GEOLOGICAL SURVEY CIRCULAR 324

STRATIGRAPHIC SECTIONS OF THE
PHOSPHORIA FORMATION IN
WYOMING, 1951

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UNITED STATES DEPARTMENT OF THE INTERIOR

Douglas McKay, Secretary

GEOLOGICAL SURVEY

W. E. Wrather, Director

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

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INTRODUCTION

The U. S. Geological Survey has measured and sampled the Phosphoria formation of Permian age at many localities in Wyoming and adjacent states. The 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, 1953a).

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 rest were made in the Survey laboratory in Denver, Colo., under the direction of L. F. Rader, by G. W. Boyes, J. A. Miskowiec, and N. Morris.

K. S. Bergman compiled most of the data. Anita Wise organized 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 the 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 the A, B, C, D, and E members 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 member, Rex chert member, and upper shale member of the Phosphoria formation in Idaho and

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

Figure 2. —Generalized section of the Phosphoria formation at Coal Canyon, Wyoming (lot no. 1201).

southwestern Wyoming (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.

In southwestern Wyoming the Phosphoria formation consists of 3 members: a lower phosphatic shale member, 95-145 feet in thickness; the Rex chert member, cherty limestone, 65-145 feet in thickness; and the upper shale member, 15-60 feet in thickness (fig. 2). Although the underlying Wells formation of Pennsylvanian age consists largely of quartzose sandstone, calcareous in part; the upper 25 feet or more is a dark-gray limestone that is equivalent to the upper member of the Wells formation in Idaho and may be the correlative of the lowermost member (the A member) of the Phosphoria formation in northwestern Wyoming and Montana and, according to McKelvey (1949), the lower limestone member of the Park City formation in Utah. The overlying Dinwoody formation of Triassic age 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 discussed in greater detail in a later publication. The phosphatic shale member in southwestern Wyoming and its correlative, the B member, in northwestern Wyoming, contain most of the phosphate-bearing layers. The upper shale member and its correlative, the D member, contain only thin layers of phosphatic chert and phosphatic layers of local significance.

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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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.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)
				P ₂ O ₅	Acid insoluble	
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 ¹	--	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
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
P-11	Sandstone, carbonatic, phosphatic chert, and chert	6583-TMC	1.5	9.5	49.1	99.2

¹Fossil collection made by J. E. Smedley, U. S. Geological Survey.

Red Creek—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)
				P ₂ O ₅	Acid insoluble	
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.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)
				P ₂ O ₅	Acid insoluble	
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 ¹	--	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
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

¹Fossil collection made by J. E. Smedley, U. S. Geological Survey.

Forellen Peak—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)
				P ₂ O ₅	Acid insoluble	
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						

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. 97, 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. F. Sheldon, T. M. Cheney, and J. A. Peterson in October 1951. Samples analyzed by U. S. Bureau of Mines laboratory, Albany, Oreg.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P ₂ O ₅ (cumulative) ⁵
				P ₂ O ₅	Acid insoluble		
Upper shale member of Phosphoria formation—top not exposed							
U-18	Sandstone; fos. col. no. 12667 ¹	6794-TMC	5.4	6.3	76.8	5.4	--
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
U-14	Carbonate rock, argillaceous and carbonatic mudstone	6792- RPS	1.0	1.7	41.3	27.4	14.30
U-13	Mudstone, carbonatic	6791- RPS	1.3	3.3	48.6	28.7	18.59
U-12	Mudstone, carbonatic and mantle	6790- RPS	1.2	3.0	60.3	29.9	22.19
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
U-9	Mudstone, carbonatic	6788-TMC	5.7	2.3	63.2	44.6	25.21
U-8	Mudstone	6787- JAP	4.5	1.9	72.06	49.1	33.76
U-7	Phosphate rock, argillaceous, carbonatic	6786- JAP	.2	17.3	30.06	49.3	37.22
U-6	Mudstone, carbonatic	6785- JAP	.9	3.3	58.8	50.2	40.19
U-5	Phosphate rock, argillaceous	6784- JAP	.4	24.6	19.4	50.6	50.03
U-4	Phosphate rock, argillaceous	6783- JAP	.6	24.6	19.6	51.2	64.79
U-3	Mudstone, carbonatic	6782- JAP	2.5	3.6	57.8	53.7	73.79
U-2	Mudstone, carbonatic	6781- JAP	2.2	5.4	57.6	55.9	85.67
U-1	Phosphate rock, argillaceous; fos. col. no. 12666	6780- JAP	.7	28.6	20.5	56.6	105.69

