the rhyolite porphyries but have more soda because of abundant albite and the sodic pyroxene, aegerite.

In the Black Hills of South Dakota the huge mass of grorudite which makes up Terry Peak was tested in several places at and near the top of the Peak (fig. 3) It contains about 0.005 percent equivalent uranium. Tests on a large dump on the northwest flank of the Peak, near sample BH-5-45, indicate a somewhat higher radioactivity for the grorudite, possibly as much as 0.010 percent equivalent uranium.

BH-17-45 is from a 2.5 foot rhyolite dike on Deadwood Creek 5 miles above Deadwood and contains 0.008 percent equivalent uranium. In a railroad cut at the same place, BH-18-45 was chipped across 12 feet of quartz monzonite porphyry and schist breccia. It contains 0.014 percent equivalent uranium and 0.002 percent uranium. A dike, also in the railroad cut, contains approximately 0.008 percent equivalent uranium. A breccia dike contains about 0.005 percent equivalent uranium Two narrow dikes cut schist about one-half mile farther up Deadwood Creek. They contain about 0.008 percent equivalent uranium.

On the north side of the canyon occupied by Deadwood Creek, about 3 miles from Deadwood, is an area of manganese mineralization in quartz monzonite porphyry. The rock contains less than 0.005 percent equivalent uranium where there is no manganese mineralization but where the rock is stained and coated with manganese minerals the equivalent uranium content is about 0.010 percent.

A rhyolite dike on Whitewood Creek at the southwestern city limits of Deadwood is low in radioactivity, probably containing about 0.002 percent equivalent uranium.

Quartz-monzonite porphyry on the hill above the Golden Bottle claim in the upper drainage of Squaw Creek probably contains less than 0.005 percent equi-

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valent uranium. The minera[redacted] Bottle claim is discussed separately.

Monzonites:--In the Tinton area of the Black Hills (fig. 3) the most abundant Tertiary igneous rocks are called monzonite and syenite porphyries by Smith and Page-/. Rocks of this type were tested in an open cut at Tinton, along the road between Tinton and Mineral Hill, and on Cement Ridge. They probably contain less than 0.003 percent equivalent uranium wherever tested.

-/Smith, W. C. and Page, L. R., Tin-bearing pegmatites of the Tinton District, Lawrence County, South Dakota, a preliminary report: U. S. Geol. Survey. Bull. 922-T, 1941.

Monzonite porphyry was tested in the Bear Lodge Mountains, Wyoming, 1 to 2 miles west of Warren Peaks (fig. 7). It probably contains less than 0.002 percent equivalent uranium. Manganese-bearing rocks of this type were tested at numerous other places in the Bear Lodge. Copper-bearing porphyry was tested at one place. The reader is referred to the section on manganese deposits.

Lamprophyres:--Three narrow lamprophyre dikes were tested in an open cut at Tinton (fig. 3). They are very low in radioactivity, probably less than 0.001 percent equivalent uranium.

Pseudoleucite-bearing rocks:--Rocks of this type were tested at several places near Mineral Hill. They probably contain less than 0.002 percent equivalent uranium.

Conclusion:--The phonolites are the most commonly radioactive of the Tertiary igneous rocks in the Black Hills. Sills which contain many millions of tons probably have a uniform radioactivity of 0.008 to 0.011 percent equivalent uranium. Some rhyolite porphyry dikes contain as much as 0.014 percent equivalent uranium. Only two samples have been chemically analyses for uranium; in one, uranium is responsible for about 15 percent of the radioactivity; in the other, 35 percent is due to uranium. Thorium has not been determined in any of the samples but the difference between equivalent uranium and uranium is believed to be chiefly due to thorium. [redacted]

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UNITED STATES DEPARTMENT OF INTERIOR [redacted]
GEOLOGICAL SURVEY

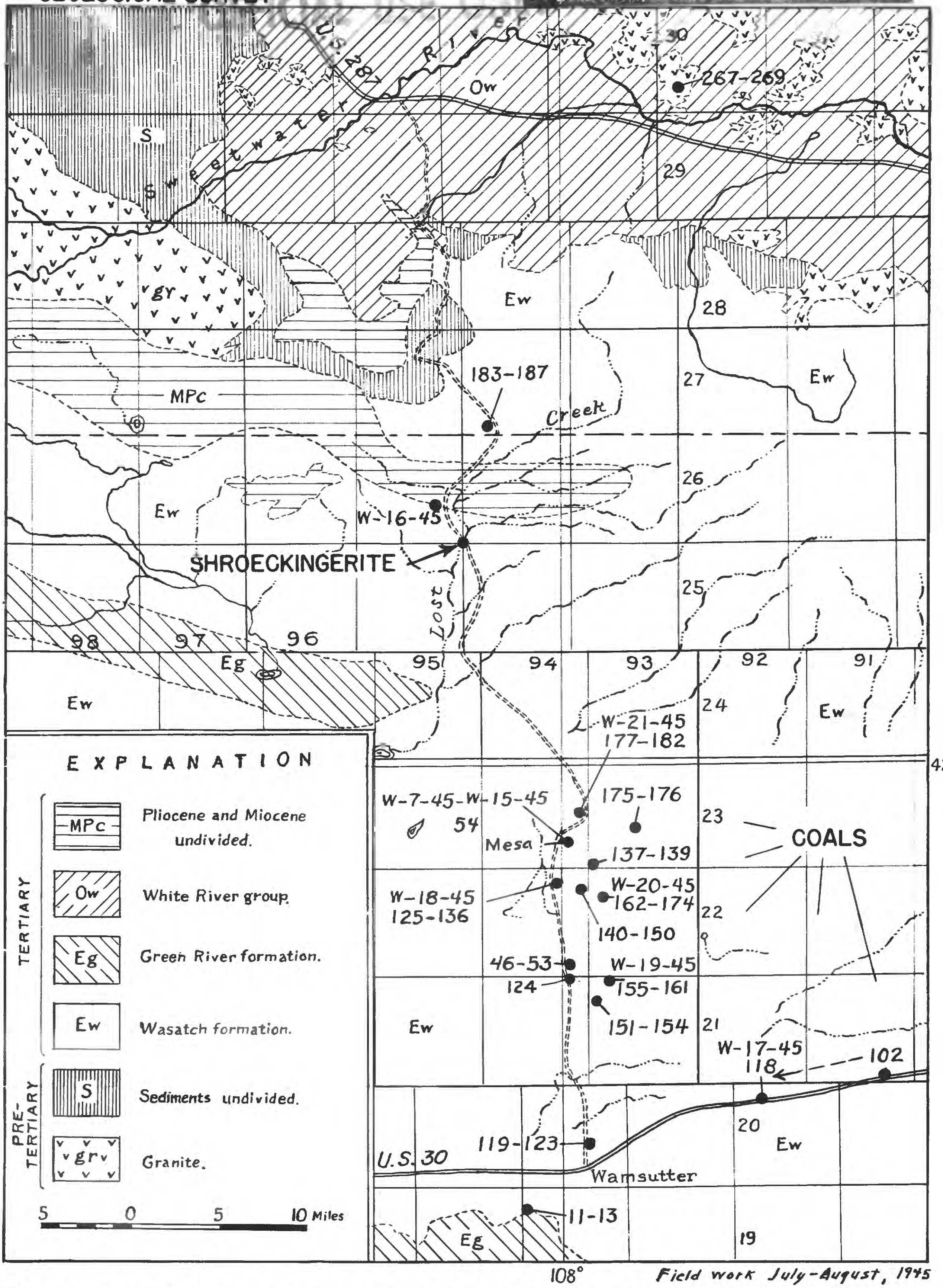

FIG. 4 INDEX AND GEOLOGIC MAP OF PART OF THE RED DESERT, WYOMING, SHOWING LOCATIONS OF SHROECKINGERITE AREA AND OTHER AREAS TESTED [redacted]

[redacted]

Pre-Cambrian granites and gneisses

Pre-Cambrian granites and gneisses are exposed just north of the cemetery at Lusk, Niobrara Co., Wyo. (fig. 1). Outcrops 1 to 9 are described in table 2. The radioactivity of altered, schistose granite outcrops indicates an E.U. content as high as 0.006 percent.

Coarse red granite crops out along highway U.S. 30 just west of Rawlins, Wyo. The radioactivity of one outcrop (outcrop 10) indicates approximately 0.001 percent E.U.

About 10 miles of granite was traversed by car in the Wind River Mountains southwest of Lander, Wyoming, on the road between Sinks Canyon and Atlantic City. At places where radioactivity measurements in the car seemed higher than average, the radioactivity of the outcrops was measured. Measurements on the granite were rather uniform, showing a radioactivity of less than 0.005 percent E.U. (outcrops 249-256, table 2, fig. 1).

Granites, gneisses and granitic gneisses were tested near the north end of the Sweetwater Arch near highway 287 about 50 miles east of Lander. Continuous measurements of radioactivity were taken while driving over about 10 miles or more of exposures and outcrop tests (outcrops 257 to 269) indicate about 0.003 percent E.U. (see table 2 also fig. 4).

The radioactivity of the granitic core of the Bighorn Mountains was measured at many outcrops (281-302) along the highway between Shell, and Sheridan, Wyoming. The measurements indicate a range in E.U. content from 0.000 to about 0.007 percent. The highest radioactivity was obtained in a road cut near the beginning of the descent on the east side of the mountains.

Volcanic rocks

Lavas of the Leucite Hills:--The Leucite Hills in Sweetwater County, Wyoming

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[redacted]

are scattered over an area about 15 miles square, the center of which is about 25 miles northeast of Rock Springs, Wyo. The leucite-rich rocks occur as volcanic necks and associated dikes, intruded lava sheets, stocks, dikes, and flows with one or more cones. Schultz and Cross[1] have described the lavas as containing

---

[1] Schultz, A. R., and Cross, W., Potash-bearing rocks of the Leucite Hills, Sweetwater County, Wyo.: U. S. Geol. Survey Bull. 512, 1912.

---

three principal minerals; phlogopite, diopside, and leucite in minute round grains crowded between larger grains of diopside and 2-3 mm. hexagonal phlogopite plates. The rocks vary in color from reddish-brown to yellow. Many are quite vesicular.

Outcrop tests (outcrops 20 to 43) were made on six widely spaced bodies. (see table 2, also fig. 1). Pumice beneath a flow had the highest E.U. content, 0.007 percent. Outcrop radioactivity indicates that the average E.U. content of the lavas is about 0.004 percent (outcrops 20-43).

Volcanics at Twogwotee Pass, Wyoming:--Two measurements of the radioactivity of andesitic or basaltic agglomerate at Twogwotee Pass on highway 287 between Dubois and Moran, Wyo. (fig. 1) indicate 0.003 percent E.U. (outcrops 341-342).

Pre-Cambrian schists and quartzites

In the Black Hills (fig. 3), along Whitewood Creek south of Lead, Lawrence County, S. Dak., a number of radioactivity measurements were made on outcrops of black, pyritic schist, red and yellow stained schist, and dark quartzite. Measurements indicate less than 0.002 percent E.U. Two zones of black graphitic slate, 20 and 40 feet wide, were tested near sample BH-4-45 (fig. 3). These also probably contain less than 0.002 percent E.U.

A sample of schist, W-3-45, from a dump near the uranophane deposit at Lusk (p. 20) contains 0.010 percent E.U. by field measurement. Measurement of

[redacted]

the radioactivity of schist and quartzite float about one-half mile to the north indicates an equivalent uranium content of less than 0.005 percent (4).

Radioactivity of mica schist outcrops in the Bridger Mountains, north of Shoshoni Wyo., indicate an E.U. content of about 0.001 percent (outcrops 275, 277).

Fluorescent pebbles

Near the schroeckingerite locality (fig. 4) in the Red Desert country of Wyoming the surface is covered with siliceous pebbles. Some pebbles of flint, chert, and opal fluoresce with a light yellow color. A sample of the fluorescent pebbles was picked up at the spot shown on the map (W-16-45). It contains 0.030 percent E.U. The source of the pebbles is not known. They are too few to constitute a source of uranium.

Coals and shales of Cretaceous age

In the Leucite Hills about 2 miles east of Endlich Hill the radioactivity of an outcrop of black shale containing thin coal beds suggests an E.U. content of about 0.002 percent (outcrops 38, 39). The shale is believed to be of Cretaceous age.

Dark gray fissile shale of probable Cretaceous age was tested near the mouth of Little Popo Agie Canyon south of Lander (outcrops 260 to 262, fig. 1). The outcrop radioactivity indicates about 0.003 percent E.U.

An exposure of what may be the Mancos shale of Cretaceous age was tested along highway 287 about 15 miles from Lander (outcrops 263-265, fig. 1). Included were two black fissile shale beds and a narrow coal bed. The shales were the more radioactive and probably contain less than 0.003 percent E.U.

