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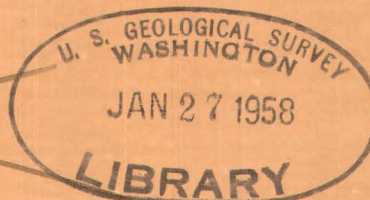
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# Stratigraphic Sections of the Phosphoria Formation in Wyoming, 1951

By T. M. Cheney, <sup>1926-7</sup> R. P. Sheldon, <sup>1923-</sup> R. G. Waring, and M. A. Warner

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*Trace Elements Investigations Report 377*

UNITED STATES DEPARTMENT OF THE INTERIOR

✓ U.S. GEOLOGICAL SURVEY

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Geology and Mineralogy

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UNITED STATES DEPARTMENT OF THE INTERIOR

✓  
U.S. GEOLOGICAL SURVEY

STRATIGRAPHIC SECTIONS OF THE PHOSPHORIA FORMATION

IN WYOMING, 1951\*

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By

*Bernice Phillips* 4/1/57  
Signature of person making change; and date

T. M. Cheney, R. P. Sheldon,  
R. G. Waring, and M. A. Warner

November 1953

Trace Elements Investigations Report 377

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\*This report concerns work done partly on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

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## STRATIGRAPHIC SECTIONS OF THE PHOSPHORIA FORMATION IN WYOMING, 1951

by T. M. Cheney, R. P. Sheldon, R. G. Waring, and M. A. Warner

### INTRODUCTION

The U. S. Geological Survey has measured and sampled the Phosphoria formation of Permian age at many localities in Wyoming and adjacent states. These data will not be fully synthesized for many years, but segments of the data, accompanied by little or no interpretation, are published as preliminary reports as they are assembled. This report, which contains abstracts of the sections measured in western Wyoming (fig. 1) during 1951, is the third Wyoming report of this series. The field and laboratory procedures adopted in these investigations are described in a previous report (McKelvey and others, 1953b).

Many people have taken part in this investigation. J. W. Hill, H. W. Peirce, J. A. Peterson, and R. A. Smart participated in the description of strata and the collection of samples referred to in this report. The laboratory preparation of samples for chemical analysis was done in Denver, Colo., under the direction of W. P. Huleatt.

Most of the  $P_2O_5$  and acid-insoluble analyses were made for the Survey by the U. S. Bureau of Mines at the Northwest Electrodevelopment Laboratory, Albany, Oreg., under the direction of S. M. Shelton and M. L. Wright. The remainder were made in the Trace Elements Section laboratory of the Survey in Denver, Colo., under the direction of L. F. Rader, by chemists G. W. Boyes, J. A. Miskowicz, and N. Morris. The radioactivity analyses were made in this laboratory by S. P. Furman and J. N. Roshold and the

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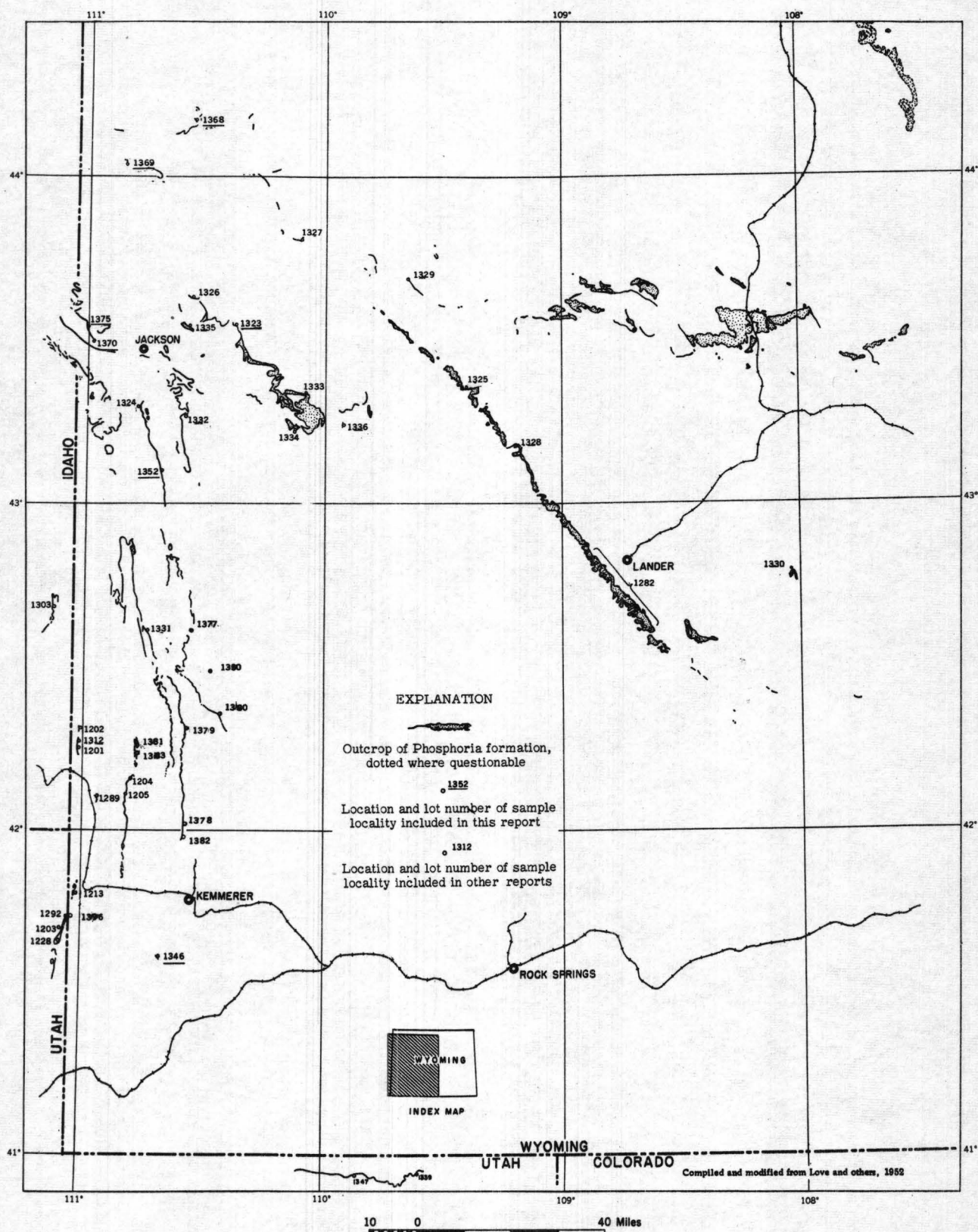


Figure 1.—Outcrops of the Phosphoria formation in Wyoming and localities sampled

chemical uranium analyses were made in this laboratory by Boyes, Miskowiec, Morris, and J. S. Wahlberg.

K. S. Bergman compiled most of the data and Anita Wise organized most of the tabular data.

#### Acknowledgments

Special thanks are due J. D. Love, W. W. Rubey, and J. Steele Williams, who contributed much in the way of advice and suggestions in planning and organization of the field program. The cost of both the field and laboratory investigations has been borne partly by the Division of Raw Materials of the Atomic Energy Commission.

It is a pleasure to acknowledge the fine cooperation extended to the field parties by local residents, property owners, and phosphate companies, who furnished information and services and gave access to property.

#### STRATIGRAPHY OF THE PHOSPHORIA FORMATION IN WESTERN WYOMING

In northwestern Wyoming the Phosphoria formation is about 200 feet thick and has been divided into five members. These members have been tentatively correlated with the five members in Montana that are designated A, B, C, D, and E, from oldest to youngest (Klepper and others, in McKelvey, 1949). Member A overlies the Tensleep sandstone of Pennsylvanian age and consists of cherty carbonate and detrital rocks; it may be equivalent to the upper part of the Wells formation in Idaho. Members B, C, and D, composed respectively of phosphatic, cherty, and phosphatic rocks, are equivalent to the phosphatic shale, Rex chert, and upper shale members of



the Phosphoria in Idaho (Sheldon in Swanson and others, 1953). Member E, not yet recognized in southeastern Idaho, consists of chert, sandstone, and carbonate rock and is overlain by the Dinwoody formation of Triassic age.

The Phosphoria formation in southwestern Wyoming consists of a lower phosphatic shale member, 95-145 feet in thickness that is overlain by the Rex chert member, cherty limestone 65-145 feet in thickness; and is capped by an upper shale member, 15-60 feet in thickness (fig. 2). It overlies the Wells formation of Pennsylvanian age and underlies the Dinwoody formation of Triassic age. Although the Wells formation consists largely of quartzose sandstone, calcareous in part, the upper 25 feet or more is dark-gray limestone. It is equivalent to the upper member of the Wells formation in Idaho and may be the correlative of the lowermost member (A member) of the Phosphoria formation in northwestern Wyoming and Montana and the lower limestone member of the Park City formation in Utah (McKelvey, 1949). The Dinwoody formation consists of limestone, calcareous siltstone, and sandstone.