¹Fossil collection made by H. I. Saunders, 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 ₂ O ₅ (cumulative)
				P ₂ O ₅	Acid insoluble		
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.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P ₂ O ₅ (cumulative) ⁵
				P ₂ O ₅	Acid insoluble		
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	--
D member of Phosphoria formation							
D-25	Mudstone; fos. col. no. 12124 ¹ -----	4898- HWP	2.5	1.4	69.6	2.5	3.50
D-24	Mudstone, carbonatic and argillaceous phosphate rock; fos. col. no. 12123 -----	4897- HWP	1.0	5.3	55.7	3.5	8.80
D-23	Mudstone, carbonatic and phosphate rock --	4896- HWP	1.6	8.6	45.9	5.1	22.56
D-22	Mudstone, carbonatic; fos. col. no. 12122 --	4895- HWP	1.4	2.7	56.3	6.5	26.34
D-21	Mudstone, carbonatic -----	4894- HWP	.8	3.0	53.4	7.3	28.74
D-20	Carbonate rock, argillaceous -----	4893- HWP	.8	1.5	38.8	8.1	29.94
D-19	Mudstone, carbonatic -----	4892- HWP	1.2	2.3	53.1	9.3	32.70
D-18	Mudstone, carbonatic -----	4891- HWP	1.3	1.4	54.7	10.6	34.52
D-17	Mudstone, carbonatic -----	4890- RGW	1.6	1.7	57.5	12.2	37.24
D-16	Mudstone, carbonatic -----	4889- RGW	1.5	1.4	63.1	13.7	39.34
D-15	Carbonate rock -----	4888- RGW	.6	.5	9.9	14.3	39.64
D-14	Mudstone; contains calcareous mudstone concretion 0.5 foot thick -----	4887- RGW	3.3	1.3	61.7	17.6	43.93
D-13	Mudstone, calcareous -----	4886- RGW	3.2	1.4	56.8	20.8	48.41
D-12	Mudstone, carbonatic; fos. col. no. 12121 --	4885- RGW	2.0	2.3	55.3	22.8	53.01
D-11	Mudstone, carbonatic -----	4884- RAS	2.1	1.5	56.0	24.9	56.16

¹ Fossil collection made by J. E. Smedley, 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_2O_5 (cumulative)
				P_2O_5	Acid insoluble		
D-10	Phosphate rock, argillaceous; fos. col. no. 12120 -----	4883-RAS	1.1	23.9	17.5	26.0	82.45
D-9	Carbonate rock, argillaceous -----	4882-MAW	1.3	1.2	24.4	27.3	84.01
D-8	Mudstone, carbonatic -----	4881-MAW	1.5	2.2	59.2	28.8	87.31
D-7	Mudstone; fos. col. no. 12119 -----	4880-MAW	2.3	5.3	54.1	31.1	99.50
D-6	Phosphate rock, argillaceous -----	4879-MAW	.7	20.3	25.2	31.8	113.71
--	Mudstone, calcareous; concretion -----	--	(.5)	--	--	--	--
D-5	Mudstone, carbonatic -----	4878-MAW	4.7	3.0	52.5	36.5	127.81
D-4	Mudstone, phosphatic -----	4877-MAW	1.6	8.7	62.7	38.1	141.73
D-3	Mudstone, phosphatic, carbonatic; fos. col. no. 12118 -----	4876-MAW	3.5	12.1	34.5	41.6	184.08
D-2	Mudstone, carbonatic; fos. col. no. 12117 --	4875-MAW	5.2	4.1	56.1	46.8	205.40
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	--
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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	--
C-22	Sandstone; fos. col. no. 12545 -----	6578-RGW	4.5	9.5	34.9	5.0	--
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	--
C-19	Sandstone; fos. col. no. 12544 -----	6576-RGW	3.9	12.2	12.3	14.0	--
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	--