Part of the Almond coal group of the Mesaverde formation of Upper Cretaceous age was tested along highway 30 just east of Point of Rocks, Sweetwater County, Wyo. A 3½-foot coal bed has no perceptible radioactivity and the several

[redacted]

feet of shales tested probably contain less than 0.003 percent E.U. (outcrops 14 to 19).

Coals and shales of Tertiary age

Red Desert region, Wyoming:--The Tertiary Wasatch formation in the Red Desert region, Sweetwater County, Wyoming (fig. 4) contains many coals and shaly coals of varying thickness. They are interbedded with gray, dark gray, and brown, fissile or hackly shales. Selenite, as veinlets and as thin layers along bedding planes, is in some places abundant both in the shale and in the coal. Many of the layers have abundant yellow stains.

For the most part the coals and associated shales are low in radioactivity where tested but in one area they are relatively high. The locations of samples taken in this area are shown on fig. 4. The sample information is listed on the following page. The shaly parts of the sections are in all cases more highly radioactive than the coals. Several thin shale beds (less than 1 foot) contain from 0.020 to 0.030 percent E.U. In places where coal layers are included with shale in the samples, the radioactivity is lower than for samples composed entirely of shale. For instance, a 2.8-foot coal bed contains only 0.004 percent E.U.

Some of the clinker and ash which results from the burning of parts of coal beds has about the same radioactivity as the most highly radioactive shales (0.020 to 0.030 percent E.U.). Such material derived from coal of very low or no radioactivity is, of course, not made noticeably radioactive by the burning.

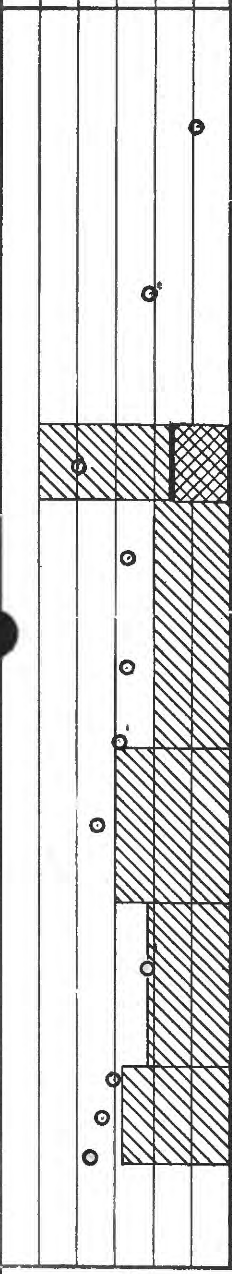
Only about 25 to 35 percent of the total radioactivity of the shales is due to uranium, much less than for most shales of comparable radioactivity. The ash and clinker resulting from burning of the coal also has a low ratio of uranium to E.U. No thorium analyses are available.

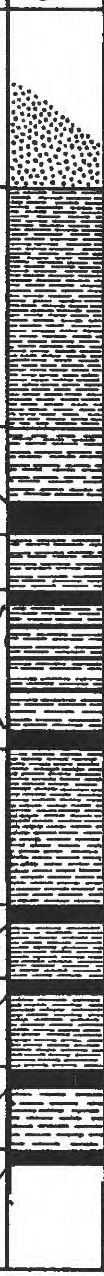
[redacted]

Fig. 5

Section of coal and shale beds

West end of mesa, 19.3 miles north of Wamsutter, Wyo.





Thickness in Feet	Sample No.	DESCRIPTION	Formation
		Sandstone, yellow to buff, very fine-grained.	Wasatch formation (Tertiary)
2.5		Shale, brown to gray, fissile.	
0.8	7	Shale, gray to dark-gray, hackly to fissile.	
0.3	8	Coal, fissile, brown shale in part.	
0.6		Shale, gray, hackly to fissile.	
0.2		Coal, fissile.	
1.2		Shale, gray, hackly, fissile in part, yellow-brown stains, separated into lenticular parts by thin coal seams.	
0.2		Coal, shaly, fissile, abundant yellow stains.	
1.6	9	Shale, dark-gray to black, fissile, thin coaly layers, gypsum in thin layers in bedding.	
0.2	10	Coal.	
0.5		Shale, dark-gray to black, fissile.	
0.2		Coal, shaly, fissile.	
0.8		Shale, gray to black, partly fissile, gypsum.	
0.2	11	Coal, shaly, fissile.	
0.6		Shale, dark-gray to light-gray, clayey, hackly.	
0.2		Coal, shaly, fissile.	

Section continued on next page.

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SCALE: 2 0 2 4 Feet

o Radioactivity by outcrop test.

(Diagonal hatching) *Approximate radioactivity determined by testing (in field) crushed rock, expressed in thousandths of percent equivalent uranium. Not determined for all samples.*

(Cross hatching) *Uranium content determined by chemical analysis, expressed in thousandths of percent.*

Measured and sampled by

A. L. Slaughter
John M. Nelson
July 20, 1945

100471

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Fig. 5 continued

Radioactivity and uranium content (25 20 15 10 5)	Thickness in Feet	Columnar Section	Sample No.	DESCRIPTION	Formation
	1.5		11	Shale, gray, hackly, jointed, yellow on joints, darker and more fissile in part, soft, clayey; gypsum.	Wasatch formation (Tertiary)
	2.8		12	Coal, fissile and shaly in part, yellow stains and coatings along bedding, gypsum, selinite.	
	0.3		13	Shale, black, fissile.	
	0.4		14	Shale, dark-brown, clayey.	
				Base of section not exposed.	
				Samples W-7-45 to W-14-45 inclusive.	

o Radioactivity by outcrop test.

Approximate radioactivity determined by testing (in field) crushed rock, expressed in thousandths of percent equivalent uranium. Not determined for all samples.

Uranium content determined by chemical analysis, expressed in thousandths of percent.

SCALE: 2 0 2 4 Feet

Measured and sampled by

A. L. Slaughter
John M. Nelson
July 20, 1945

100471

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Table 1

Samples of coal and shale from Red Desert region

Sample No.	Thick. ft.	Description	Percent E.U. field	Percent E.U. lab.	Percent uranium
W-7-45	0.8	Shale, gray to dark gray, hackly to fissile	0.025	0.030	0.008
W-8-45	2.5	Shale, gray, hackly to fissile, 3 thin coal beds	0.010		
W-9-45	1.6	Shale, dark gray to black, fissile thin coaly layers, gypsum	0.015		
W-10-45	1.7	Shale, gray to black, fissile, 2 thin coal beds	0.011		
W-11-45	2.5	Shale, light to dark gray, fissile to hackly, 2 thin coals beds in upper part	0.014		
W-12-45	2.7	Coal, fissile and shaly in part, yellow stains, gypsum	0.004		
W-13-45	0.3	Shale, black, fissile	0.016		
W-14-45	0.4	Shale, dark brown, clayey	0.024	0.028	0.007
W-15-45		Selenite	0.000		
W-17-45		Clinker, black, hard, scor-iaceous	0.020	0.012	0.004
W-18-45	2.5	Shale, brown, thin-bedded to blocky, coaly layers	0.012		
W-19-45	1.5	Ash, red, very light weight, mixed with some paper-thin, red baked shale	0.019	0.023	0.004
W-20-45	0.7	Shale, reddish brown, fissile	0.014		
W-21-45	0.8	Shale, black, hackly to fissile	0.024	0.026	0.010

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The most completely sampled exposure of coals and shales is illustrated by columnar section (fig. 5). Samples W-7-45 to W-15-45 were taken at this locality. W-15-45, a sample of selenite picked up at the base of the outcrop, is not radioactive. The 12.5-foot section contains an average of 0.012 percent uranium. A pile of light-weight red material believed to be coal ash lies several feet from the base of the outcrop. It is covered by pieces of blocky red shale. Measurements of the radioactivity of the ash indicate about 0.025 percent E.U. This outcrop is at the west end of a low mesa which is about 1200 feet long and 100 to 200 feet wide. Outcrop radioactivity of a shale bed at the opposite end of the mesa indicates about 0.019 percent E.U. (outcrop 54, fig. 4).

Some of the same beds which were tested at the mesa were tested at three places along a nearly east-west trending escarpment about 2 miles south of the mesa; W-18-45; outcrops 125 to 135; outcrops 140 to 150; W-20-45; and outcrops 162 to 174 (fig. 4). Details of outcrop radioactivity measurements are given in table 2. W-18-45 is a 2.5 foot sample of shales and coals and contains 0.012 percent E.U. (field determination). About 10 feet of shales and coals tested here have about the same radioactivity as similar beds tested at the mesa. Farther east along the escarpment, 15 feet of shales and coals were tested (outcrops 140 to 150) and these, too, have about the same radioactivity. W-20-45 was taken still farther east where a 14-foot section of shales was tested. This is believed to be the same horizon which in other places has thin coal layers. W-20-45 is 0.7 feet of reddish-brown fissile shale which contains 0.014 percent E.U. (field determination). The average for the shale is probably about 0.010 percent E.U.

The coal and shale beds which are exposed in the mesa are also exposed in a bluff about 2 miles to the north (W-21-45, and outcrops 177 to 182 in figure 4). About 15 feet of beds were tested. W-21-45 is from an 0.8-foot bed of black shale where the outcrop is most radioactive. It contains 0.026 percent

E.U. and 0.010 percent uranium. [redacted]

Outcrop tests 46 to 53 (fig. 4), about 7 miles south of the mesa, were made on about 12 feet of coals and shales similar in lithology to those discussed above but the stratigraphic relation to the shales of the mesa area is unknown. The radioactivity here is much less; the best shales probably contain no more than 0.006 percent E.U.

Outcrop tests 183 to 187 (fig. 4), about 22 miles north of the mesa, were made on shale and coal beds. They probably contain less than 0.006 percent E.U.

A large number of outcrop tests were made on coals and adjacent shale beds between Rawlins and Wamsutter Wyo. These include outcrop tests 59 to 123. Locations of the tests are shown on figs. 1 and 4. Details of the tests are given in table 2. Many stratigraphic horizons in the Wasatch are represented, although the stratigraphic position of any one in relation to the beds in the mesa is unknown. The coals and shales are low in radioactivity; probably none contain more than 0.005 percent E.U. except at the locality where W-17-45 was collected.

W-17-45 is a sample of clinker. It contains 0.012 percent E.U. and 0.004 percent uranium. Nearby coal contains up to 0.005 percent E.U. Some of the fine, powdery, yellow and red coal ash may contain as much as 0.015 percent E.U. The burned areas appear to be rather small isolated spots and the volume of such material is not great.

Outcrop tests 11 to 13 were taken on 6 feet of coal near Wamsutter, Wyo. which is said by Barb and Ball[1] to be in the upper Wasatch or lower Green

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[1] Barb, C. F. and Ball, J.O., Hydrocarbons of the Uinta Basin of Utah and Colorado; Colo. School of Mines Quarterly, vol. 39, no. 1, p. 28, Jan., 1944.

River formation and described by them as "alum coal". The coal and adjacent

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shales are tested.

It is estimated that, in the general area of the mesa there are tens of millions of tons of unburned coal and shale containing 0.010 to 0.015 percent E.U., about 0.002 to 0.004 percent uranium. Ash from burned coal beds in some places may contain as much as 0.025 percent E.U. and probably about 0.005 percent uranium but the quantity of such material is comparatively small.

Because the Tertiary sediments are in some places unusually high in radioactivity and because much of the region has not been examined, more work should probably be done in the hope of finding a more radioactive area. There is a suggestion of increasing radioactivity toward the north and west in the area of the mesa.

Burned coals in northeastern Wyoming:--The occurrence of burned-out coal beds and the resulting natural slags and baked shales have been reported over almost the entire northeastern one-quarter of Wyoming and adjacent parts of Montana and the Dakotas.

Many outcrop tests were made on coals, shales, baked and vitrified shales, and light ash-like material along highway U. S. 14 between Sheridan and Gillette, Sheridan County, Wyo. Locations of the tests are indicated on the index map (fig. 1). Descriptions and radioactivity measurements are given in table 2. A low radioactivity is indicated at all places where readings were taken but was slightly higher near Sheridan than it was near Gillette. Outcrop tests on a burned bed of bone, now a red to yellowish shale, indicate about 0.005 percent E.U.

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Oil shale in the Green River shale

Outcrop tests were made on layers of oil shale in the Green River shale just west of Green River, Sweetwater County, Wyo. (see table 2, outcrops 44 and 45). The oil shale is very low in radioactivity, probably containing about 0.001 percent E.U.

Asphaltite

Several outcrop tests (outcrops 247, 248, also fig. 1) made on some asphalt-impregnated Minnelusa sandstone near Rocky Ford, Crook County, Wyo. indicate that it is non-radioactive. The asphaltite is 2 feet thick at one place, 8 feet at another.