The correlation of individual beds of the phosphatic shale members with those in adjacent parts of Idaho, Montana, and Utah will be considered in greater detail in a later publication. In southwestern Wyoming most phosphate bearing layers are in the phosphatic shale member of the Phosphoria formation; in northwestern Wyoming, however, the B member contains most of the phosphate bearing layers. The upper shale member in southwestern Wyoming and its correlative, the D member, in northwestern Wyoming contain thin layers of phosphatic chert and locally, significant phosphatic layers.

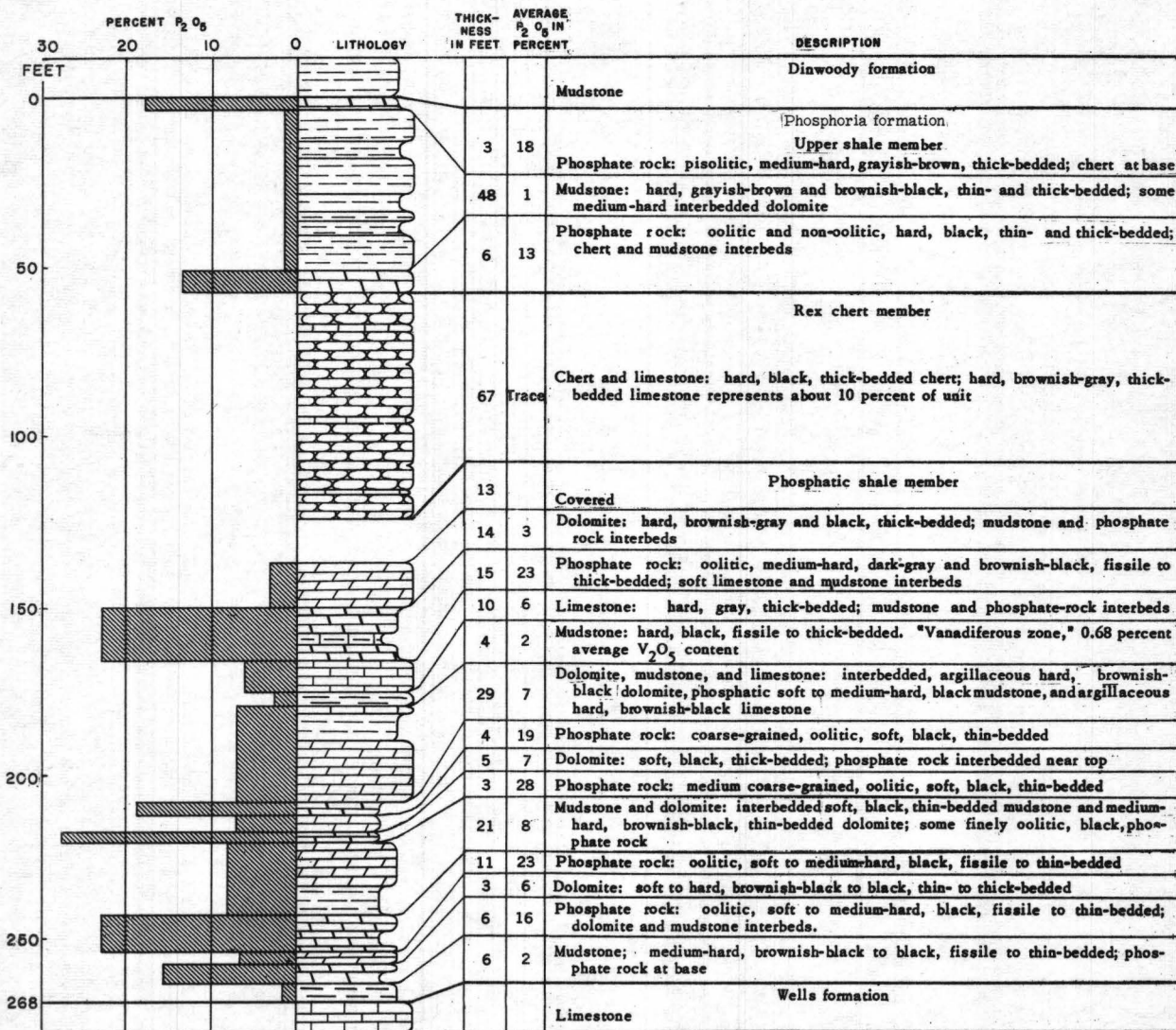


Figure 2.—Generalized section of the Phosphoria formation at Coal Canyon, Wyoming, lot number 1201

## STRATIGRAPHIC SECTIONS

Analytical data and abstracts of stratigraphic sections measured at seven localities follow. Their locations, as well as the locations of those reported previously (McKelvey and others, 1953b, Sheldon and others, 1953) and of others to be reported later, are shown in figure 1.

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Red Creek, Wyo., lot 1368

Phosphoria formation measured and sampled at natural exposures on Red Creek about  $\frac{1}{2}$  mile from its juncture with the Snake River, 6 miles east of the Snake River Ranger Station, Yellowstone National Park. The area is unsurveyed. Formation outcrops on the north flank of a small anticline. Beds strike north-south and dip 20° E. Section measured and sampled by R. P. Sheldon, R. G. Waring, T. M. Cheney, and R. A. Smart in August 1951. Samples analyzed by U. S. Bureau of Mines laboratory, Albany, Oreg.

Samples analyzed for eU and chem. U by the U. S. Geological Survey laboratory, Geochemistry and Petrology Branch.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Uranium content (percent)	
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble		eU	Chem. U
Phosphoria formation—top not exposed								
	A few feet of cover separate the Phosphoria formation from the Chugwater formation.							
P-33	Sandstone; fos. col. no. 12553 <sup>1</sup> -----	--	8.2	--	--	8.2	--	--
P-32	Chert, sandy -----	--	3.6	--	--	11.8	--	--
P-31	Chert -----	--	7.1	--	--	18.9	--	--
P-30	Chert -----	--	8.5	--	--	27.4	--	--
P-29	Chert -----	--	3.4	--	--	30.8	--	--
P-28	Chert -----	--	2.7	--	--	33.5	--	--
P-27	Chert -----	--	4.8	--	--	38.3	--	--
P-26	Chert -----	--	2.2	--	--	40.5	--	--
P-25	Chert -----	--	2.5	--	--	43.0	--	--
P-24	Chert -----	--	6.5	--	--	49.5	--	--
P-23	Chert -----	--	4.3	--	--	53.8	--	--
P-22	Phosphate rock, argillaceous; fos. col. no. 12552	6581- RPS	.6	20.4	39.6	54.4	0.005	0.004
P-21	Sandstone -----	--	4.5	--	--	58.9	--	--
P-20	Chert, sandy and phosphatic sandstone -----	--	6.7	--	--	65.6	--	--
P-19	Sandstone, phosphatic and cherty sandstone ----	--	2.2	--	--	67.8	--	--
P-18	Sandstone, cherty -----	--	5.7	--	--	73.5	--	--
P-17	Sandstone, cherty -----	--	1.5	--	--	75.0	--	--
	The remainder of the section was measured on opposite (east) side of Red Creek. The correlation between segments is reliable.							
P-16	Chert, sandy and cherty sandstone -----	--	12.5	--	--	87.5	--	--
P-15	Sandstone, carbonatic -----	--	.6	--	--	88.1	--	--
P-14	Sandstone, cherty; fos. col. no. 12551 -----	--	6.6	--	--	94.7	--	--
P-13	Chert, sandy -----	--	2.5	--	--	97.2	--	--
P-12	Mudstone, phosphatic and mudstone -----	6582-TMC	.5	12.3	54.9	97.7	.008	.004
P-11	Sandstone, carbonatic, phosphatic chert, and chert -----	6583-TMC	1.5	9.5	49.1	99.2	.013	.010

<sup>1</sup> Fossil collection made by J. E. Smedley, Paleontology and Stratigraphic Branch, U. S. Geological Survey.

Red Creek—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Uranium content (percent)	
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble		eU	Chem. U
P-10	Sandstone -----	--	2.9	--	--	102.1	--	--
P- 9	Carbonate rock, sandy; fos. col. no. 12550-----	--	.9	--	--	103.0	--	--
P- 8	Sandstone, carbonatic -----	--	3.0	--	--	106.0	--	--
P- 7	Sandstone; fos. col. no. 12549 -----	--	15.0	--	--	121.0	--	--
P- 6	Chert and carbonate rock -----	--	2.4	--	--	123.4	--	--
P- 5	Sandstone, carbonatic; fos. col. no. 12548 -----	--	2.6	--	--	126.0	--	--
P- 4	Carbonate rock, sandy -----	--	11.2	--	--	137.2	--	--
P- 3	Carbonate rock -----	--	2.9	--	--	140.1	--	--
P- 2	Sandstone, carbonatic -----	--	3.2	--	--	143.3	--	--
P- 1	Sandstone, conglomerate; fos. col. no. 12547-----	--	5.0	--	--	148.3	--	--
Tensleep formation—top beds only								
T- 1	Carbonate rock, chert, and sandstone; fos. col. no. 12546 -----	--	1.9	--	--	1.9	--	--
T- 2	Quartzite -----	--	2.9	--	--	4.8	--	--
T- 3	Sandstone, carbonatic and chert -----	--	6.4	--	--	11.2	--	--
T- 4	Quartzite -----	--	3.4	--	--	14.6	--	--

## Forellen Peak, Wyo., lot 1369

Phosphoria formation measured and sampled at a natural exposure on south slope of Forellen Peak in the northern portion of Grand Teton National Park, unsurveyed land. Section crops out on the east flank of an anticline. Beds strike north-south and dip gently east. Section measured and sampled by R. P. Sheldon, R. G. Waring, and R. A. Smart in August 1951. Samples analyzed by U. S. Bureau of Mines laboratory, Albany, Oreg.