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	--
B-6	Mudstone, cherty -----	--	.3	--	--	12.2	--
B-5	Mudstone and phosphate rock -----	6574- RAS	.6	11.5	42.3	12.8	--
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	--
B-1	Phosphate rock -----	6572- RAS	.8	25.0	19.7	16.1	--

Tensleep formation—not measured

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

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)
				P ₂ O ₅	Acid insoluble	
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
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
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.					

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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
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

¹ Fossil collection made by J. E. Smedley, U. S. Geological Survey.

Teton Pass—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)
				P ₂ O ₅	Acid insoluble	
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
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
P-3	Mudstone-----	--	.5	--	--	24.3
P-2	Phosphate rock, carbonatic-----	6585- RAS	1.5	21.7	12.6	25.8
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.

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

¹ Fossil collection made by H. I. Saunders, U. S. Geological Survey.

² Fossil collection made by J. E. Smedley, U. S. Geological Survey.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative) ⁵
				P_2O_5	Acid insoluble		
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
P-36	Mudstone -----	6490-MAW	1.6	5.6	64.1	2.4	28.64
P-35	Mudstone -----	6489-MAW	1.8	.5	77.9	4.2	29.54
P-34	Mudstone, carbonatic -----	6488-MAW	4.4	.3	66.0	8.6	30.86
P-33	Mudstone, carbonatic -----	6487-MAW	2.0	.9	70.0	10.6	32.66
P-32	Mudstone, carbonatic -----	6486-MAW	.6	3.6	58.1	11.2	34.82
P-31	Mudstone -----	6485-MAW	2.4	1.1	83.7	13.6	37.46
P-30	Mudstone, phosphatic -----	6484-MAW	.5	14.4	41.3	14.1	44.66
P-29	Mudstone -----	6483-MAW	4.2	.6	76.7	18.3	47.18
P-28	Mudstone -----	6482-MAW	1.8	1.5	83.7	20.1	49.88
P-27	Phosphate rock, argillaceous and phosphatic mudstone -----	6481-MAW	.5	18.7	29.4	20.6	59.23
P-26	Mudstone, phosphatic, carbonatic -----	6480-MAW	1.4	13.3	34.7	22.0	77.85
P-25	Carbonate rock -----	6479-MAW	2.7	.5	18.0	24.7	79.20
P-24	Mudstone -----	6478-MAW	.6	6.9	63.3	25.3	83.34
P-23	Mudstone -----	6477-MAW	1.0	1.7	78.8	26.3	85.04
P-22	Mudstone, phosphatic -----	6476-MAW	1.3	14.2	42.1	27.6	103.50
P-21	Carbonate rock, argillaceous -----	6475-RGW	1.9	1.3	23.8	29.5	105.97
P-20	Mudstone and argillaceous phosphate rock -----	6474-RGW	.9	10.1	56.2	30.4	115.06
P-19	Mudstone, phosphatic and carbonatic mudstone -----	6473-RGW	1.3	13.3	35.9	31.7	132.35
P-18	Phosphate rock, carbonatic, argillaceous -----	6472-RGW	.5	18.4	24.8	32.2	141.55
P-17	Carbonate rock, argillaceous -----	6471-RGW	2.8	.9	23.8	35.0	144.07
P-16	Mudstone, carbonatic -----	6470-RGW	.9	1.4	48.6	35.9	145.33
P-15	Mudstone, carbonatic -----	6469-RGW	1.3	4.3	48.7	37.2	150.92
P-14	Mudstone, carbonatic -----	6468-RGW	1.6	4.5	45.6	38.8	158.12
P-13	Mudstone, phosphatic and carbonatic mudstone -----	6467-RGW	1.0	11.8	39.8	39.8	169.92