Phosphate in the Wind River Mountains

Phosphatic beds of the Phosphoria formation throughout most of southwestern Montana contain 0.007 to 0.010 percent uranium 1/. The phosphatic beds of the

1/ Butler, A. P. Jr., and Chesterman, C. W., Investigations of the Phosphoria formation in southwestern Montana: U. S. Geol. Survey Trace Elements Investigations, Rept. 5, Jan., 1945, unpublished.

Phosphoria formation in the Wind River Mountains near Lander, Fremont County, Wyo. were known to contain less B.P.L 2/ (bone phosphate of lime) than the Montana

2/ Condit, D. D., Phosphate in the Wind River Mountains, near Lander, Wyoming: U. S. Geol. Survey Bull. 764, 1924.

phosphates. It was therefore suspected that they might also be less radioactive and this was proved to be true.

In the Wind River Mountains the Phosphoria formation is 200 to 300 feet thick. It contains thick beds of massive limestone, platy limestones with

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shaly partings, thick layers of gray shale, some chert, and two phosphate beds. The lower phosphate bed is 40 to 55 feet above the base and the upper 60 to 75 feet below the top[1].

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[1] Condit, D. D., op cit.

A Geological Survey party under the direction of Ralph King was engaged in sampling and mapping the phosphate of this area during the past field season. Full advantage of trenches excavated by this party was taken in making the radioactivity measurements.

In the canyon of the Little Popo Agie River about 11 miles south of Lander, trenching has exposed all the covered parts of the Phosphoria. Details of outcrop tests are given in table 2, outcrops 188 to 227. The highest radioactivity occurs in the lower phosphate bed which is 4 feet thick and probably contains about 0.006 percent E.U. The upper zone consists of several oolitic phosphate beds separated by limestone, the whole being 7.3 feet thick. Two 2-foot phosphate beds each contain approximately 0.004 E.U.

On Baldwin Creek, about 15 miles northwest along the mountain front from the above section, the upper and lower phosphate beds have been exposed by trenching. Outcrop tests 231 to 240 were taken in the upper zone, 241 to 246 in the lower. The upper bed is 1.8 feet thick and overlies 2.5 feet of phosphatic limestone which gave almost as high outcrop tests as the phosphate rock. W-22-45 is a sample of the 1.8-foot bed and contains 0.005 percent E.U. The lower bed is one foot thick and probably contains about 0.008 percent E.U. W-23-45 is a sample from an 0.7 foot-bed of phosphatic limestone which underlies the phosphate rock. It contains 0.007 percent E.U.

On the South Fork of Little Wind River about 20 miles northwest of Lander a natural exposure of the lower phosphate bed just above the face of the dam was tested (outcrops 228-230). The bed is 4 feet thick and contains about

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0.005 percent E.U.

Conclusion:--Phosphate rock of Wind River Mountains appears to have a rather uniform radioactivity of about 0.008 percent E.U. which is too low to be of interest although the tonnage of such material is probably great.

Uranophane deposit at Lusk, Niobrara County, Wyoming

The Silver Cliff mine is on Silver Cliff hill at the west edge of the city of Lusk, Niobrara County, Wyo. Silver and copper were mined here in a small way prior to 1918. Production as given by Dietz/, was five carloads

/ Dietz, C. S., The developed and undeveloped mineral resources of Wyoming: Wyo. Geol. Survey Bull. 21, 1929.

of "radium" ore, each worth $6000.00, between December, 1913 and September, 1919. Lind and Davis/ say that several carloads of 3 percent U_3O_8 was produced.

/ Lind, S. C. and Davis, C. W., A new deposit of uranium ore: Science, new ser., vol. 49 - 1271, pp. 441-443, May 9, 1919.

Uranophane occurs mainly as coatings on fracture surfaces in quartzite along the west side of a north-south striking fault of about 76 feet displacement (fig. 6). The conglomeratic quartzite overlies steeply dipping pre-Cambrian rocks and may be the basal part of the Mississippian Guernsey formation of Smith and Darton/.

/ Smith W.S.T. and Darton, N. H., Hartville, Wyo. U. S. Geol. Survey Geologic Folio 91, 1903.

The mineralogy of the deposit has been described by Larsen, Hess, and Schaller/. They list the following primary minerals: chalcocite, pitchblende.

/Larsen, E. S., Hess, F. L., and Schaller W. T., Uranium minerals from Lusk, Wyo.: Amer. Mineralogist, vol. 11, pp. 155-164, 1924.

calcite which is the principal introduced mineral, and probably some quartz. As secondary minerals they list the following: azurite, malachite, chrysocolla,

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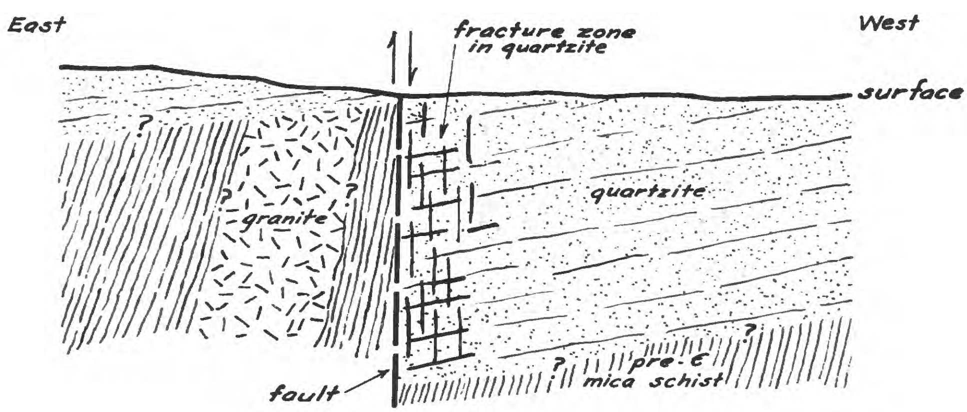

Fig. 6 - Cross Section Sketch

North Side Silver Cliff Hill, Lusk, Wyo.

Scale ~ 1 inch = approx. 50 feet

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October, 1945

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uranophane, and a few small masses of red mineral thought to be gummite. Uranophane is the most abundant uranium mineral now present. It is a silicate with the chemical formula, $CaO.2UO_3.2SiO_2.7H_2O$. In addition to coatings as much as 1/16 inch thick on fracture surfaces, uranophane occurs as impregnations in the quartzite extending out from fractures as much as 1 inch. Crystals in radiating aggregations one half of an inch in diameter are found on some of the fracture surfaces.

The area of older rocks containing this deposit is at the northern end of the Hartville uplift. The quartzite adjacent to the fault has been explored by surface pits and cuts and by underground workings for 1500 to 2000 feet along the strike. The underground workings are confined to the northern half of this distance, main entry being from the north side of Silver Cliff hill, the northward termination of the deposit. The extent of the deposit to the south is not known; the most southerly pits do not contain any radioactive material and a short distance beyond these the quartzite is covered by younger rocks.

Uranophane is not evenly distributed over the explored length. It occurs as far as 30 feet from the fault. Most of the uranophane-coated surfaces are either nearly vertical or gently dipping to the east. The latter correspond to the attitude of the bedding the quartzite.

The mica schist of the hanging wall was tested at several places in the underground workings and is relatively low in radioactivity. An adit has been driven into the schist in the north side of Silver Cliff hill a few feet above creek level. W-3-46 is a sample of schist from the dump. It contains 0.010 percent E.U. by field determination.

Because of the uneven distribution of the uranophane, no samples were taken of the material in place. However, as the dumps contain from 3000 to 5000 tons of material, two samples were taken from the largest dump on the north side of Silver Cliff hill. The samples are each about 10 pounds in weight and consist of pieces of quartzite up to 1 inch picked up at intervals around the face of the dump. W-1-45 contains 0.154 percent E.U., 0.076 percent uranium. W-2-45 contains 0.135 percent E.U., 0.090 percent uranium.

Conclusion:--There are from 3000 to 5000 tons of material in dumps which probably contain about 0.075 to 0.100 percent uranium. A smaller tonnage of higher grade material could be produced by hand sorting. More extensive examination and sampling would be necessary to estimate the underground reserves which may not be more than a few thousand tons. The possible existence of other similar deposits along the strike of the fault to the north or to the south would be the chief incentive for further work. The same quartzite horizon may reappear in two areas of Mississippian rocks which have been mapped a few miles north of Lusk. A mapping program of a few weeks duration would probably be worthwhile as a guide for further exploration.

Manganese deposits

The first suggestion of a possible relation between manganese mineralizations and radioactivity was shown by a sample from a manganese-bearing vein in the Sierra Diablo north of Van Horn, Texas. The sample (S150-452) was taken by Slaughter and Clabaugh[1]. Three occurrences of manganese were tested in

[1] Slaughter, A. L, and Clabaugh, S. E., Reconnaissance in Central and Southwestern states: U. S. Geol. Survey, Trace Elements Investigations Rept. 9, p. 35, 1945 unpublished.

Wyoming and South Dakota. In each occurrence, manganese-bearing rock is more radioactive than adjacent rock which contains no manganese.

Thorium is responsible for the greater part of the radioactivity of the manganiferous material.

Bear Lodge manganese area:--The Bear Lodge Mountains in Crook County, Wyo.

are a part of the Black Hills uplift. Tertiary monzonite porphyry, which is exposed over an area about 6 to 7 miles long and up to 4 miles wide, makes up the greater part of the core. Manganese oxides are widely scattered through the porphyry, especially in the area just north of Warren Peaks (see fig. 7). The manganese occurs in most places as irregular veinlets and coatings. Steeply dipping veins, as much as 1 foot in width, occur in a few places. Most of the rock is stained brown by iron.

Attention was called to the radioactivity of the manganese-bearing rock by a marked increase in the gamma ray counting rate as the counter was carried along in a car. The locations of these high counts and of the samples which were later taken are shown on the map (fig. 7). Some of the roads were then systematically traversed by car with the counter turned on. The procedure was to record the gamma ray count per 30 seconds while driving from 5 to 10 miles per hour. The recorded gamma ray counts were marked alongside the roads on areal photographs and the results are shown graphically on fig. 6. Statistical variations over such short counting periods may cause erroneous results and for this reason a more sensitive counter would be desirable. Also, with the few samples that were taken, it is difficult to convert the car readings to percent equivalent uranium in the rocks. However, it is felt that car traversing does indicate the presence of the more highly radioactive spots such as that about 3/4 of a mile north of Warren Peaks. Gamma ray counts in the car at this locality were as high as 60 per minute as compared to a normal count of about 8 per minute in non-radioactive rocks.

Sample locations are shown on the map (fig. 7); sample information is summarized below.

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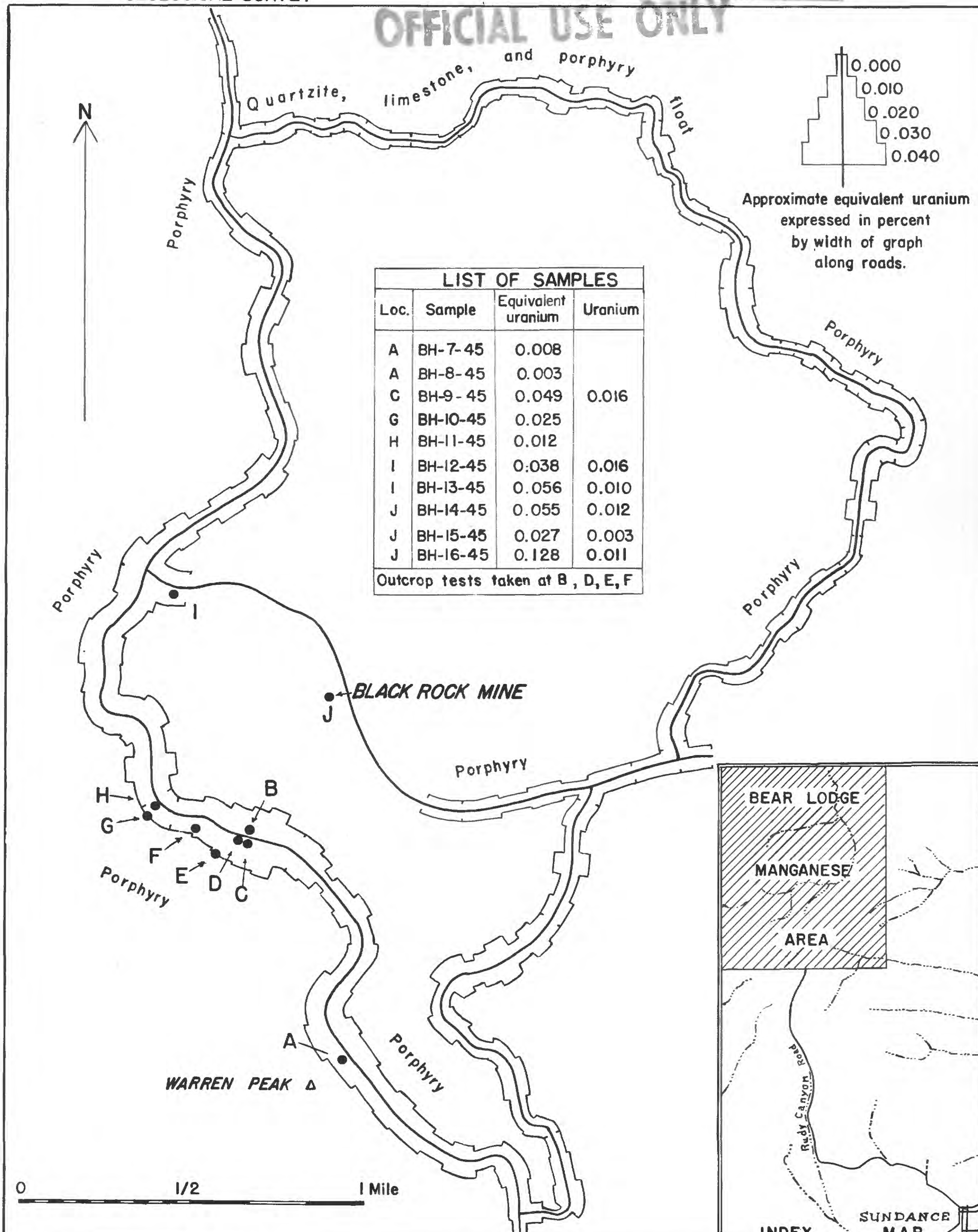
GEOLOGICAL SURVEY [redacted]