Samples analyzed for eU and chem. U by the U. S. Geological Survey laboratory, Geochemistry and Petrology Branch.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Uranium content (percent)	
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble		eU	Chem. U
Phosphoria formation—top not exposed								
	A 3- to 5-foot covered interval separates the Phosphoria formation from the Dinwoody formation.							
P-30	Sandstone, cherty; fos. col. no. 12560 <sup>1</sup> -----	--	2.5	--	--	2.5	--	--
P-29	Covered interval -----	--	5.0	--	--	7.5	--	--
P-28	Sandstone -----	--	7.5	--	--	15.0	--	--
P-27	Sandstone -----	--	7.4	--	--	22.4	--	--
P-26	Sandstone, cherty -----	--	3.3	--	--	29.0	--	--
P-25	Covered interval -----	--	5.0	--	--	34.0	--	--
P-24	Sandstone, carbonatic; fos. col. no. 12559 -----	--	4.9	--	--	38.9	--	--
P-23	Covered interval -----	--	10.0	--	--	48.9	--	--
P-22	Chert, sandy; fos. col. no. 12558 -----	--	3.4	--	--	52.3	--	--
P-21	Covered interval (probably chert); fos. col. no. 12558 -----	--	3.3	--	--	55.6	--	--
P-20	Chert, argillaceous; fos. col. no. 12558 -----	--	6.0	--	--	61.6	--	--
P-19	Covered interval -----	--	2.0	--	--	63.6	--	--
P-18	Chert, argillaceous -----	--	2.4	--	--	66.0	--	--
P-17	Chert -----	--	5.2	--	--	71.2	--	--
P-16	Covered interval -----	--	7.0	--	--	78.2	--	--
P-15	Chert, sandy -----	--	12.5	--	--	90.7	--	--
P-14	Chert, sandy -----	--	6.2	--	--	96.9	--	--
P-13	Chert -----	--	18.3	--	--	115.2	--	--
P-12	Phosphate rock, argillaceous; fos. col. no. 12557 -----	6584-RGW	.6	23.9	31.9	115.8	0.006	0.004
P-11	Sandstone; fos. col. no. 12557 -----	--	1.0	--	--	116.8	--	--
P-10	Sandstone, carbonatic; fos. col. no. 12557 -----	--	4.5	--	--	121.3	--	--
P- 9	Sandstone, cherty and carbonatic sandstone -----	--	1.8	--	--	123.1	--	--
P- 8	Sandstone, carbonatic; fos. col. no. 12556 -----	--	2.5	--	--	125.6	--	--
P- 7	Sandstone; fos. col. no. 12556 -----	--	6.4	--	--	132.0	--	--
P- 6	Sandstone -----	--	17.0	--	--	149.0	--	--

<sup>1</sup> Fossil collection made by J. E. Smedley, Paleontology and Stratigraphy Branch, U. S. Geological Survey.



Forellen Peak—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Uranium content (percent)	
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble		eU	Chem. U
P- 5	Sandstone; fos. col. no. 12555 -----	--	6.0	--	--	155.0	--	--
P- 4	Covered interval -----	--	6.0	--	--	161.0	--	--
P- 3	Chert, argillaceous -----	--	6.2	--	--	167.2	--	--
P- 2	Covered interval -----	--	20.0	--	--	187.2	--	--
P- 1	Sandstone, phosphatic; fos. col. no. 12554 -----	--	--	--	--	--	--	--

Tensleep formation—not measured

## Hungry Creek, Wyo., lot 1375

Upper shale and Rex chert members of the Phosphoria formation measured and sampled in a bulldozer trench and at a natural exposure on Hungry Creek about 9 miles southeast of Victor, Idaho, on the Teton Pass highway, sec. 9?, T. 41 N., R. 118 W., Teton County, Wyo., on the southwest limb of an anticline. Beds strike N. 20° W. and dip 40° SW. Section measured and sampled by R. P. Sheldon, T. M. Cheney, and J. A. Peterson in October 1951. Samples analyzed by U. S. Bureau of Mines laboratory, Albany, Oreg.

Samples analyzed for eU and chem. U by the U. S. Geological Survey laboratory, Geochemistry and Petrology Branch.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P <sub>2</sub> O <sub>5</sub> (cumulative)	Uranium content (percent)		Thickness x percent eU (cumulative)
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble			eU	Chem. U	
Upper shale member of Phosphoria formation—top not exposed										
U-18	Sandstone; fos. col. no. 12667 <sup>1</sup> -----	6794-TMC	5.4	6.3	76.8	5.4	--	0.002	--	--
U-17	Covered interval -----	--	14.0	--	--	19.4	--	--	--	--
U-16	Mudstone and mantle -----	--	4.0	--	--	23.4	--	--	--	--
	Bed U-16 badly slumped and mixed with mantle.									
U-15	Mudstone, carbonatic -----	6793- RPS	3.0	4.2	47.7	26.4	12.60	.002	--	0.006
U-14	Carbonate rock, argillaceous and carbonatic mudstone -----	6792- RPS	1.0	1.7	41.3	27.4	14.30	.001	--	.007
U-13	Mudstone, carbonatic -----	6791- RPS	1.3	3.3	48.6	28.7	18.59	.002	--	.010
U-12	Mudstone, carbonatic and mantle -----	6790- RPS	1.2	3.0	60.3	29.9	22.19	.004	--	.014
U-11	Mudstone and mantle -----	--	3.5	--	--	33.4	--	--	--	--
	Beds U-11 and U-12 badly slumped and mixed with mantle.									
U-10	Mudstone, carbonatic -----	6789-TMC	5.5	2.2	55.03	38.9	*12.10	.002	--	*.011
U- 9	Mudstone, carbonatic -----	6788-TMC	5.7	2.3	63.2	44.6	25.21	.003	--	.028
U- 8	Mudstone -----	6787- JAP	4.5	1.9	72.06	49.1	33.76	.002	--	.037
U- 7	Phosphate rock, argillaceous, carbonatic --	6786- JAP	.2	17.3	30.06	49.3	37.22	.005	0.004	.038
U- 6	Mudstone, carbonatic -----	6785- JAP	.9	3.3	58.8	50.2	40.19	.003	--	.041
U- 5	Phosphate rock, argillaceous -----	6784- JAP	.4	24.6	19.4	50.6	50.03	.005	.004	.043
U- 4	Phosphate rock, argillaceous -----	6783- JAP	.6	24.6	19.6	51.2	64.79	.006	.004	.046
U- 3	Mudstone, carbonatic -----	6782- JAP	2.5	3.6	57.8	53.7	73.79	.004	--	.056
U- 2	Mudstone, carbonatic -----	6781- JAP	2.2	5.4	57.6	55.9	85.67	.005	.001	.067
U- 1	Phosphate rock, argillaceous; fos. col. no. 12666 -----	6780- JAP	.7	28.6	20.5	56.6	105.69	.003	--	.070

<sup>1</sup> Fossil collection made by H. I. Saunders, Paleontology and Stratigraphy Branch, U. S. Geological Survey.

\* Cumulative data incomplete because of missing information. Computations start from zero after interruption.

## Hungry Creek—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P <sub>2</sub> O <sub>5</sub> (cumulative)	Uranium content (percent)		Thickness x percent eU (cumulative)
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble			eU	Chem. U	
Rex chert member of Phosphoria formation										
R-24	Sandstone; fos. col. no. 12665 -----	--	4.3	--	--	4.3	--	--	--	--
R-23	Sandstone, carbonatic and sandy chert; fos. col. no. 12664 -----	--	3.4	--	--	7.7	--	--	--	--
R-22	Sandstone -----	--	2.8	--	--	10.5	--	--	--	--
R-21	Carbonate rock, argillaceous; fos. col. no. 12663 -----	--	8.8	--	--	19.3	--	--	--	--
R-20	Sandstone, carbonatic -----	--	4.0	--	--	23.3	--	--	--	--
R-19	Carbonate rock -----	--	2.5	--	--	25.8	--	--	--	--
R-18	Covered interval; carbonate rock float -----	--	3.2	--	--	29.0	--	--	--	--
R-17	Carbonate rock -----	--	3.4	--	--	32.4	--	--	--	--
R-16	Carbonate rock -----	--	5.4	--	--	37.8	--	--	--	--
R-15	Carbonate rock -----	--	6.2	--	--	44.0	--	--	--	--
R-14	Chert -----	--	.9	--	--	44.9	--	--	--	--
R-13	Carbonate rock; fos. col. no. 12662 -----	--	13.3	--	--	58.2	--	--	--	--
R-12	Sandstone and chert; fos. col. no. 12661 -----	--	7.0	--	--	65.2	--	--	--	--
R-11	Carbonate rock -----	--	1.8	--	--	67.0	--	--	--	--
R-10	Sandstone -----	--	2.2	--	--	69.2	--	--	--	--
R- 9	Covered interval; contains a few outcropping sandstone beds -----	--	5.5	--	--	74.7	--	--	--	--
R- 8	Sandstone -----	--	5.1	--	--	79.8	--	--	--	--
R- 7	Chert -----	--	2.7	--	--	82.5	--	--	--	--
R- 6	Sandstone; fos. col. no. 12660 -----	--	7.0	--	--	89.5	--	--	--	--
R- 5	Chert -----	--	2.2	--	--	91.7	--	--	--	--
R- 4	Sandstone; fos. col. no. 12659 -----	--	4.5	--	--	96.2	--	--	--	--
R- 3	Carbonate rock -----	--	.3	--	--	96.5	--	--	--	--
R- 2	Phosphate rock, sandy -----	--	.4	--	--	96.9	--	--	--	--
R- 1	Carbonate rock -----	--	.4	--	--	97.3	--	--	--	--
Phosphatic shale member of Phosphoria formation—not measured										
	The phosphatic shale member is badly crumpled and thinned at this locality. Gardner (1944) has described and sampled the phosphatic shale member at locality B about ½ mile southeast of this locality. ---	--	--	--	--	--	--	--	--	--
Wells formation—top bed only										
Cw-1	Chert -----	--	11.0	--	--	11.0	--	--	--	--



Crystal Creek, Wyo., lot 1323

Phosphoria formation measured and sampled at a natural exposure near Crystal Creek, S $\frac{1}{2}$ NW $\frac{1}{4}$  sec. 34, T. 42 N., R. 113 W., Teton County, Wyo. Beds strike N. 10° E. and dip 20° E. D and E members measured and sampled by R. G. Waring, H. W. Peirce, J. W. Hill, R. A. Smart, and M. A. Warner in July 1950; B and C members measured and sampled by R. P. Sheldon, Waring, and Smart in August 1951. Samples analyzed by U. S. Bureau of Mines laboratory, Albany, Oreg.

Samples analyzed for eU and chem. U by the U. S. Geological Survey laboratory, Geochemistry and Petrology Branch.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P <sub>2</sub> O <sub>5</sub> (cumulative)	Uranium content (percent)		Thickness x percent eU (cumulative)
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble			eU	Chem. U	
Dinwoody formation—not measured										
E member of Phosphoria formation										
E- 8	Mudstone -----	--	9.0	--	--	9.0	--	--	--	--
E- 7	Chert -----	--	1.2	--	--	10.2	--	--	--	--
E- 6	Mudstone -----	--	2.4	--	--	12.6	--	--	--	--
E- 5	Sandstone -----	--	1.9	--	--	14.5	--	--	--	--
E- 4	Chert -----	--	10.2	--	--	24.7	--	--	--	--
E- 3	Chert -----	--	22.8	--	--	47.5	--	--	--	--
E- 2	Chert and mudstone -----	--	9.8	--	--	57.3	--	--	--	--
E- 1	Chert, carbonatic -----	4899-HWP	3.0	0.7	81.8	60.3	--	0.001	0.001	--
D member of Phosphoria formation										
D-25	Mudstone; fos. col. no. 12124 <sup>1</sup> -----	4898-HWP	2.5	1.4	69.6	2.5	3.50	0.002	0.001	0.005
D-24	Mudstone, carbonatic and argillaceous phosphate rock; fos. col. no. 12123 -----	4897-HWP	1.0	5.3	55.7	3.5	8.80	.004	.003	.009
D-23	Mudstone, carbonatic and phosphate rock --	4896-HWP	1.6	8.6	45.9	5.1	22.56	.002	.002	.012
D-22	Mudstone, carbonatic; fos. col. no. 12122 --	4895-HWP	1.4	2.7	56.3	6.5	26.34	.003	.001	.016
D-21	Mudstone, carbonatic -----	4894-HWP	.8	3.0	53.4	7.3	28.74	.002	.001	.018
D-20	Carbonate rock, argillaceous -----	4893-HWP	.8	1.5	38.8	8.1	29.94	.002	.001	.020
D-19	Mudstone, carbonatic -----	4892-HWP	1.2	2.3	53.1	9.3	32.70	.003	.001	.023
D-18	Mudstone, carbonatic -----	4891-HWP	1.3	1.4	54.7	10.6	34.52	.002	.001	.026
D-17	Mudstone, carbonatic -----	4890-RGW	1.6	1.7	57.5	12.2	37.24	.003	.001	.031
D-16	Mudstone, carbonatic -----	4889-RGW	1.5	1.4	63.1	13.7	39.34	.003	.001	.035
D-15	Carbonate rock -----	4888-RGW	.6	.5	9.9	14.3	39.64	.000	.001	.035
D-14	Mudstone; contains calcareous mudstone concretion 0.5 foot thick -----	4887-RGW	3.3	1.3	61.7	17.6	43.93	.001	.001	.038
D-13	Mudstone, calcareous -----	4886-RGW	3.2	1.4	56.8	20.8	48.41	.003	.001	.048
D-12	Mudstone, carbonatic; fos. col. no. 12121 --	4885-RGW	2.0	2.3	55.3	22.8	53.01	.003	.001	.054
D-11	Mudstone, carbonatic -----	4884-RAS	2.1	1.5	56.0	24.9	56.16	.003	.001	.060

<sup>1</sup> Fossil collection made by J. E. Smedley, Paleontology and Stratigraphy Branch, U. S. Geological Survey.

Crystal Creek—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P <sub>2</sub> O <sub>5</sub> (cumulative)	Uranium content (percent)		Thickness x percent eU (cumulative)
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble			eU	Chem. U	
D-10	Phosphate rock, argillaceous; fos. col. no. 12120 -----	4883-RAS	1.1	23.9	17.5	26.0	82.45	0.007	0.008	0.068
D-9	Carbonate rock, argillaceous -----	4882-MAW	1.3	1.2	24.4	27.3	84.01	.002	.001	.071
D-8	Mudstone, carbonatic -----	4881-MAW	1.5	2.2	59.2	28.8	87.31	.003	.001	.075
D-7	Mudstone; fos. col. no. 12119 -----	4880-MAW	2.3	5.3	54.1	31.1	99.50	.005	.003	.087
D-6	Phosphate rock, argillaceous -----	4879-MAW	.7	20.3	25.2	31.8	113.71	.005	.005	.090
--	Mudstone, calcareous; concretion -----	--	(.5)	--	--	--	--	--	--	--
D-5	Mudstone, carbonatic -----	4878-MAW	4.7	3.0	52.5	36.5	127.81	.004	.002	.109
D-4	Mudstone, phosphatic -----	4877-MAW	1.6	8.7	62.7	38.1	141.73	.003	.003	.114
D-3	Mudstone, phosphatic, carbonatic; fos. col. no. 12118 -----	4876-MAW	3.5	12.1	34.5	41.6	184.08	.003	.004	.124
D-2	Mudstone, carbonatic; fos. col. no. 12117 --	4875-MAW	5.2	4.1	56.1	46.8	205.40	.001	.001	.129
D-1	Mudstone; fos. col. no. 12116 -----	--	3.2	--	--	50.0	--	--	--	--

The remaining lower portion of the Phosphoria formation at Crystal Creek was not measured in 1950, but was measured by R. G. Waring, R. A. Smart, and R. P. Sheldon in August 1951. Location and geologic setting already described. Samples analyzed by U. S. Bureau of Mines laboratory, Albany, Oreg.