LIST OF SAMPLES

Loc.	Sample	Equivalent uranium	Uranium
A	BH-7-45	0.008	
A	BH-8-45	0.003	
C	BH-9-45	0.049	0.016
G	BH-10-45	0.025	
H	BH-11-45	0.012	
I	BH-12-45	0.038	0.016
I	BH-13-45	0.056	0.010
J	BH-14-45	0.055	0.012
J	BH-15-45	0.027	0.003
J	BH-16-45	0.128	0.011

Outcrop tests taken at B, D, E, F

A.L. Slaughter, John M. Nelson — Field work July, 1945

FIG. 7 MAP OF BEAR LODGE MANGANESE AREA SHOWING LOCATIONS OF SAMPLES AND APPROXIMATE EQUIVALENT URANIUM IN ROCKS DETERMINED BY GAMMA RAY COUNTS IN MOVING CAR

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Bear Lodge Samples

Sample No.	Thick. ft.	Description	Percent E.U. field	Percent E.U. lab.	Percent uranium
BH-7-45		Chip sample of pegmatitic granite, Mn coatings and veinlets	0.014	0.008	
BH-8-45		Feldspar crystals weathered from granite	0.003		
BH-9-45		Pieces of Mn ore from pit	0.077	0.049	0.016
BH-10-45	10	Chip sample, porphyry with Mn stains from face of cut	0.040	0.025	
BH-11-45	6	Chip sample of porphyry with Mn veinlets at portal of adit	0.016	0.012	
BH-12-45		Pieces of Cu-stained porphyry from dump	0.035	0.038	0.016
BH-13-45		Large grab sample from dump of finely broken Mn and Cu-stained porphyry	0.064	0.056	0.010
BH-14-45	1.0	Mn vein at Blackrock mine	0.070	0.055	0.012
BH-15-45	1.5	Crushed and stained porphyry in hanging wall of vein	0.022	0.027	0.003
BH-16-45		Hard black and yellow rock at Black Rock mine	0.135	0.138	0.011

Some rock containing a relatively small amount of manganese as stains or veinlets may contain as much or more equivalent uranium than rock with considerably more manganese (compare samples BH-11-45 and BH-10-45). However, samples BH-14-45 and BH-9-45 which are manganese ore, are relatively high in radioactivity. Manganese was produced in 1942 and 1943 from narrow veins at the Black Rock mine. BH-14-45 is from a vein which dips 50 degrees to the north and is very irregular in width. The wallrock of the vein consists of brown-stained porphyry cut by small manganese-filled fractures. BH-15-45 is from the hanging

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wall of this vein. It contains about one-half as much equivalent uranium as the vein but contains much less than one-half as much manganese.

Copper, probably malachite, occurs with the manganese at one place (location 1, fig. 7). BH-12-45 is a sample of copper-stained porphyry with no visible manganese. BH-13-45 is from a dump containing 300 to 400 tons of finely broken porphyry stained with both copper and manganese.

The most highly radioactive sample was chipped from some large pieces of hard, yellow and black mottled rock at the Black Rock mine. It is very fine grained, almost glassy, and may be a silicified monzonite porphyry. The rock was not found in place. It contains 0.128 percent E.U. but only 0.011 percent uranium.

As can be seen from the table, (p.24), uranium is responsible for a minor, but varying amount (from 9 to 42 percent) of the total radioactivity of the manganese-bearing rock and manganese ore of the Bear Lodge area. Most of the activity is assumed to be due to thorium.

<u>Conclusion</u>:--Whatever the nature of the radioactive substance or substance in the rock it appears evident that such material accompanied the manganese and copper mineralization.

Manganese-rich rock (BH-9-45, BH-14-45), such as mined for manganese ore, contains about 0.050 percent E.U., 0.012 to 0.016 percent uranium. The veins are narrow and irregular and the mineable tonnage of such material is probably not more than 100,000 tons.

Little is known about the extent of the copper mineralization; 300 to 400 tons of dump material may contain 0.056 percent E.U., 0.010 percent uranium.

Manganese stained porphyry containing 0.012 to 0.027 percent E.U. probably less than 0.005 percent uranium, gives the most promise of large tonnages. Reserves of such material may be several million tons.

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As a uranium source, the Bear Lodge manganese deposits are probably of no further interest. If the indicated thorium content of some of the rock, 0.025 to 0.14 percent, is of interest, more work should be done in the Bear Lodge to determine more accurately the radioactivity and reserves of the deposits.

Manganese deposit in the Laramie Mountains:--A manganese deposit, at one time worked by the Poverty Mining Company of Laramie, Wyo., lies on a gently sloping mesa on the western flank of the Laramie Mountains, about 7 miles south of Marshall in the northern part of Albany County, Wyo. (fig. 1).

The manganese deposit is in two chert beds which are interbedded with limestone and sandstone of the Casper formation of Carboniferous age, which overlies pre-Cambrian granite in this area.

The two chert beds each average about 6 feet in thickness and are separated by 3 to 4 feet of reddish sandstone. Both are explored by rather limited underground workings. The ore consists of manganese oxides, manganite and pyrolusite, in mammillary crusts, irregular nodular masses, and dendritic growths which have wholly or partly replaced the chert. Abundant cavities are present. The ore occurs irregularly in the chert beds. The chert is nearly black and is believed by Jones[/] to be the source of the manganese.

[/] Jones, E. L. Jr., A deposit of manganese ore in Wyoming: U. S. Geol. Survey Bull. 715, pp. 57-59, Contributions to economic geology, 1920.

Samples are listed below:

Sample No.	Thick ft.	Description	Percent E.U. field	Percent E.U. lab.	Percent uranium
W-4-45		Pieces of Mn ore picked from ore pile, no chert	0.046	0.023	0.006
W-5-45	6.0	Chip sample across lower Mn bed, contains some chert	0.026		
W-6-45		Pieces of dark chert from dump	0.014		

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The ore pile from which sample W-4-45 was taken is from the upper manganese bed. The figure of 0.046 percent is believed to be more nearly right for equivalent uranium content than 0.023 percent. W-5-45 was chipped from the lower bed and contains some of the dark chert. Tests were made on a waste pile of reddish sandstone which came from beds above the upper chert layer. It probably contains less than 0.003 percent E.U.

Conclusion:--Again, as in the Bear Lodge manganese deposit, uranium is responsible for a minor part of the total radioactivity. The extent of the manganese deposit in the chert beds is unknown, but unless thorium in amounts which may be as high as 0.05 percent is important, this occurrence is probably of no further interest.

Manganese deposit near Deadwood, S. Dak.:--Some manganese has been produced from irregular veins and masses in fractured quartz monzonite porphyry on the north side of Deadwood Gulch about 3 miles from Deadwood, Lawrence County, S. Dak. (fig. 3). Where the porphyry is stained and coated with manganese minerals it contains about 0.010 percent E.U. In places where the rock has not been affected by the manganese mineralization it probably contains less than 0.005 percent E.U. If the uranium-thorium ratio is applicable here, the uranium content of the mineralized porphyry is only about 0.002 percent.

Mineral Deposits in the Black Hills

Ross Hannibal mine near Lead, S. Dak:--The Ross Hannibal is an abandoned gold mine about 3 miles southwest of Lead, Lawrence County, S. Dak. (fig. 3). The ore was formed by a siliceous replacement of Cambrian dolomite of the Deadwood formation. Torbernite ($Cu(UO_2)_2P_2O_8 + 8H_2O$) was reported by Zeigler[1]

[1] Zeigler Victor, Minerals of the Black Hills; S. Dak. Sch. of Mines Bull. 10, pp. 205-207, 1914.

to occur as small, green, tabular crystals in vugs and cavities of the siliceous ore. The underground workings are now inaccessible. The dumps consist largely of blue and brown shale and shaly dolomite but a few small piles of ore were found. No torbernite was seen and tests indicate a very low radioactivity for all the dump material.

Golden Bottle claim near Trojan, Lawrence County, S. Dak:--The ore on this claim is in a narrow vertical fracture zone in quartz-monzonite porphyry. It contains several ounces of gold per ton over a width of a few inches. Outcrop tests indicate that the mineralized porphyry immediately adjacent to the fractures contains about 0.010 percent E.U.

Copper Glance prospect near Pactola, S. Dak:--The Copper Glance is a copper prospect near Pactola, Lawrence County S. Dak., about 25 miles southeast of Lead. Zeigler[1] says that torbernite probably occurs on this claim, but none

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[1] Zeigler, Victor, op. cit.

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was found. Tests were made in several shallow shafts and pits which were in crushed and fractured zones in pre-Cambrian mica schist. Some vein quartz is commonly present and there are greenish copper stains. Where tested, this material is essentially non-radioactive.

Hidden Treasure and Big 4 mines:--The Hidden Treasure and Big 4 mines are on Deadwood Creek, west of Deadwood, Lawrence County, S. Dak. Both are abandoned gold mines. At the Hidden Treasure, tests were made on a dump consisting of quartz-monzonite porphyry, pieces of mineralized schist and quartz. A value of less than 0.005 percent E.U. is indicated for the main part of the dump. At the bottom of the dump are large pieces of porphyry containing abundant pyrite. This material probably contains about 0.008 percent E.U. At the Big 4 the dumps consist of quartz monzonite porphyry and red-stained quartz and schist, all with much pyrite. Parts of the dumps may contain as much as 0.005 percent E.U.

Fluorite deposit in Bear Lodge Mountains:--A fluorite prospect about 3 miles southwest of Warren Peaks, Crook County, Wyo. was tested (fig. 7). Monzonite porphyry has been partly replaced by fluorite. Tests made on small piles of the material and on some boulders indicate a low radioactivity, probably less than 0.003 percent E.U.

Atlantic gold district

The Atlantic gold district is situated near the southeastern end of the Wind River Mountains in Fremont County, about 25 miles south of Lander, Wyo., in an area of pre-Cambrian metamorphic and intrusive rocks. It is just off the northwest corner of fig. 4. Test 258 (see fig. 1) is on a pile of quartz ore at one of the old mines; test 257 is on a dump of brown, red and black stained quartz at a caved shaft. Both tests indicate very low radioactivity (see table 2). Radioactivity of rocks along the road was measured from the car while driving over several miles of pre-Cambrian rocks. Radioactivity was uniformly low.

Pegmatites

Tinton district, S. Dak.:--Several outcrop tests were taken on a large mass of pegmatite in the open cut on the Rough and Ready claim just west of Tinton, Lawrence County, S. Dak. (fig. 3). At all places tested the pegmatite probably contains less than 0.001 percent E.U. Tin has been produced from ore bodies in the oligoclase-quartz-muscovite pegmatite at the Rough and Ready mine. The Tinton pegmatites have been described by Smith and Page[1].

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[1] Smith, W. C., and Page, L. R., Tin-bearing pegmatites of the Tinton districk, Lawrence County, South Dakota: U. S. Geol. Survey Bull 922T, 1941.

Pegmatites in Fremont County, Wyo.:--Irregular pegmatite dikes which have been intruded into pre-Cambrian rocks in the Bridger Mountains were tested east of Wind River Canyon and north of Shoshoni, Wyo., (Outcrops 270 to 280, table 2; fig. 1). Wherever tested they probably contain less than 0.003 percent E.U.

Schroeckingerite (dakeite) area, Wyoming

This uranium deposit is located in the Red Desert region of south-central Wyoming (fig. 1 and 4), 43 miles by road north of Wamsutter, Sweetwater County, in section 36, T. 26N., R. 95 W. It is in the northern part of the Great Divide Basin, an undrained topographic basin situated on the Continental Divide. The average elevation is about 7000 feet. The deposit is well exposed in the bank of Lost Creek, called the Lost Creek bluff in this report. Schroeckingerite is found over an area of about 25 acres which lies to the east of the bluff (fig. 8). The deposit was visited briefly in the summer of 1944 by Harder and Wyant—/ who recommended that further work be done, especially with the thought of finding other occurrences of the mineral.

—/ Harder, J. O. and Wyant, D. G., Reconnaissance in western states, preliminary report: U. S. Geol. Survey Trace Elements Rept. 4, p. 22, Oct. 1944, unpublished.

Geology:--The deposit lies in a large area underlain by the Tertiary (Eocene) Wasatch formation which consists of several thousand feet of variegated clays and shales, sands and sandstone, gravels and conglomerates. Areal geology of the region is shown on the map (fig. 4).

The sediments in the schroeckingerite area are shown in the sketches of the face of the Lost Creek bluff (fig. 9). They are interbedded green to gray clays or clayey shales and beds of gravelly sand or poorly cemented conglomeratic sandstone. In some places the clays contain varying amounts of sand and the conglomeratic sandstone beds in some places contain pockets and lenses of

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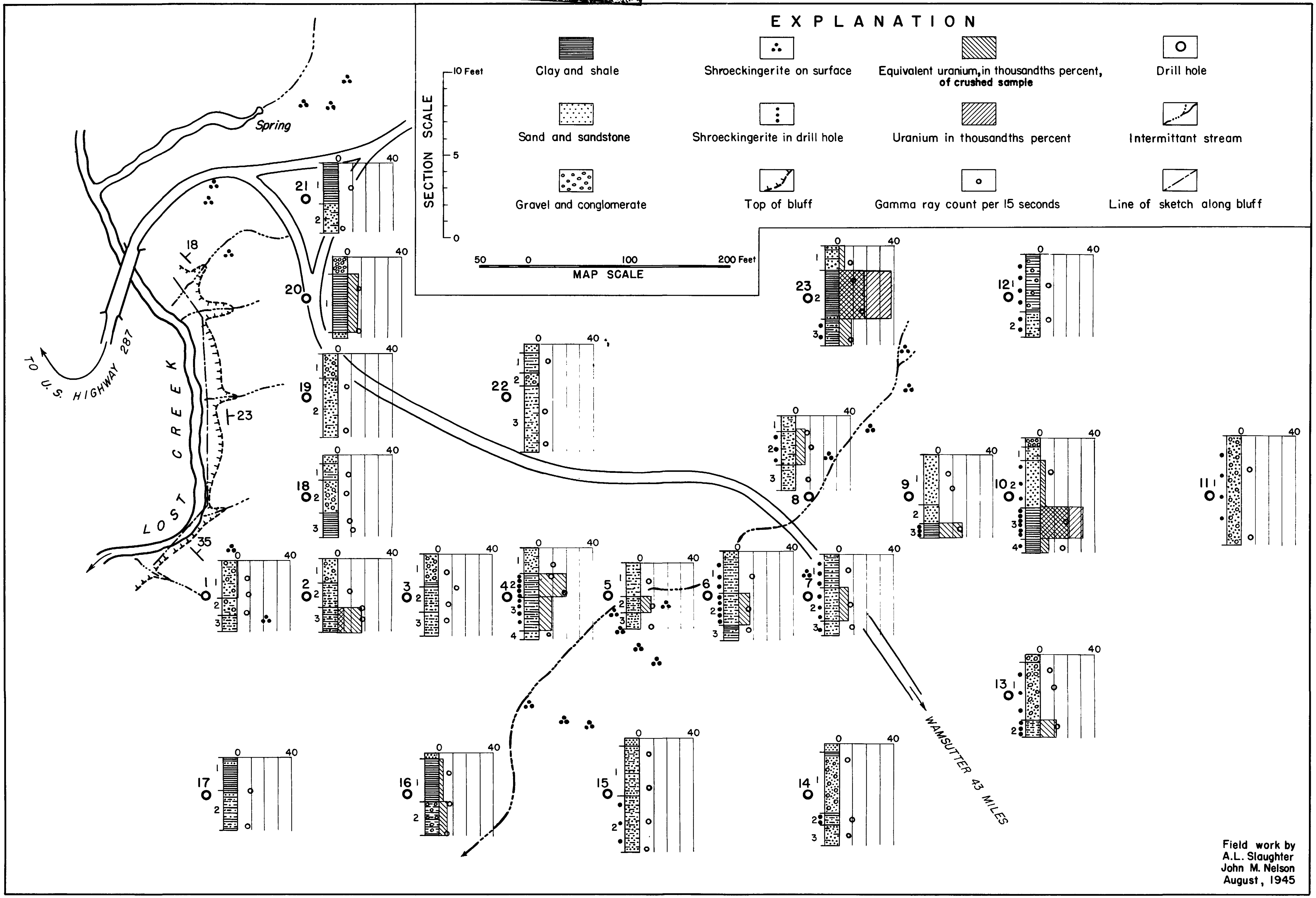

FIG. 8 MAP AND DRILL HOLE SECTIONS OF LOST CREEK SHROECKINGERITE AREA, SWEETWATER COUNTY, WYOMING FIG. 8

[redacted]

clay. These beds, which are assumed to belong to the Wasatch formation strike from N to N 45°W and dip from 18°-35°NE. The beds are in some places unconformably overlain by sand and gravel of probably Pleistocene or Recent age. This unconformity is well shown in the south end of the bluff.

Methods used in sampling and testing the deposit:--Full use of both the ultra violet light and the Geiger-Mueller counter was made in attempting to determine the extent and grade of the deposit. The ultra violet light was of more use than the counter in picking out areas of schroeckingerite on the surface but the counter proved of value in locating places where radioactivity is due to non-fluorescent material.

Channel samples were cut on the face of the bluff (fig. 9). Shallow holes were drilled to sample the deposit east of the bluff (fig. 8). The method used to drill the holes is as follows: a sharpened 1-inch pipe is driven into the ground about 6 inches; the pipe is then pulled out of the hole and hammered to cause the "core" to fall out; the pipe is then driven another 6 inches etc. It was found that if more than 6 inches is driven at a time; it is difficult to pull the pipe from the hole and to get the core out of the pipe. Tools needed for the job are several pieces of 1-inch pipe of different lengths (about 3, 5 and 7 feet), 6-pound sledge, pipe wrench to help in removing pipe from hole, a hacksaw to saw off tops of pipes when they become battered and broken, and a file for sharpening the driving ends of the pipes. The deepest hole drilled was 7 feet.

Radioactivity tests of 3 minutes duration were taken at intervals in the drill holes (see sections fig. 8). The radioactivity of the rocks was also tested in 1-foot horizontal holes driven into the face of the bluff along the channel samples and below. This was done so that the tests in the face of the bluff and in the vertical drill holes would be comparable.

[redacted]

All samples were examined for schroeckingerite under ultra violet light.

Samples D-1-1 to D-26-1 are from the drill holes. Equivalent uranium has been determined only for part of the drill hole samples. These were selected chiefly on the basis of radioactivity tests in the holes and schroeckingerite visible in the samples (with and without ultraviolet light). Equivalent uranium determinations have been made on all channel samples, D-1-45 to D-17-45. Some of the better samples have been chemically analyzed for uranium.

Mineralogy and distribution of schroeckingerite:--The soft greenish-yellow mineral from this location was first described in 1937 by Dr. E. S. Larsen[1]

[1] Larsen, E. S., and Gonyer, F. A., Dakeite, a new uranium mineral from Wyoming: Am. Mineralogist, vol. 22, no. 5, pp. 561-563, May, 1937.

(the locality is incorrectly given in the paper referred to). He named the mineral "dakeite" after H. C. Dake first suspected that it contained uranium. However, Novacek[2] has shown that the Wyoming material is identical in composition

[2] Novacek, Radim, The identity of dakeite and schroeckingerite: Am. Mineralogist, vol. 24, no. 5, pp. 317-323, May, 1939.

and mineralogical characteristics to the mineral "schroeckingerite" which was described by Schrauf in 1873.

Schroeckingerite is greenish-yellow and occurs in irregularly shaped masses as much as 3/4 inch in diameter. The material is soft and is easily broken into tiny micaceous flakes. It is often disseminated in the sand and clay in pieces too small to be seen except under ultra violet light where it fluoresces with a brilliant greenish-yellow color. It is slowly soluble in water. The chemical formula according to Larsen is $3\ CaO.Na_2O.UO_3.3CO_2.SO_3.10H_2O$. Another specimen was examined at the University of Wyoming by Knight and Gilbert[3]. They found

[3] Knight, S. H. and Gilbert, C. S., The geological occurrence, chemical composition and optical properties of a new uranium mineral: paper presented before Chemistry section of A.A.A.S. at Denver, June, 1947, unpublished.

[redacted]

twice as much sodium as is shown in the above formula. The mineral contains about 20 percent uranium.

The schroeckingerite is by far the most abundant, and occurs in the largest pieces, in the clayey beds (fig. 8 and 9). When present in the sand it occurs as tiny disseminated flakes adhering to the sand grains or pebbles. Being soluble it is carried by moving waters and is often left as an efflorescence when water evaporates at or near the surface of the ground. Other soluble salts accompany the uranium mineral in places. White crusts on the surface of clayey soil were in some places found to contain schroeckingerite and in some of these, larger pieces of schroeckingerite were found beneath the surface. Pieces of damp clay after partly drying out had the mineral on the dry surface but none in the still damp interior. Tiny particles of the mineral were found on roots and on the walls of holes made by roots in the clay. No schroeckingerite was found more than 6 feet below the surface in the drill holes and in the face of the bluff none was found more than 5 feet below the top.

The distribution of the schroeckingerite in the face of the bluff is shown in the sketches (fig. 9). The surface exposures of the mineral and its occurrence in the drill holes are shown on the map and sections (fig. 8). The mineral is unevenly distributed in the deposit. It occurs in several places along the face of the bluff, but it does not extend very far into the bluff as none was found in drill holes 1, 2, 18, 19, 20, 21. It is exposed at the surface at several places along the dry stream bed which crosses the center of the map. The best drill hole samples are from hole 10 (D-10-3) and hole 23. Drill hole 11 does not extend through the sand but small pieces of schroeckingerite were seen adhering to the sand. The clay bed which contains the mineral in hole 10 was not reached in hole 11 and may contain schroeckingerite here. The deposit is therefore not necessarily delimited in this direction.

About 400 feet in a S10° W direction from hole 14 is a small area showing schroeckingerite in association with whitish crusts on the surface. Three rather closely spaced holes, which are beyond the limits of the map (fig. 8), were drilled, but no schroeckingerite was seen in the core. A 3.3 foot sample contains 0.006 percent E.U. Other surface occurrences were seen near the spring in the northwest corner of the map. These are also just thin surface coatings.

A search at night with an ultraviolet light was made along the banks of Lost Creek for about ½ mile each way from the bluff, but none was found nor was any found along the opposite bank at the bluff.

Radioactivity:--The results of determinations of equivalent uranium in crushed samples and of uranium in a small number of samples that were analyzed are shown graphically in fig. 8 or 9.

As the schroeckingerite has formed very recently, in fact is forming at the present time, the uranium is not in radioactive equilibrium; the more radioactive disintegration products, such as radium, have not formed in significant quantities. Therefore, samples in which the radioactivity is due to schroeckingerite contain more actual uranium than is indicated by their gamma ray count.

Three samples, all of which have abundant schroeckingerite (D-10-3, D-4-45, D-15-45), contain from 50 to 120 percent more uranium than equivalent uranium. The most highly radioactive sample (D-15-45) is from a 1.0-foot clay bed with abundant schroeckingerite in large pieces and contains 0.143 percent E.U., 0.330 percent uranium. Sand that does not contain schroeckingerite or clay is not radioactive. Some clayey sands and sands that have some schroeckingerite contain as much as 0.010 percent E.U.

A number of clay samples, some of which have small amounts of schroeckingerite and some of which have none, contain between 0.006 percent and 0.010 percent E.U. One clay sample (D-2-3), which has no schroeckingerite, contains 0.018 percent E.U. but only 0.004 percent uranium. This proves the presence of some radioactive material which does not derive the greater part of its radioactivity from uranium. Thorium is probably present, but the analyses for thorium are not yet available.

Sample D-6c-48 is a salt formed on a pile of moist clay at the foot of the bluff near the edge of the creek. It contains 0.015 percent E.U.

Sample D-22-2 is from a 2-foot clay bed that contains 0.019 percent E.U., 0.039 percent uranium, although no schroeckingerite was seen in the sample. If the determinations on this sample are correct, another recently formed uranium compound must be present.