D member of Phosphoria formation—basal bed only

D-1	Phosphate rock, logged as equivalent to sample 4877-MAW (bed D-4) above	6580-RGW	0.5	24.1	19.7	0.5	--	0.005	0.003	--
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C member of Phosphoria formation

C-23	Sandstone, phosphatic; fos. col. no. 12545 -----	6579-RGW	0.5	11.6	58.8	0.5	--	0.005	0.002	--
C-22	Sandstone; fos. col. no. 12545 -----	6578-RGW	4.5	9.5	34.9	5.0	--	.002	--	--
C-21	Sandstone, carbonatic and chert; fos. col. no. 12544 -----	--	4.0	--	--	9.0	--	--	--	--
C-20	Sandstone, phosphatic; fos. col. no. 12544 -----	6577-RGW	1.1	20.4	22.3	10.1	--	.004	--	--
C-19	Sandstone; fos. col. no. 12544 -----	6576-RGW	3.9	12.2	12.3	14.0	--	.003	--	--
C-18	Sandstone and chert; fos. col. no. 12543 ----	--	2.4	--	--	16.4	--	--	--	--
C-17	Sandstone, carbonatic; fos. col. nos. 12543 and 12542 -----	--	5.9	--	--	22.3	--	--	--	--
C-16	Carbonate rock; fos. col. no. 12541 -----	--	3.7	--	--	26.0	--	--	--	--

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C-15	Carbonate rock -----	--	9.4	--	--	35.4	--	--	--	--
C-14	Carbonate rock; fos. col. no. 12540-----	--	3.1	--	--	38.5	--	--	--	--
C-13	Carbonate rock -----	--	1.3	--	--	39.8	--	--	--	--
C-12	Mudstone, carbonatic -----	--	4.0	--	--	43.8	--	--	--	--
C-11	Carbonate rock, argillaceous -----	--	1.0	--	--	44.8	--	--	--	--
C-10	Carbonate rock, sandy -----	--	2.0	--	--	46.8	--	--	--	--
C- 9	Carbonate rock, argillaceous, sandy; fos. col. no. 12539 -----	--	1.8	--	--	48.6	--	--	--	--
C- 8	Sandstone -----	--	3.0	--	--	51.6	--	--	--	--
C- 7	Sandstone, cherty -----	--	1.2	--	--	52.8	--	--	--	--
C- 6	Chert -----	--	5.3	--	--	58.1	--	--	--	--
C- 5	Mudstone, carbonatic; fos. col. no. 12538 ---	--	1.0	--	--	59.1	--	--	--	--
C- 4	Chert -----	--	4.4	--	--	63.5	--	--	--	--
C- 3	Chert and cherty mudstone -----	--	2.6	--	--	66.1	--	--	--	--
C- 2	Chert -----	--	1.2	--	--	67.3	--	--	--	--
C- 1	Chert and cherty mudstone -----	--	2.4	--	--	69.7	--	--	--	--

B member of Phosphoria formation

B-12	Mudstone -----	--	2.7	--	--	2.7	--	--	--	--
B-11	Mudstone -----	--	3.2	--	--	5.9	--	--	--	--
B-10	Mudstone -----	--	3.3	--	--	9.2	--	--	--	--
B- 9	Mudstone -----	--	.7	--	--	9.9	--	--	--	--
B- 8	Siltstone -----	--	1.4	--	--	11.3	--	--	--	--
B- 7	Mudstone, carbonatic -----	6575- RAS	.6	5.2	62.3	11.9	--	0.003	--	--
B- 6	Mudstone, cherty -----	--	.3	--	--	12.2	--	--	--	--
B- 5	Mudstone and phosphate rock -----	6574- RAS	.6	11.5	42.3	12.8	--	.005	0.001	--
B- 4	Mudstone, cherty -----	--	1.0	--	--	13.8	--	--	--	--
B- 3	Mudstone -----	--	.8	--	--	14.6	--	--	--	--
B- 2	Phosphate rock, argillaceous -----	6573- RAS	.7	15.4	40.7	15.3	--	.007	.005	--
B- 1	Phosphate rock -----	6572- RAS	.8	25.0	19.7	16.1	--	.007	.004	--

Tensleep formation—not measured

	Present but not described. Consists of massive, cross-bedded sandstone. -----	--	--	--	--	--	--	--	--	--
--	--	----	----	----	----	----	----	----	----	----

Teton Pass, Wyo., lot 1370

Phosphoria formation sampled in road cut on U. S. Highway no. 22,  $\frac{1}{2}$  mile west of Teton Pass summit, sec. 23, T. 41 N., R. 117 W., Teton County, Wyo. Beds strike N. 65° W. and dip 60° N. Section measured and sampled by R. G. Waring and R. A. Smart in August 1951. Samples analyzed by U. S. Bureau of Mines laboratory, Albany, Oreg.

Samples analyzed for eU and chem. U by the U. S. Geological Survey laboratory, Geochemistry and Petrology Branch.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Uranium content (percent)	
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble		eU	Chem. U
Dinwoody formation—basal bed only								
Td-1	Sandstone, carbonatic -----	--	--	--	--	--	--	--
Upper shale member of Phosphoria formation—top not exposed								
	The Phosphoria formation and Dinwoody formation are separated by a fault of unknown stratigraphic displacement. Hence bed U-17 is not necessarily the highest bed in the Phosphoria formation.							
U-17	Chert -----	--	7.5	--	--	7.5	--	--
U-16	Chert -----	--	12.6	--	--	20.1	--	--
U-15	Chert and cherty mudstone -----	--	8.1	--	--	28.2	--	--
U-14	Mudstone and cherty mudstone -----	--	1.0	--	--	29.2	--	--
U-13	Mudstone -----	--	1.4	--	--	30.6	--	--
U-12	Mudstone -----	--	.6	--	--	31.2	--	--
U-11	Mudstone -----	--	2.4	--	--	33.6	--	--
U-10	Mudstone -----	--	1.9	--	--	35.5	--	--
U- 9	Mudstone -----	--	2.0	--	--	37.5	--	--
U- 8	Mudstone -----	--	1.2	--	--	38.7	--	--
U- 7	Mudstone -----	--	1.7	--	--	40.4	--	--
U- 6	Mudstone -----	--	2.3	--	--	42.7	--	--
U- 5	Mudstone -----	--	.9	--	--	43.6	--	--
U- 4	Phosphate rock, argillaceous; fos. col. no. 12581 -----	6590- RAS	.2	25.3	18.8	43.8	0.005	0.004
U- 3	Mudstone -----	--	1.1	--	--	44.9	--	--
U- 2	Mudstone -----	--	2.2	--	--	47.1	--	--
U- 1	Mudstone, phosphatic -----	6589- RAS	1.9	14.3	46.0	49.0	.002	--
Rex member of Phosphoria formation								
R-25	Carbonate rock -----	--	2.5	--	--	2.5	--	--
R-24	Carbonate rock; fos. col. no. 12580 -----	--	3.2	--	--	5.7	--	--
R-23	Carbonate rock -----	--	2.3	--	--	8.0	--	--



R-22	Carbonate rock; fos. col. no. 12579 -----	--	2.2	--	--	10.2	--	--
R-21	Carbonate rock; fos. col. no. 12579 -----	--	1.9	--	--	12.1	--	--
R-20	Carbonate rock -----	--	2.3	--	--	14.4	--	--
R-19	Carbonate rock -----	--	3.2	--	--	17.6	--	--
R-18	Mudstone -----	--	.9	--	--	18.5	--	--
R-17	Mudstone; fos. col. no. 12578 -----	--	1.3	--	--	19.8	--	--
R-16	Mudstone -----	--	.4	--	--	20.2	--	--
R-15	Mudstone and chert -----	--	.6	--	--	20.8	--	--
R-14	Mudstone -----	--	2.2	--	--	23.0	--	--
R-13	Mudstone -----	--	2.2	--	--	25.2	--	--
R-12	Mudstone -----	--	.8	--	--	26.0	--	--
R-11	Carbonate rock -----	--	3.8	--	--	29.8	--	--
R-10	Chert -----	--	.5	--	--	30.3	--	--
R- 9	Carbonate rock; fos. col. no. 12577 -----	--	2.1	--	--	32.4	--	--
R- 8	Mudstone; fos. col. no. 12577 -----	--	3.3	--	--	35.7	--	--
R- 7	Mudstone -----	--	1.5	--	--	37.2	--	--
R- 6	Mudstone -----	--	1.0	--	--	38.2	--	--
R- 5	Quartzite -----	--	2.2	--	--	40.4	--	--
R- 4	Carbonate rock -----	--	3.4	--	--	43.8	--	--
R- 3	Carbonate rock, sandy -----	--	1.7	--	--	45.5	--	--
R- 2	Chert -----	--	3.7	--	--	49.2	--	--
R- 1	Sandstone, carbonatic -----	--	1.0	--	--	50.2	--	--
This thickness of the Rex chert member is about 50 feet less than the average Rex chert member thickness over this area. No structure was noted at this road cut.								
Phosphatic shale member of Phosphoria formation—base not exposed								
P-21	Mudstone, cherty, mudstone, and phosphate rock -----	--	2.9	--	--	2.9	--	--
P-20	Mudstone, cherty and cherty carbonate rock ---	--	2.1	--	--	5.0	--	--
P-19	Phosphate rock; contains siltstone concretion---	6588-RGW	.9	28.8	13.4	5.9	0.007	0.006
P-18	Sandstone and phosphate rock -----	--	.9	--	--	6.8	--	--
P-17	Carbonate rock -----	--	.9	--	--	7.7	--	--
P-16	Mudstone; fos. col. no. 12576 -----	--	.9	--	--	8.6	--	--
P-15	Phosphate rock and chert. Sandstone and chert lens occurs at top of unit. -----	--	.7	--	--	9.3	--	--
P-14	Chert, sandy and phosphate rock -----	--	1.3	--	--	10.6	--	--
P-13	Mudstone. Sandstone lens occurs at top of unit. -----	--	1.9	--	--	12.5	--	--
P-12	Chert -----	--	1.2	--	--	13.7	--	--

<sup>1</sup> Fossil collection made by J. E. Smedley, Paleontology and Stratigraphy Branch, U. S. Geological Survey.