Several exposures of clay and sandy clay beds which are lithologically similar to those exposed in the bluff at the schroeckingerite locality were examined for schroeckingerite and were tested with the counter by placing the counter tube in short drill holes. One of these is a high steep bank about one half mile down Lost Creek from the Lost Creek bluff. Some green sandy clay beds may contain as much as 0.005 percent E.U. Soft greenish clay may have about the same radioactivity in the floor of a playa (outcrops 151-154) and in exposures indicated on the map (fig. 4) by outcrops 137-139 and 172-176. No schroeckingerite was seen in any of these exposures.

The radioactivity of coals and associated shales in the Red Desert region has been discussed in the preceding pages (pp. 13-17). Only about one-fifth of the radioactivity of these beds is due to uranium, about the same ratio as for the non-schroeckingerite clay bed at the Lost Creek bluff discussed above.

Moderately radioactive clays and shales are of rather widespread occurrence in the Tertiary beds of the Red Desert region. It may be that these radioactive sediments are the direct source of the schroeckingerite.

<u>Reserves</u>:--Because of the spotty occurrence of the schroeckingerite, more closely spaced sampling is necessary to calculate measured reserves. It is possible on the basis of the present information to calculate indicated reserves.

In the area drilled and tested, about 120,000 tons of rock have an average radioactivity of 0.007 percent E.U. The uranium content may be less than or exceed 0.007 percent because comparisons of the radioactivity and uranium content of samples indicate that the uranium content of highly radioactive samples exceeds the equivalent uranium and that the uranium content of less radioactive samples is less than the equivalent uranium. The above tonnage was calculated for rocks in an area 800 feet long, 800 feet wide, and extending to an average depth of 4.4 feet below the surface. The rock was assumed to weigh 1 ton for each 15 cubic feet.

In calculating the reserves of the higher grade material, only those samples which contain more than 0.015 percent equivalent uranium and in which the radioactivity appears to be mainly due to schroeckingerite were used. One exception is D-23-2 which is relatively high in uranium but contains no schroeckingerite. By selectively choosing the more radioactive parts of the drilled area, about 16,000 tons of rock could be mined containing about 0.030 percent E.U.

The high-uranium sample (D-15-45, 0.330 percent uranium) was not used in determining grade of reserves.

The largest block of indicated higher grade ore is in an irregular area which includes drill holes 4, 23, 9 and 10 and the surface occurrences near the head of a dry stream bed. Drill hole 11 was drilled to a depth of 5.5 feet through sand and gravel and did not reach the clay bed which carries schroeckingerite in hole 10. Another block includes the surface exposures near drill hole 15. Other small blocks extend a short distance into the bluff from the sampled face. Only equivalent uranium determinations and chemical analyses were used in calculating high-grade reserves.

Conclusions:--The schroeckingerite deposit is estimated to have indicated reserves of 16,000 tons of material which contains about 0.030 percent E.U. Although the uranium content of these rocks is low, the fluorescent and water-soluble character of the mineral offers hope of inexpensive sorting and recovery.

Clay beds of low radioactivity are rather widespread in the Red Desert region, but no other deposits of schroeckingerite were found. Some shale beds that are associated with coals are relatively high in radioactivity, an unknown part of which is due to uranium.

It is suggested that the radioactive sediments are the direct source of the schroeckingerite.

CONCLUSIONS

Only a few of the rocks and mineral deposits are sufficiently radioactive to be worthy of further mention.

At the old Silver Cliff mine at Lusk, Niobrara County, Wyo., dumps contain 3000 to 5000 tons of uranophane-bearing quartzite with a uranium content of 0.075 to 0.100 percent. Several carloads of ore reported to contain 3 percent U_3O_8 have been shipped. Other deposits may exist to the south or to the north along this or other nearby fault zones.

At the schroeckingerite area in Sweetwater County, Wyoming, the reserves are estimated to be 16,000 tons of indicated ore containing 0.030 percent E.U. and 130,000 tons of indicated ore containing about 0.007 percent E.U.

Radioactive material has been found to accompany some manganese deposits, but the radioactivity at such places is largly due to thorium. In the Bear Lodge manganese area of northeastern Wyoming there may be as much as 100,000 tons of manganese ore which contains about 0.050 percent equivalent uranium, 0.012 to 0.016 percent uranium. An unknown amount of rock may contain as much as 0.14 percent thorium.

Some Tertiary shales associated with coals in the Red Desert region, Sweetwater County, Wyoming contain 0.010 to 0.015 percent equivalent uranium, only 0.002 to 0.004 percent uranium. The radioactive shales are rather widespread in the Red Desert. The most radioactive sample contained 0.020 percent E.U. of which 0.008 percent was uranium.