Teton Pass—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Uranium content (percent)	
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble		eU	Chem. U
P-11	Mudstone, cherty-----	--	0.5	--	--	14.2	--	--
P-10	Chert, argillaceous-----	--	.8	--	--	15.0	--	--
P- 9	Mudstone-----	--	3.2	--	--	18.2	--	--
P- 8	Mudstone-----	--	2.8	--	--	21.0	--	--
P- 7	Mudstone, phosphatic-----	6587- RAS	.6	16.2	41.1	21.6	0.004	--
P- 6	Mudstone; fos. col. no. 12575-----	--	1.3	--	--	22.9	--	--
P- 5	Mudstone and cherty mudstone-----	--	.5	--	--	23.4	--	--
P- 4	Phosphate rock, argillaceous-----	6586- RAS	.4	22.4	22.2	23.8	.006	0.004
P- 3	Mudstone-----	--	.5	--	--	24.3	--	--
P- 2	Phosphate rock, carbonatic-----	6585- RAS	1.5	21.7	12.6	25.8	.008	.005
P- 1	Mudstone-----	--	1.1	--	--	26.9	--	--
	Bed P-1 is not necessarily the lowest bed of the Phosphatic shale member because it is separated from the Wells formation by a fault.							
Wells formation—not measured								
	Present but not described. fos. col. no. 12574-----	--	--	--	--	--	--	--

Steer Creek, Wyo., lot 1352

Phosphoria formation measured and sampled in a bulldozer trench and at a natural exposure on the west limb of an anticline on the north fork of Steer Creek, sec. 9, T. 36 N., R. 116 W., Lincoln County, Wyo. Beds strike N. 35° W., and dip 45° W. Section measured and sampled by T. M. Cheney, R. G. Waring, R. A. Smart, and M. A. Warner in July 1951. Samples analyzed by U. S. Bureau of Mines laboratory, Albany, Oreg.

Samples analyzed for eU and chem. U by the U. S. Geological Survey laboratory, Geochemistry and Petrology Branch.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P <sub>2</sub> O <sub>5</sub> (cumulative) <sup>5</sup>	Uranium content (percent)		Thickness x percent eU (cumulative)
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble			eU	Chem. U	
Dinwoody formation—lower part only										
Td-3	Siltstone, carbonatic -----	--	78.0	--	--	78.0	--	--	--	--
Td-2	Sandstone; fos. col. no. 12648 <sup>1</sup> -----	--	3.5	--	--	81.5	--	--	--	--
Td-1	Sandstone, carbonatic; fos. col. nos. 12647 <sup>1</sup> and 12649 <sup>2</sup> -----	--	4.3	--	--	85.8	--	--	--	--
Upper shale member of Phosphoria formation										
U-14	Mudstone, phosphatic; fos. col. no. 12646 <sup>1</sup> -----	6507-TMC	0.9	10.8	59.3	0.9	9.72	0.002	--	0.002
U-13	Mudstone, carbonatic -----	6506-TMC	2.1	3.6	57.9	3.0	17.28	.003	--	.008
U-12	Mudstone -----	6505-TMC	1.9	3.7	71.7	4.9	24.31	.003	--	.014
U-11	Mudstone -----	6504-TMC	1.4	3.7	70.8	6.3	29.49	.002	--	.017
U-10	Mudstone -----	6503-TMC	4.8	4.1	66.0	11.1	49.17	.002	--	.026
U- 9	Mudstone, carbonatic-----	6502-TMC	3.3	6.2	54.9	14.4	69.63	.003	--	.036
U- 8	Mudstone, phosphatic-----	6501-TMC	5.0	8.0	58.8	19.4	109.63	.004	--	.056
U- 7	Mudstone, carbonatic-----	6500- RAS	1.0	4.6	53.5	20.4	114.23	.002	--	.058
U- 6	Phosphate rock, argillaceous-----	6499- RAS	1.9	24.7	21.2	22.3	161.16	.005	0.003	.068
U- 5	Mudstone-----	6498- RAS	.6	5.5	61.6	22.9	164.46	.005	.001	.071
U- 4	Mudstone-----	6497- RAS	1.9	4.6	68.1	24.8	173.20	.003	--	.076
U- 3	Mudstone-----	6496- RAS	.8	6.8	57.1	25.6	178.64	.005	.002	.080
U- 2	Mudstone, phosphatic-----	6495- RAS	1.0	11.1	45.1	26.6	189.74	.005	.002	.085
U- 1	Phosphate rock, argillaceous-----	5494- RAS	1.1	29.2	18.1	27.7	221.86	.005	.004	.091
Rex member of Phosphoria formation										
R-13	Carbonate rock -----	--	2.0	--	--	2.0	--	--	--	--
R-12	Sandstone, phosphatic; fos. col. no. 12645 <sup>1</sup> -----	6493- RAS	1.0	9.3	60.1	3.0	--	0.001	--	--
R-11	Carbonate rock, argillaceous -----	--	1.6	--	--	4.6	--	--	--	--
R-10	Carbonate rock -----	--	2.2	--	--	6.8	--	--	--	--
R- 9	Phosphate rock, carbonatic -----	6492- RAS	.7	22.5	9.4	7.5	--	--	--	--

<sup>1</sup> Fossil collection made by H. I. Saunders, Paleontology and Stratigraphy Branch, U. S. Geological Survey.

<sup>2</sup> Fossil collection made by J. E. Smedley, Paleontology and Stratigraphy Branch, U. S. Geological Survey.

## Steer Creek—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent $P_2O_5$ (cumulative) <sup>5</sup>	Uranium content (percent)		Thickness x percent eU (cumulative)
				$P_2O_5$	Acid insoluble			eU	Chem. U	
R- 8	Carbonate rock -----	--	3.1	--	--	10.6	--	--	--	--
R- 7	Carbonate rock -----	--	3.0	--	--	13.6	--	--	--	--
R- 6	Carbonate rock, argillaceous -----	--	1.7	--	--	15.3	--	--	--	--
R- 5	Carbonate rock, sandy; fos. col. no. 12644 -----	--	2.4	--	--	17.7	--	--	--	--
R- 4	Covered interval; largely carbonate rock ---	--	108.0	--	--	125.7	--	--	--	--
R- 3	Chert -----	--	2.7	--	--	128.4	--	--	--	--
R- 2	Sandstone -----	--	.9	--	--	129.3	--	--	--	--
R- 1	Chert -----	--	2.3	--	--	131.6	--	--	--	--
Phosphatic shale member of Phosphoria formation										
P-37	Phosphate rock, argillaceous and mudstone -----	6491-MAW	0.8	24.6	29.0	0.8	19.68	0.004	--	0.003
P-36	Mudstone -----	6490-MAW	1.6	5.6	64.1	2.4	28.64	.005	0.004	.011
P-35	Mudstone -----	6489-MAW	1.8	.5	77.9	4.2	29.54	.003	--	.017
P-34	Mudstone, carbonatic -----	6488-MAW	4.4	.3	66.0	8.6	30.86	.004	--	.034
P-33	Mudstone, carbonatic -----	6487-MAW	2.0	.9	70.0	10.6	32.66	.005	.002	.044
P-32	Mudstone, carbonatic -----	6486-MAW	.6	3.6	58.1	11.2	34.82	.007	.007	.048
P-31	Mudstone -----	6485-MAW	2.4	1.1	83.7	13.6	37.46	.002	--	.053
P-30	Mudstone, phosphatic -----	6484-MAW	.5	14.4	41.3	14.1	44.66	.010	.009	.058
P-29	Mudstone -----	6483-MAW	4.2	.6	76.7	18.3	47.18	.002	--	.067
P-28	Mudstone -----	6482-MAW	1.8	1.5	83.7	20.1	49.88	.003	--	.072
P-27	Phosphate rock, argillaceous and phosphatic mudstone -----	6481-MAW	.5	18.7	29.4	20.6	59.23	.011	.008	.078
P-26	Mudstone, phosphatic, carbonatic -----	6480-MAW	1.4	13.3	34.7	22.0	77.85	.007	.007	.087
P-25	Carbonate rock -----	6479-MAW	2.7	.5	18.0	24.7	79.20	.001	--	.090
P-24	Mudstone -----	6478-MAW	.6	6.9	63.3	25.3	83.34	.005	.003	.093
P-23	Mudstone -----	6477-MAW	1.0	1.7	78.8	26.3	85.04	.002	--	.095
P-22	Mudstone, phosphatic -----	6476-MAW	1.3	14.2	42.1	27.6	103.50	.008	.007	.105
P-21	Carbonate rock, argillaceous -----	6475-RGW	1.9	1.3	23.8	29.5	105.97	.001	--	.107
P-20	Mudstone and argillaceous phosphate rock --	6474-RGW	.9	10.1	56.2	30.4	115.06	.008	.005	.114
P-19	Mudstone, phosphatic and carbonatic mudstone -----	6473-RGW	1.3	13.3	35.9	31.7	132.35	.011	.009	.129
P-18	Phosphate rock, carbonatic, argillaceous --	6472-RGW	.5	18.4	24.8	32.2	141.55	.016	.013	.137
P-17	Carbonate rock, argillaceous -----	6471-RGW	2.8	.9	23.8	35.0	144.07	.002	--	.142
P-16	Mudstone, carbonatic -----	6470-RGW	.9	1.4	48.6	35.9	145.33	.003	--	.145
P-15	Mudstone, carbonatic -----	6469-RGW	1.3	4.3	48.7	37.2	150.92	.005	.003	.152
P-14	Mudstone, carbonatic -----	6468-RGW	1.6	4.5	45.6	38.8	158.12	.008	.005	.164
P-13	Mudstone, phosphatic and carbonatic mudstone -----	6467-RGW	1.0	11.8	39.8	39.8	169.92	.011	.009	.175