Table 2

Rocks tested in Wyoming

Out-crop num-ber	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in rep-ort	Location	Rocks tested
1	0.003	----------	----------	10	Hill north of Lusk, Wyo.	Granite gneiss,
2	0.002	----------	----------	10	----------	Granite.
3	0.004	----------	----------	10	----------	Manganese-stained granite.
4	0.004	----------	----------	10	----------	Grainte schist and quartzite float.
5	0.005	----------	----------	10	----------	Altered schistose granite.
6	0.000	----------	----------	10	----------	Granite gneiss.
7	0.001	----------	----------	10	----------	Granite gneiss.
8	0.006	----------	----------	10	----------	Granite gneiss.
9	0.000	----------	----------	10	----------	Large quartz mass in granite.
10	0.001	----------	----------	10	Highway 30, 1 mile west of Rawlins, Wyo.	Granite at edge of road.
11	0.000	----------	----------	16	Southwest of Wamsutter, Wyoming, 5 miles T.19N., R.94W., Sec. 7.	Coal bed reported to contain unusual elements.
12	0.001	----------	----------	16	----------	Coal bed.
13	0.000	----------	----------	16	----------	Dump of coal and overlying shale.
14	0.003	----------	----------	13	Highway 30 just east of Point of Rocks. Wyoming.	Almond coal group; overlying silt-stone.
15	0.000	----------	----------	13	----------	3½ feet of coal with shale layers.
16	0.003	----------	----------	13	----------	Underlying purplish siltstone.
17	0.001	----------	----------	13	----------	Siltstone 2 feet below coal.
18	0.002	----------	----------	13	Across highway----------	Brown shale above small coal bed.
19	0.003	----------	----------	13	----------	Brown fissile shale.
20	0.004	----------	----------	11	Leucite Hills, Wyo. on west edge of Zirkel Mesa.	Flow breccia beneath flow of leucite-rich andesite.
21	0.004	----------	----------	11	----------	Same breccia.
22	0.004	----------	----------	11	----------	Same breccia.
23	0.004	----------	----------	11	One half mile north.	Flow breccia on small dump.
24	0.004	----------	----------	11	----------	Flow.
25	0.002	----------	----------	11	East side of Orenda Mesa	Flow.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
26	0.006	----------	----------	11	----------	Flow.
27	0.003	----------	----------	11	----------	Flow.
28	0.003	----------	----------	11	----------	Flow.
29	0.005	----------	----------	11	----------	Uppermost flow.
30	0.006	----------	----------	11	----------	Uppermost flow.
31	0.004	----------	----------	11	----------	Pumice.
32	0.007	----------	----------	11	----------	Pumice.
33	0.002	----------	----------	11	Leucite Hills, N. side of Black Butte.	Large blocks of lava.
34	0.001	----------	----------	11	" " " " " " " " "	Large blocks of lava.
35	0.006	----------	----------	11	" " " " " " " " "	Large blocks of lava.
36	0.003	----------	----------	11	" " " " " " " " "	Large blocks of lava.
37	0.003	----------	----------	11	" " " " " " " " "	Large blocks of lava.
38	0.002	----------	----------	12	Leucite Hills, 2 or 3 miles northeast of Endlich Hill.	Black carbonaceous shale with narrow bands of coal.
39	0.003	----------	----------	12	" " " " " " " " "	Same beds.
40	0.002	----------	----------	11	Leucite Hills, Cross Mesa.	Large blocks of lava.
41	0.003	----------	----------	11	" " " " " " " " "	Large blocks of lava.
42	0.004	----------	----------	11	" " " " " " " " "	Large blocks of lava.
43	0.004	----------	----------	11	" " " " " " " " "	Large blocks of lava.
44	0.001	----------	----------	18	Short adit on north side of canyon just west of Green River, Wyoming.	Petroliferous Green River shale.
45	0.001	----------	----------	18		Petroliferous Green River shale.
46	0.003	----------	----------	16	North of Wamsutter, Wyo. 14 miles.	Shale overlying 10 feet coal.
47	0.000	----------	----------	16		Upper surface of coal.
48	0.002	----------	----------	16	" " " " " " " " "	Below top of coal 1 foot.
49	0.005	----------	----------	16	" " " " " " " " "	Below top of coal 3 feet.
50	0.001	----------	----------	16	" " " " " " " " "	Below top of coal 5 feet.
51	0.005	----------	----------	16	" " " " " " " " "	Below top of coal 7 feet.
52	0.005	----------	----------	16	" " " " " " " " "	Below top of coal 9 feet.
53	0.006	----------	----------	16	" " " " " " " " "	Below top of coal 10 feet in ash derived from coal.
54	0.019	----------	----------	15	North of Wamsutter, Wyo., 19.3 miles on east end of mesa.	Gray shale bed near base of about 10 feet of coals and shales. Similar to section in Fig. 5.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
55	0.007	----------------		25	Bluff 1 mile downstream	Gray-brown silty clay.
56	0.008	----------------		25	from Lost Creek Schroeck-	Green sandy clay.
57	0.006	----------------			ingerite locality.	Green sandy clay.
58	0.006	----------------		25	" " " " " " " " "	Green sandy clay.
59	0.004	----------------		16	Highway 30, 7 miles west	Black fissile shale.
60	0.004	----------------		16	of Rawlins, Wyoming.	Black fissile shale.
61	0.004	----------------		16	" " " " " " " " "	Black fissile shale.
62	0.003	----------------		16	" " " " " " " " "	Black fissile shale.
63	0.002	----------------		16	Highway 30, 7.2 miles	Black fissile shale.
64	0.001	----------------		16	west of Rawlins, Wyo.	Black fissile coaly shale.
65	0.004	----------------		16	" " " " " " " " "	Dark-brown hackly to fissile shale.
66	0.003	----------------		16	" " " " " " " " "	Dark-gray to black fissile shale.
67	0.003	----------------		16	" " " " " " " " "	Brown coaly shale with plant fragments.
68	0.003	----------------		16	" " " " " " " " "	Brown hackly shale.
69	0.002	----------------		16	Across road	Black fissile shale.
70	0.004	----------------		16	" " " " " " " " "	Dark-gray fissile shale.
71	0.003	----------------		16	" " " " " " " " "	Black fissile shale.
72	0.001	----------------		16	" " " " " " " " "	Dark-brown fissile shale, selenite.
73	0.002	----------------		16	" " " " " " " " "	Black fissile shale and brown shale.
74	0.004	----------------		16	" " " " " " " " "	Black fissile coaly shale.
75	0.001	----------------		16	" " " " " " " " "	Brown hackly shale.
76	0.004	----------------		16	" " " " " " " " "	Brown to black fissile shale.
77	0.003	----------------		16	" " " " " " " " "	Dark-gray to black fissile shale.
78	0.002	----------------		16	Highway 30, 719 miles	Dark-brown shale.
79	0.002	----------------		16	west of Rawlins, Wyo.	Black fissile shale.
80	0.003	----------------		16	" " " " " " " " "	Black fissile shale.
81	0.003	----------------		16	" " " " " " " " "	Thin coal bed.
82	0.002	----------------		16	" " " " " " " " "	Dark-brown siltstone.
83	0.003	----------------		16	Highway 30, 8.5 miles	Shaly coal.
84	0.004	----------------		16	west of Rawlins, Wyo.	Brown shale with coal seams.
85	0.003	----------------		16	Highway 30, 8.8 miles west of Rawlins, Wyo.	Brown coaly shale 4 feet thick.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
86	0.004	----------		16	Highway 30, 6.75 miles west of Rawlins, Wyo.	Brown fissile shale.
87	0.007	----------		16	Highway 30, 6.8 miles	Brown shale below coal.
88	0.005	----------		16	west of Rawlings, Wyo.	Same brown shale.
89	0.003	----------		16	" " " " " " " "	Coal bed above brown shale.
90	0.004	----------		16	" " " " " " " "	Brown shale above coal.
91	0.004	----------		16	" " " " " " " "	Higher gray to brown fissile shale.
92	0.001	----------		16	" " " " " " " "	Upper coal.
93	0.003	----------		16	" " " " " " " "	Dark-brown shale above upper coal.
94	0.006	----------		16	" " " " " " " "	Shale below upper coal.
95	0.006	----------		16	" " " " " " " "	Shale below upper coal.
96	0.002	----------		16	Highway 30, 16.4 miles	Clayey shale.
97	0.003	----------		16	west of Rawlings, Wyo.	Higher clayey shale.
98	0.003	----------		16	" " " " " " " "	Dark-brown to black coaly shale.
99	0.005	----------		16	" " " " " " " "	Gray clayey shale.
100	0.003	----------		16	" " " " " " " "	Dark-brown to black fissile shale.
101	0.005	----------		16	" " " " " " " "	Gray clayey shale.
102	0.001	----------		16	Highway 30, 30.3 miles	Gray-green clayey shale.
103	0.004	----------		16	west of Rawlins, Wyo.	Gray to brown clayey shale.
104	0.002	----------		16	" " " " " " " "	Gray to brown clayey shale.
105	0.003	----------		16	About 1 mile north of Highway 30, 29.3 miles	Clinkers and ash along vertical joint in shale above burned coal.
106	0.011	----------		16	west of Rawling, Wyo.	Clinkers and ash from burned coal.
107	0.011	0.020	----------	16	" " " " " " " "	Clinkers and ash from burned coal. Sample U-17-45.
108	0.010	----------		16	" " " " " " " "	Clinkers and ash from burned coal.
109	0.007	----------		16	" " " " " " " "	Partly burned coal.
110	0.006	----------		16	In gully to the northwest.	Partly burned shaly coal.
111	0.007	----------		16	" " " " " " " "	Brick-red burned coaly shale.
112	0.005	----------		16	" " " " " " " "	Shaly coal.
113	0.006	----------		16	" " " " " " " "	Shale and ash and yellow powder.
114	0.015	----------		16	" " " " " " " "	Fine powdery ash with shiny black flakes.
115	0.009	----------		16	" " " " " " " "	Same ash 1 foot higher.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
116	0.010	———	———	16	In gully to the northwest.	Same ash another foot up.
117	0.006	———	———	15	" " " " " " " "	Gray clay.
118	0.004	———	———	16	" " " " " " " " "	Dark brown shale; top of section.
119	0.005	———	———	16	North of Wamsutter, Wyo.,	Varicolored shale.
120	0.004	———	———	16	2.9 miles toward Lost Creek.	Slacked coal.
121	0.004	———	———	16	" " " " " " " " "	Gray shale above coal.
122	0.004	———	———	16	" " " " " " " " "	Grey shale beneath coal.
123	0.002	———	———	16	" " " " " " " " "	Gray shale beneath coal.
124	0.001	———	———	16	North of Wamsutter, Wyo., 13.3 miles toward Lost Creek.	Coal bed.
125	0.006	———	———	15	North of Wamsutter, Wyo.; 18.1 miles toward Lost	Laminated buff silty shale at top of coal section. 1 foot.
126	0.011	———	———	15	Creek; 100 ft. east of the dirt road.	Thin-bedded buff silty shale with 2-inch coaly shale at top. 1.1 feet.
127	0.015	0.012	———	16	" " " " " " " " "	Platy lignitic thin-bedded shale. 0.1 feet. Part of sample W-18-45.
128	0.025	0.012	———	15	" " " " " " " " "	Buff blocky shale; 0.1 feet. Part of sample W-18-45.
129	0.018	0.012	———	15	" " " " " " " " "	Platy thin-bedded lignitic shale. 0.4 feet thick. Part of W-18-45.
130	0.009	0.012	———	15	" " " " " " " " "	Laminated to thin-bedded brown shale 1.8 feet thick; part of W-18-45.
131	0.014	———	———	15	" " " " " " " " "	Laminated to thin-bedded brown lignitic shale, 1.5 feet thick.
132	0.015	———	———	15	" " " " " " " " "	Medium-gray platy shale, coaly. Plant fragments; 0.5 feet thick.
133	0.011	———	———	15	" " " " " " " " "	At base of 0.7 feet soft black coal and top of 1.5 feet shaly brown coal
134	0.009	———	———	15	" " " " " " " " "	Center of 1.5 feet shaly brown coal noted above.
135	0.016	———	———	15	" " " " " " " " "	Soft black coal and platy brown shaly coal. 1.1 feet thick.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent Uranium	Page in report	Location	Rocks tested
136	0.018	----------		15	Creek; 100 ft. east of the dirt road.	Bottom of exposure in rock noted above. Base of coal not exposed.
137	0.008	----------		35	East 0.3 miles from township corner 22, 23, N; 93, 94 W. See fig. 4.	Gray-green gritty clay.
138	0.004	----------		35		Gray-green gritty clay.
139	0.003	----------		35		Coarse sand.
140	0.013	----------		15	N. of Wamsutter, Wyo. about 1.7 miles S. 70 E. from sample W-18-45. Fig. 4.	Top of coal section. Gray hackly clay 1 foot with 0.2 feet coaly shale at top.
141	0.014	----------		15	" " " " " " " " "	Brown shale, 1 foot.
142	0.013	----------		15	" " " " " " " " "	Brown shale, another foot.
143	0.016	----------		15	" " " " " " " " "	Brown fissile shale with plants, 2 feet thick.
144	0.018	----------		15	" " " " " " " " "	Base of 0.5 feet black fissile shale with coal seams and top of brown fissile shale with plant remains 3 feet thick.
145	0.015	----------		15	" " " " " " " " "	Middle of 3 feet brown fissile shale noted above.
146	0.016	----------		15	" " " " " " " " "	Brown clayey to fissile shale 3 feet thick.
147	0.010	----------		15	" " " " " " " " "	Platy coal and brown lignitic shale 2.5 feet thick.
148	0.009	----------		15	" " " " " " " " "	Base of 1 foot brown fissile shale and top of 30 feet of silty to sandy green and yellow clays.
149	0.006	----------		15	" " " " " " " " "	Below top of green and yellow clays noted above 5 feet.
150	0.005	----------		15	" " " " " " " " "	Lower in clays by 10 feet.
151	0.006	----------		35	North of Wamsutter, Wyo., 11.4 miles by road and then 2.5 miles east in valley to playa near well.	Gamma ray count from car above saline playa sediments derived from cliffs containing radioactive coal sections.
152	0.010	----------		35	See fig. 4.	In drill hole 1 foot below surface.
153	0.009	----------		35	" " " " " " " " "	In drill hole 3 feet below surface.
15[illegible]	0.006	----------		35	" " " " " " " " "	Surface of playa.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
155	0.005	----------------		15	About 2 miles N. 15 E. from well noted above. fig. 4.	Top of coal section. Purplish shale with brown layers 1.3 feet thick overlain by 0.3 feet coal.
156	0.001	----------------		15	" " " " " " " " " "	Gray to yellow shale 2 feet thick overlain by 1 foot of coal and shale
157	0.016	----------------		15	" " " " " " " " " "	Base of 3 feet of alternating coal and gray shale and top of 3 feet of lignitic shale with coal layers.
158	0.013	----------------		15	" " " " " " " " " "	Center of 1 foot light-gray heckly shale overlain by 0.2 feet coal and underlain by coal.
159	0.010	----------------		15	" " " " " " " " " "	1 foot below top of 4-foot coal bed
160	0.016	----------------		15	" " " " " " " " " "	3 feet below top of same coal, shaly.
161	0.019	0.019		15	" " " " " " " " " "	Ash from burned coal. Sample W-19-45.
162	0.005	----------------		15	North of Wamsutter, Wyo., about 2.7 miles east of sample locality W-18-45	Top of coal section tested elsewhere in area but here containing less coal. 3 feet buff silty shale.
163	0.007	----------------		15	See fig. 4.	Top of 4 feet fissile shale.
164	0.010	----------------		15	" " " " " " " " " "	Center of 4 feet fissile shale noted above.
165	0.011	----------------		15	" " " " " " " " " "	Top of 2 feet red-brown fissile shale with plant fragments.
166	0.010	----------------		15	" " " " " " " " " "	Base of shale noted above and top of 0.4 feet brown-gray sand.
167	0.008	----------------		15	" " " " " " " " " "	Center of 2 feet gray clayey shale.
168	0.006	----------------		15	" " " " " " " " " "	1.6 feet coarse sand.
169	0.009	----------------		15	" " " " " " " " " "	Center of 1.1 feet brown fissle shale.
170	0.009	----------------		15	" " " " " " " " " "	Center of 1.5 feet brown shale.
171	0.015	0.014		15	" " " " " " " " " "	Top of 1-foot brown fissile shale.
172	0.014	0.014		15	" " " " " " " " " "	Base of same bed. Sample W-20-45.
173	0.009	----------------		15	Moved to adjacent gully.	3.5 feet gray-brown shale.
174	0.013	----------------		15	" " " " " " " " " "	Brown fissile shale with plant remains. Base not exposed.
175	0.006	----------------		35	Four and one half miles to North in opp[illegible]te valley wall.	Beds similar to above section. Gray clayey shale between coal beds.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
176	0.006	————		35	Four and one half miles to north in opposite valley wall.	Brown shale between coal beds.
177	0.014	————		15	North of Wamsutter, Wyo., 2 miles N 30 E, of Mesa.	Top of coal section. Center of 3-foot dark-gray hackly shale.
178	0.006	————		15	Fig. 4.	Center of 1.2 feet black fissile coaly shale.
179	0.023	0.024	————	15	" " " " " " " " " "	Center of 0.7 feet black hackly to fissile shale underlying 0.4 feet gray shale which underlies 0.3 feet buff sandstone. Sample W-21-45.
180	0.015	————		15	" " " " " " " " " "	Center of 2.8 feet brown to gray hackly shale.
181	0.011	————		15	" " " " " " " " " "	Near top of 1.9 feet dark-brown fissile shale.
182	0.016	————		15	" " " " " " " " " "	Below top of gray hackly shale 1.3 feet. Base not exposed.
183	0.002	————		16	Eight miles north of Lost Creek schroeckingerite locality.	Coal and shale section. Brown fissile shale with abundant plant remains.
184	0.003	————		16	" " " " " " " " " "	Same beds.
185	0.001	————		16	" " " " " " " " " "	Yellow-gray shale.
186	0.005	————		16	" " " " " " " " " "	Red-brown fissile shale.
187	0.004	————		16	" " " " " " " " " "	Red-brown fissile shale.
188	0.002	————		19	Little Popo Agie Canyon near Lander, Wyoming.	Phosphoria formation. Base of massive limestone and top of 10 feet of thin-bedded interbedded limestone and shale.
189	0.001	————		19	" " " " " " " " " "	2.5 feet below base of massive limestone.
190	0.001	————		19	" " " " " " " " " "	6 feet below base of massive limestone.
191	0.001	————		19	" " " " " " " " " "	7 feet below base of massive limestone.
192	0.000	————		19	" " " " " " " " " "	8.2 feet below base of massive limestone.
193	0.001	————		19	" " " " " " " " " "	Base of 10 feet of thin-bedded interbedded limestone and shale. Top of lower massive limestone.

Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
194	0.004	————————		19	A second trench farther up slope, and higher in Phosphoria formation.	Phosphoria formation 0.3 feet below massive limestone in 0.8 feet gray-green shale.
195	0.001	————————		19	" " " " " " " " "	Center of 1-foot limestone bed 2 feet below massive limestone.
196	0.003	————————		19	" " " " " " " " "	2.5 feet below massive limestone in 0.2 feet phosphate rock below 0.2 feet broken limey shale and above 0.3 feet limestone.
197	0.004	————————		19	" " " " " " " " "	3.3 feet below massive limestone in gray shale with brown stains below 0.3 feet limestone and above 0.3 feet phosphate rock.
198	0.005	————————		19	" " " " " " " " "	4.3 feet below massive limestone in 4.0 feet black fossiliferous oolitic phosphate rock.
199	0.005	————————		19	" " " " " " " " "	5.3 feet below massive limestone in the 4.0 feet phosphate bed.
200	0.006	————————		19	" " " " " " " " "	6.9 feet below massive limestone 1 foot above base of 4 feet phosphate bed.
201	0.003	————————		19	A third trench farther up slope and higher in	2.5 feet below massive limestone in gray shale.
202	0.001	————————		19	Phosphoria formation.	5 feet below massive limestone in shale with two chert layers and some bitumin.
203	0.003	————————		19	" " " " " " " " "	8.3 feet below massive limestone in shale with brown-stained calcite nodules.
204	0.002	————————		19	" " " " " " " " "	11.3 feet below massive limestone in shale.
205	0.002	————————		19	" " " " " " " " "	13.5 feet below massive limestone in shale.
206	0.002	————————		19	" " " " " " " " "	16.5 feet below massive limestone in shale.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
207	0.003	----------		19	A third trench farther up slope and higher in Phosphoria formation.	19 feet below massive limestone in shale.
208	0.003	----------		19	" " " " " " " " "	23 feet below massive limestone in shale.
209	0.003	----------		19	" " " " " " " " "	26 feet below massive limestone in shale.
210	0.001	----------		19	" " " " " " " " "	29 feet below massive limestone at base of shale section and top of another massive limestone.
211	0.000	----------		19	Fourth and highest trench on slope.	At base of thin-bedded chert and top of 4-foot greenish calcareous shale.
212	0.000	----------		19	" " " " " " " " "	Center of the 4-foot greenish shale.
213	0.001	----------		19	" " " " " " " " "	1 foot shaly oolitic carbonate rock which is 50 to 60 feet beneath the 4-foot greenish shale and separated from it by thin bedded calcareous shales and limestones.
214	0.004	----------		19	" " " " " " " " "	Center of 2.3 feet coarsely oolitic black phosphate rock and separated from the shaly oolitic carbonate roc by one foot of gray limestone.
215	0.002	----------		19	" " " " " " " " "	1 foot black to dark-brown oolitic phosphate rock beneath 1 foot phosphatic limestone.
216	0.004	----------		19	" " " " " " " " "	2 feet dark-brown to black phosphate rock beneath 1-foot limestone.
217	0.004	----------		19	" " " " " " " " "	Base of above phosphate bed.
218	0.002	----------		19	" " " " " " " " "	Calcareous shale about 40 feet below phosphate 217.
219	0.000	----------		19	" " " " " " " " "	Limey beds in shale about 55 feet below phosphate 217.
220	0.002	----------		19	" " " " " " " " "	Another 3 feet down in limey shale.
221	0.003	----------		19	" " " " " " " " "	Another 4 feet down in limey shale.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent urnaium	Page in report	Location	Rocks tested
223	0.003	----------	----------	19	Fourth and highest trench on slope.	Another 4 feet down in limey shale.
223	0.001	----------	----------	19	" " " " " " " " " "	Another 5 feet down in limey shale.
224	0.001	----------	----------	19	" " " " " " " " " "	Another 3 feet down in limey shale.
225	0.002	----------	----------	19	" " " " " " " " " "	Another 3 feet down in gray clay.
226	0.003	----------	----------	19	" " " " " " " " " "	Another 3 feet down in limey shale.
227	0.001	----------	----------	19	" " " " " " " " " "	Another 5 feet down in limey shale. immediately above a massive limesto
228	0.004	----------	----------	19	South Fork Little Wind River near Lander, Wyoming	One foot below top of 4-foot black to dark-brown oolitic phosphate bed
229	0.007	----------	----------	19	Phosphoria formation	Two feet below top of same bed.
230	0.004	----------	----------	19	" " " " " " " " " "	Three feet below top of same bed.
231	0.002	----------	----------	19	Baldwin Creek near Lander, Wyoming.	Phosphoria formation. Top of upper Phosphate zone. Soft brown siltstone.
232	0.003	----------	----------	19	" " " " " " " " " "	Top of 2.5 feet dark-brown fissile to platy shale.
233	0.002	----------	----------	19	" " " " " " " " " "	Near base of the 2.5 feet shale.
234	0.004	----------	----------	19	" " " " " " " " " "	0.2 feet black oolitic phosphate rock.
235	0.005	----------	----------	19	" " " " " " " " " "	Center of 0.9 feet brown to yellow clayey shale.
236	0.005	0.005	----------	19	" " " " " " " " " "	Near top of 1.8 feet dark-brown to black phosphate rock, platy and coarsely oolitic. The upper phosphate bed. Sample W-22-45.
237	0.008	0.005	----------	19	" " " " " " " " " "	Near base of upper phosphate bed. Sample W-22-34.
238	0.005	----------	----------	19	" " " " " " " " " "	One foot below top of 2.5 feet of massive phosphatic limestone containing coarse brown phosphate pellets.
239	0.005	----------	----------	19	" " " " " " " " " "	Near base of 2.5 feet bed noted abo
240	0.002	----------	----------	19	" " " " " " " " " "	Center of 2.5 feet glauconitic thin-bedded limestone.
24	0.001	----------	----------	19	Same locali	Phosphoria formation, lower pho phate zone. Base of limestone thin shale partings.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
242	0.004	0.007	----------	19	Same locality.	Upper contact of 1-foot bed of dark gray to black oolitic hard phosphate rock. Part of sample W-23-45.
243	0.004	0.007	----------	19	" " " " " " " " "	Upper part of same phosphate bed.
244	0.008	0.007	----------	19	" " " " " " " " "	Base of same phosphate bed. Part of sample W-23-45.
245	0.006	----------	----------	19	" " " " " " " " "	Top of massive limestone with brown phosphate pellets near top.
246	0.001	----------	----------	19	" " " " " " " " "	One foot below top of same limestone
247	0.000	----------	----------	18	Rocky Ford, Wyoming.	Minnelusa sandstone asphaltite bed about 2 feet thick.
248	0.000	----------	----------	18	" " " " " " " " "	Same bed along outcrop where it is about 1 foot thick.
249	0.004	----------	----------	10	C.C.C. road from Lander	Granite.
250	0.004	----------	----------	10	to Atlantic City, Wyo.	Granite.
251	0.005	----------	----------	10	via Sinks Canyon. Locality is 2 miles beyond Frye Lake.	Granite.
252	0.004	----------	----------	10	Same road near Sawmill Cr.	Granite
253	0.004	----------	----------	10	" " " " " " " " "	Medium to coarse-grained granite.
254	0.003	----------	----------	10	Same road near Rock Creek.	Pegmatite dike 3 feet wide.
255	0.003	----------	----------	10	" " " " " " " " "	Coarse-grained weathered granite.
256	0.001	----------	----------	10	" " " " " " " " "	Dark dike cutting granite.
257	0.001	----------	----------	29	Same road. Dump near cave-	Black, brown, and red-stained quartz
258	0.002	----------	----------	29	shaft close to National Forest Boundry.	Quartz ore near shaft house.
259	0.000	----------	----------	12	Lander to Rock Springs road near junction with Highway 287.	Dark-gray fissile shale, Cretaceous?
260	0.003	----------	----------	12	Road from Lander to Rock Springs near turnoff to	Dark-gray and brown fissile shale. Cretaceous?
261	0.004	----------	----------	12	Little Popo Agie.	Same shale.
262	0.003	----------	----------	12	" " " " " " " " "	Same shale.
263	0.002	----------	----------	12	Highway 287 about 20 miles	10 feet of black fissile shale, Mancos?
264	0.003	----------	----------	12	east of Lander.	Same shale.

Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
265	0.002	---------------		12	Highway 287 about 20 miles east of Lander.	A 4-foot black fissile shale bed
266	0.001	---------------		12	" " " " " " " " "	Thin coaly shale.
267	0.003	---------------		10	About 45 miles southeast	Light-colored granite.
268	0.003	---------------		10	of Lander in Sweetwater arch. T30 N., R. 92 W.	Gneissic granite.
269	0.003	---------------		10	" " " " " " " " "	Granite gneiss interlayered with pyroxenite gneiss.
270	0.001	---------------		30	Bridger Mountains north of	Leucocratic pegmatite.
271	0.002	---------------		30	Shoshoni, Wyoming.	Pegmatite.
272	0.000	---------------		30	T. 40 N. R. 93 W. Sec. 27,	Another pegmatite.
273	0.001	---------------		30	28.	Pegmatite.
274	0.002	---------------		30	" " " " " " " " "	Another pegmatite
275	0.003	---------------		30	" " " " " " " " "	Fault zone in schist.
276	0.002	---------------		12	" " " " " " " " "	Dark mica schist.
277	0.001	---------------		12	" " " " " " " " "	Light-colored quartz-mica schist.
278	0.003	---------------		30	" " " " " " " " "	Pegmatite dike.
279	0.002	---------------		30	" " " " " " " " "	Pegmatite boulders.
280	0.002	---------------		30	" " "" " " " " " "	Another pegmatite dike.
281	0.001	---------------		10	Greybull to Sheridan, Wyo.	Large granite boulder.
282	0.002	---------------		10	across Bighorn Mountains	Another large granite boulder.
283	0.006	---------------		10	on U. S. 14, East of Shell	A pink granite boulder.
284	0.005	---------------		10	16 miles.	Another part of pink granite boulder.
285	0.004	---------------		10	" " " " " " " " "	Another part of pink granite boulder
286	0.000	---------------		10	" " " " " " " " "	A different pink granite boulder.
287	0.001	---------------		10	" " " " " " " " "	Another pink granite boulder.
288	0.004	---------------		10	" " " " " " " " "	Another pink granite boulder.
289	0.003	---------------		10	" " " " " " " " "	Another pink granite boulder.
290	0.002	---------------		10	Same road above Shell River	Granite.
291	0.003	---------------		10	Ranger Station.	Nearby granite.
292	0.004	---------------		10	" " " " " " " " "	Another nearby granite.
293	0.006	---------------		10	Same road, upland of	Weathered shale or clay in road gutter.
294	0.004	---------------		10	Bighorn Mountains.	Same shale or clay.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
295	0.006	---------------		10	Same road near sharp turn	Reddish granite.
296	0.004	---------------		10	on east side of mountains	Same.
297	0.005	---------------		10	near eastern edge of	Same.
298	0.005	---------------		10	granite.	Same.
299	0.007	---------------		10	" " " " " " " " "	Same.
300	0.007	---------------		10	" " " " " " " " "	Same.
301	0.006	---------------		10	" " " " " " " " "	Same.
302	0.010	---------------		10	" " " " " " " " "	Same.
303	0.004	---------------		17	Highway from Sheridan to Gillette, Wyo. 10.9 miles from Sheridan.	Ash and clinkers from burned coal bed.
304	0.003	---------------		17	Same highway, 15.7 miles	Thin ash beds in baked shale.
305	0.004	---------------		17	from Sheridan.	Thin ash beds in baked shale.
306	0.002	---------------		17	" " " " " " " " "	Same.
307	0.006	---------------		17	" " " " " " " " "	Mixed shale and cinders from coal.
308	0.005	---------------		17	Same highway, 16.0 miles	Burned bony coal bed.
309	0.005	---------------		17	from Sheridan.	Same.
310	0.003	---------------		17	" " " " " " " " "	Nearby thin ash bed.
311	0.004	---------------		17	" " " " " " " " "	A higher narrow ash bed.
312	0.002	---------------		17	" " " " " " " " "	Dark reddish-brown concretion.
313	0.003	---------------		17	" " " " " " " " "	Unburned bony coal.
314	0.001	---------------		17	Same highway, 16.6 miles	Coal bed.
315	0.003	---------------		17	from Sheridan.	Shale overlying the coal bed.
316	0.002	---------------		17	" " " " " " " " "	Same.
317	0.003	---------------		17	Same highway, 50.6 miles	Chocolate-colored shale.
318	0.002	---------------		17	from Sheridan.	Light gray to brown silty shale.
319	0.004	---------------		17	Same highway, 51.1	Yellow fissile shale.
320	0.004	---------------		17	miles from Sheridan.	Baked red shale.
321	0.003	---------------		17	" " " " " " " " "	Dark-gray fissile shale.
322	0.001	---------------		17	Same highway, 65.9 miles	Dark-gray fissile shale.
323	0.001	---------------		17	from Sheridan.	Dark-gray fissile shale.
324	0.002	---------------		17	" " " " " " " " "	Dark-gray fissile shale.
325	0.002	---------------		17	" " " " " " " " "	Brown fissile shale with lignite.
326	0.001	---------------		17	Same highway, 71.9 miles	Shaly coal bed 4 feet thick.
327	0.001	---------------		17	from Sheridan.	Red-brown fissile shale bed 1 foot thick.

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Outcrop number	Percent E.U. Outcrop test	Percent E.U. Sample test	Percent uranium	Page in report	Location	Rocks tested
328	0.000		————	17	Same highway, 71.9 miles from Sheridan.	Unburned coal and lignitic shale bed 4 feet thick.
329	0.001		————	17	Same highway, 76.9	Coaly fissile shale.
330	0.001		————	17	miles from Sheridan.	Light-colored ash from coal bed.
331	0.001		————	17	Same highway, 88.6	Coal bed.
332	0.000		————	17	miles from Sheridan.	Coal bed.
333	0.001		————	17	" " " " " " " " "	Red and yellow ash mixed with partly burned coal.
334	0.003		————	17	Same highway, 96 miles	Brown lignitic shale.
335	0.001		————	17	from Sheridan.	Shaly coal.
336	0.002		————	17	Same highway, 106.2 miles	Gray fine-grained sandstone.
337	0.000		————	17	from Sheridan.	Tarvia road surface on highway.
338	0.001		————	17	" " " " " " " " "	Gray fine-grained sandstone.
339	0.000		————	17	Same highway, 108 miles from Sheridan.	Brown coaly shale.
340	0.002		————	17	Highway from Gillette to Casper 42 miles out.	Ash, clinkers and burned shale.
341	0.003		————	11	Twogwotee Pass between	Basic volcanic agglomerate.
342	0.003		————	11	Moran and Dubois, Wyo.	Basic volcanic agglomerate.