P-12	Carbonate rock -----	6466- RGW	.5	1.2	11.9	40.3	170.52	.002	--	.176
	Bed P-12 appears lens-like because of squeezing.									
P-11	Carbonate rock -----	6465- TMC	1.4	2.3	6.5	41.7	173.74	.004	--	.182
P-10	Mudstone, phosphatic and argillaceous phosphate rock -----	6464- TMC	.8	18.3	27.2	42.5	188.38	.015	.013	.194
P- 9	Mudstone, argillaceous, phosphatic -----	6463- TMC	.6	10.8	33.3	43.1	194.86	.010	.009	.200
P- 8	Mudstone, argillaceous, phosphatic -----	6462- TMC	.6	11.4	33.1	43.7	201.70	.011	.009	.207
P- 7	Phosphate rock -----	6461- TMC	1.6	25.0	13.3	45.3	241.70	.014	.012	.229
P- 6	Carbonate rock -----	6460- TMC	1.6	6.8	2.7	46.9	252.58	.002	--	.232
P- 5	Carbonate rock -----	6459- TMC	1.9	3.6	2.3	48.8	259.42	.001	--	.234
P- 4	Phosphate rock -----	6458- TMC	1.1	29.5	11.7	49.9	291.87	.012	.011	.247
P- 3	Mudstone -----	6457- TMC	.9	5.7	62.9	50.8	297.00	.006	.005	.253
P- 2	Phosphate rock -----	6456- TMC	1.3	32.7	10.3	52.1	339.51	.015	.016	.272
P- 1	Mudstone, phosphatic; fos. col. no. 12643 -----	6455- RAS	1.4	8.4	67.9	53.5	351.27	.007	.005	.282

Wells formation—upper part only

Cw- 1	Mudstone -----	--	0.8	--	--	0.8	--	--	--	--
Cw- 2	Mudstone, carbonatic -----	--	3.8	--	--	4.6	--	--	--	--
Cw- 3	Mudstone, sandy -----	--	.6	--	--	5.2	--	--	--	--
Cw- 4	Mudstone, carbonatic -----	--	1.0	--	--	6.2	--	--	--	--
Cw- 5	Mudstone, carbonatic and chert -----	--	1.8	--	--	8.0	--	--	--	--
Cw- 6	Mudstone, carbonatic -----	--	.9	--	--	8.9	--	--	--	--
Cw- 7	Mudstone, carbonatic -----	--	1.8	--	--	10.7	--	--	--	--
Cw- 8	Mudstone -----	--	1.2	--	--	11.9	--	--	--	--
Cw- 9	Mudstone, carbonatic -----	--	5.7	--	--	17.6	--	--	--	--
Cw-10	Mudstone, sandy -----	--	1.3	--	--	18.9	--	--	--	--
Cw-11	Sandstone, argillaceous -----	--	4.8	--	--	23.7	--	--	--	--
Cw-12	Sandstone -----	--	3.6	--	--	27.3	--	--	--	--
Cw-13	Sandstone, argillaceous -----	--	1.1	--	--	28.4	--	--	--	--
Cw-14	Sandstone -----	--	1.4	--	--	29.8	--	--	--	--

<sup>1</sup> Fossil collection made by H. I. Saunders, Paleontology and Stratigraphy Branch, U. S. Geological Survey.



Cumberland, Wyo., lot 1346

Phosphatic shale member of Phosphoria formation measured and sampled on the west limb on an anticline near the ghost town of Cumberland, Wyo., SW $\frac{1}{4}$ NE $\frac{1}{4}$  sec. 19, T. 19 N., R. 117 W., Lincoln County, Wyo. Beds strike N. 15° E. and dip 30° W. Section measured and sampled by M. A. Warner, T. M. Cheney, R. A. Smart, and R. G. Waring in June 1951. Samples analyzed by Trace Elements Section laboratory, U. S. Geological Survey, Denver, Colo.

Samples analyzed for eU and chem. U by the U. S. Geological Survey laboratory, Geochemistry and Petrology Branch.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P <sub>2</sub> O <sub>5</sub> (cumulative) <sup>5</sup>	Uranium content (percent)		Thickness x percent eU (cumulative)
				P <sub>2</sub> O <sub>5</sub>	Acid insoluble			eU	Chem. U	
Rex chert member of Phosphoria formation—basal beds only										
R- 2	Chert -----	--	3.9	--	--	3.9	--	--	--	--
R- 1	Mudstone, cherty -----	--	1.9	--	--	5.8	--	--	--	--
Phosphatic shale member of Phosphoria formation										
P-80	Mudstone -----	--	0.9	--	--	0.9	--	--	--	--
P-79	Mudstone, cherty -----	--	1.2	--	--	2.1	--	--	--	--
P-78	Mudstone -----	--	.6	--	--	2.7	--	--	--	--
P-77	Mudstone, cherty -----	--	.9	--	--	3.6	--	--	--	--
P-76	Mudstone -----	--	.5	--	--	4.1	--	--	--	--
P-75	Mudstone, phosphatic -----	6253-MAW	.7	14.0	57.9	4.8	9.80	0.003	--	0.002
P-74	Mudstone -----	6252-MAW	3.1	2.65	84.8	7.9	18.02	.003	--	.011
P-73	Mudstone, phosphatic -----	6251-MAW	.4	13.2	59.0	8.3	23.30	.003	--	.013
P-72	Mudstone -----	6250-MAW	1.0	2.20	88.2	9.3	25.50	.003	--	.016
P-71	Phosphate rock, argillaceous, carbonatic -----	6249-MAW	1.0	13.5	18.7	10.3	39.00	.005	0.004	.021
P-70	Mudstone and phosphate rock -----	6248-MAW	.5	14.7	49.6	10.8	46.34	.004	--	.023
P-69	Mudstone -----	6247-MAW	.7	3.55	78.0	11.5	48.83	.003	--	.025
P-68	Mudstone, phosphatic -----	6246-MAW	1.0	16.7	47.4	12.5	65.53	.004	--	.029
P-67	Carbonate rock, argillaceous -----	6245-MAW	.8	.60	28.5	13.3	66.01	.002	--	.030
P-66	Mudstone -----	6244-MAW	1.2	3.70	72.7	14.5	70.45	.002	--	.033
P-65	Mudstone, carbonatic -----	6243-MAW	3.5	1.35	61.4	18.0	75.18	.002	--	.040
P-64	Phosphate rock, argillaceous -----	6242-MAW	.4	23.5	21.7	18.4	84.58	.007	.004	.042
P-63	Mudstone -----	6241-MAW	3.0	.80	81.4	21.4	86.98	.002	--	.048
P-62	Mudstone -----	6240-MAW	1.2	4.20	73.3	22.6	92.02	.002	--	.051
P-61	Carbonate rock, argillaceous, phosphatic --	6239-MAW	1.6	12.7	17.3	24.2	112.34	.010	.008	.067
P-60	Carbonate rock, argillaceous -----	6238-MAW	.8	.73	40.9	25.0	112.92	.002	--	.068
P-59	Phosphate rock, argillaceous -----	6237-MAW	.7	19.9	33.8	25.7	126.85	.001	--	.069
P-58	Mudstone, carbonatic -----	6236-MAW	1.8	1.63	67.2	27.5	129.78	.003	--	.075
P-57	Phosphate rock -----	6235-MAW	.7	25.6	14.7	28.2	147.70	.003	--	.077
P-56	Carbonate rock, argillaceous -----	6234-MAW	.9	6.58	22.6	29.1	153.62	.003	--	.079

P-55	Mudstone, phosphatic -----	6233-MAW	1.2	9.55	48.9	30.3	165.08	.003	--	.083
P-54	Carbonate rock and calcareous mudstone -----	6232-MAW	1.8	1.73	18.1	32.1	168.20	.002	--	.087
P-53	Mudstone -----	6231-MAW	.6	1.00	87.8	32.7	168.80	.004	--	.089
P-52	Mudstone; fos. col. no. 12573 <sup>1</sup> -----	6230-MAW	1.4	.73	78.7	34.1	169.82	.002	--	.092
P-51	Mudstone -----	6229-MAW	1.6	2.00	65.3	35.7	173.02	.004	--	.098
P-50	Mudstone -----	6228-MAW	1.9	3.73	64.2	37.6	180.11	.000	--	.098
P-49	Mudstone -----	6227-MAW	1.5	3.55	79.0	39.1	185.43	.004	--	.104
P-48	Mudstone, carbonatic, phosphatic -----	6226-MAW	1.1	7.88	41.9	40.2	194.10	.004	--	.109
P-47	Mudstone -----	6225-MAW	3.2	1.25	79.3	43.4	198.10	.003	--	.118
P-46	Mudstone -----	6224-MAW	2.4	.73	78.4	45.8	199.85	.003	--	.125
P-45	Mudstone, carbonatic -----	6223-TMC	2.1	5.13	42.6	47.9	210.63	.004	--	.134
P-44	Mudstone, carbonatic -----	6222-TMC	1.6	6.50	45.5	49.5	221.03	.005	.003	.142
P-43	Mudstone; fos. col. no. 12572 -----	6221-TMC	2.1	5.00	58.1	51.6	231.53	.003	--	.148
P-42	Mudstone -----	6220-TMC	2.0	3.30	66.6	53.6	238.13	.003	--	.154
P-41	Mudstone, phosphatic, carbonatic -----	6219-TMC	1.0	8.23	33.5	54.6	246.36	.003	--	.157
P-40	Mudstone, carbonatic -----	6218-TMC	2.0	7.65	31.4	56.6	261.66	.004	--	.165
P-39	Mudstone, phosphatic, carbonatic -----	6217-TMC	1.1	9.55	29.1	57.7	272.16	.006	.003	.172
P-38	Phosphate rock, argillaceous -----	6216-TMC	1.9	19.2	18.7	59.6	308.64	.008	.008	.187
	Siltstone, calcareous; lens -----	(1.2)	--	--	--	--	--	--	--	--
P-37	Carbonate rock, argillaceous -----	6215-TMC	1.5	1.10	30.0	61.1	310.29	.001	--	.188
P-36	Carbonate rock, argillaceous -----	6214-TMC	1.7	1.65	30.2	62.8	313.10	.002	--	.192
P-35	Mudstone, phosphatic, carbonatic -----	6213-TMC	1.0	9.15	39.6	63.8	322.25	.004	--	.196
P-34	Phosphate rock, argillaceous, carbonatic --	6212-TMC	.8	13.2	19.6	64.6	332.81	.006	.004	.201
P-33	Carbonate rock -----	6211-TMC	.6	4.85	16.2	62.2	335.72	.003	--	.202
P-32	Mudstone, carbonatic; fos. col. no. 12571 ---	6210-TMC	1.1	7.35	36.4	65.2	343.80	.004	--	.207
P-31	Mudstone, phosphatic -----	6209-TMC	2.1	10.9	46.6	68.4	366.69	.004	--	.215
P-30	Mudstone, phosphatic, carbonatic -----	6208-TMC	1.4	12.6	25.1	69.8	384.33	.006	.005	.224
P-29	Phosphate rock and phosphatic mudstone	6207-TMC	.8	17.8	33.3	70.6	398.57	.006	.005	.228
P-28	Carbonate rock, argillaceous; fos. col. no. 12570 -----	6206-TMC	1.2	3.80	30.9	71.8	403.13	.002	--	.231
P-27	Mudstone, phosphatic -----	6205-TMC	.4	9.75	67.2	72.2	407.03	.002	--	.232
P-26	Mudstone, phosphatic -----	6204-RGW	.8	18.6	43.2	73.0	421.91	.008	.006	.238
P-25	Carbonate rock, phosphatic; fos. col. no. 12569 -----	6203-RGW	.5	10.7	2.5	73.5	427.26	.034	.038	.255
P-24	Carbonate rock, argillaceous -----	6202-RGW	.8	2.35	26.2	74.3	429.14	.008	.005	.261
P-23	Mudstone, phosphatic -----	6201-RGW	.6	8.70	67.6	74.9	434.36	.005	.004	.264
P-22	Carbonate rock, argillaceous -----	6200-RGW	3.9	2.15	39.7	78.8	442.75	.004	--	.280
P-21	Carbonate rock, argillaceous -----	6199-RGW	1.9	3.40	30.2	80.7	449.21	.001	--	.282
P-20	Sandstone and phosphate rock -----	6198-RGW	1.1	15.0	45.4	81.8	465.71	.004	--	.286
P-19	Mudstone -----	6197-RGW	.8	3.10	82.2	82.6	468.19	.004	--	.280

<sup>1</sup> Fossil collection made by J. E. Smedley, Paleontology and Stratigraphy Branch, U. S. Geological Survey.

## Cumberland Trench—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent $P_2O_5$ (cumulative)	Uranium content (percent)		Thickness x percent eU (cumulative)
				$P_2O_5$	Acid insoluble			eU	Chem. U	
P-18	Phosphate rock, argillaceous and phosphate rock; fos. col. no. 12568 -----	6196- RGW	1.0	18.7	38.6	83.6	486.89	0.004	--	0.294
P-17	Carbonate rock -----	6195- RGW	2.2	4.75	11.5	85.8	497.34	.001	--	.296
P-16	Mudstone and phosphatic mudstone; contains calcite geodes; fos. col. no. 12567- -----	6194- RGW	.7	15.0	41.8	86.5	*507.84	.003	--	*.298
P-15	Mudstone; fos. col. no. 12566 -----	--	4.0	--	--	90.5	--	--	--	--
P-14	Mudstone -----	--	4.5	--	--	95.0	--	--	--	--
P-13	Carbonate rock, argillaceous; fos. col. no. 12567 -----	6193- RGW	.9	4.70	24.8	95.9	--	.001	--	--
P-12	Mudstone -----	--	1.0	--	--	96.9	--	--	--	--
P-11	Mudstone and chert -----	--	.6	--	--	97.5	--	--	--	--
P-10	Mudstone -----	--	1.7	--	--	99.2	--	--	--	--
P-9	Mudstone and chert -----	--	4.6	--	--	103.8	--	--	--	--
P-8	Mudstone -----	--	3.5	--	--	107.3	--	--	--	--
P-7	Mudstone -----	--	1.3	--	--	108.6	--	--	--	--
P-6	Mudstone, cherty -----	--	.6	--	--	109.2	--	--	--	--
P-5	Mudstone, carbonatic; fos. col. no. 12564 -----	--	2.4	--	--	111.6	--	--	--	--
P-4	Mudstone, phosphatic -----	6192- RAS	.7	9.45	64.0	112.3	--	.000	--	--
P-3	Mudstone -----	--	1.7	--	--	114.0	--	--	--	--
P-2	Mudstone -----	6191- RAS	.8	7.75	66.9	114.8	--	.003	--	--
P-1	Mudstone, phosphatic; fos. col. no. 12663 -----	6190- RAS	.7	17.6	45.4	115.5	--	.003	--	--
Wells formation—upper part only										
Cw-1	Mudstone -----	--	2.9	--	--	2.9	--	--	--	--
Cw-2	Mudstone; fos. col. no. 12562 -----	6189- RAS	1.0	3.75	79.7	3.9	--	0.001	--	--
Cw-3	Mudstone; fos. col. no. 12562 -----	--	2.9	--	--	6.8	--	--	--	--
Cw-4	Mudstone, carbonatic; fos. col. no. 12561 -----	--	3.4	--	--	10.2	--	--	--	--
Cw-5	Carbonate rock, argillaceous; fos. col. no. 12561 -----	--	3.5	--	--	13.7	--	--	--	--
Cw-6	Mudstone, carbonatic -----	--	1.8	--	--	15.5	--	--	--	--
Cw-7	Mudstone, carbonatic -----	--	1.6	--	--	17.1	--	--	--	--
Cw-8	Mudstone -----	--	.7	--	--	17.8	--	--	--	--
Cw-9	Mudstone -----	--	.8	--	--	18.6	--	--	--	--
Cw-10	Mudstone -----	--	1.0	--	--	19.6	--	--	--	--
Cw-11	Mudstone -----	--	2.6	--	--	22.2	--	--	--	--
Cw-12	Mudstone, carbonatic -----	--	1.8	--	--	24.0	--	--	--	--
Cw-13	Carbonate rock, argillaceous -----	--	1.7	--	--	25.7	--	--	--	--
Cw-14	Chert -----	--	1.4	--	--	27.1	--	--	--	--
Cw-15	Mudstone, cherty -----	--	1.3	--	--	28.4	--	--	--	--

\* Cumulative data incomplete because of missing information.