P-12	Carbonate rock ----- Bed P-12 appears lens-like because of squeezing.	6466-RGW	.5	1.2	11.9	40.3	170.52
P-11	Carbonate rock -----	6465-TMC	1.4	2.3	6.5	41.7	173.74
P-10	Mudstone, phosphatic and argillaceous phosphate rock -----	6464-TMC	.8	18.3	27.2	42.5	188.38
P-9	Mudstone, argillaceous, phosphatic -----	6463-TMC	.6	10.8	33.3	43.1	194.86
P-8	Mudstone, argillaceous, phosphatic -----	6462-TMC	.6	11.4	33.1	43.7	201.70
P-7	Phosphate rock -----	6461-TMC	1.6	25.0	13.3	45.3	241.70
P-6	Carbonate rock -----	6460-TMC	1.6	6.8	2.7	46.9	252.58
P-5	Carbonate rock -----	6459-TMC	1.9	3.6	2.3	48.8	259.42
P-4	Phosphate rock -----	6458-TMC	1.1	29.5	11.7	49.9	291.87
P-3	Mudstone -----	6457-TMC	.9	5.7	62.9	50.8	297.00
P-2	Phosphate rock -----	6456-TMC	1.3	32.7	10.3	52.1	339.51
P-1	Mudstone, phosphatic; fos. col. no. 12643 -----	6455-RAS	1.4	8.4	67.9	53.5	351.27

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	--

¹Fossil collection made by H. I. Saunders, U. S. Geological Survey.

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.

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P ₂ O ₅ (cumulative) ⁵
				P ₂ O ₅	Acid insoluble		
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
P-74	Mudstone -----	6252-MAW	3.1	2.65	84.8	7.9	18.02
P-73	Mudstone, phosphatic -----	6251-MAW	.4	13.2	59.0	8.3	23.30
P-72	Mudstone -----	6250-MAW	1.0	2.20	88.2	9.3	25.50
P-71	Phosphate rock, argillaceous, carbonatic -----	6249-MAW	1.0	13.5	18.7	10.3	39.00
P-70	Mudstone and phosphate rock -----	6248-MAW	.5	14.7	49.6	10.8	46.34
P-69	Mudstone -----	6247-MAW	.7	3.55	78.0	11.5	48.83
P-68	Mudstone, phosphatic -----	6246-MAW	1.0	16.7	47.4	12.5	65.53
P-67	Carbonate rock, argillaceous -----	6245-MAW	.8	.60	28.5	13.3	66.01
P-66	Mudstone -----	6244-MAW	1.2	3.70	72.7	14.5	70.45
P-65	Mudstone, carbonatic -----	6243-MAW	3.5	1.35	61.4	18.0	75.18
P-64	Phosphate rock, argillaceous -----	6242-MAW	.4	23.5	21.7	18.4	84.58
P-63	Mudstone -----	6241-MAW	3.0	.80	81.4	21.4	86.98
P-62	Mudstone -----	6240-MAW	1.2	4.20	73.3	22.6	92.02
P-61	Carbonate rock, argillaceous, phosphatic -----	6239-MAW	1.6	12.7	17.3	24.2	112.34
P-60	Carbonate rock, argillaceous -----	6238-MAW	.8	.73	40.9	25.0	112.92
P-59	Phosphate rock, argillaceous -----	6237-MAW	.7	19.9	33.8	25.7	126.85
P-58	Mudstone, carbonatic -----	6236-MAW	1.8	1.63	67.2	27.5	129.78
P-57	Phosphate rock -----	6235-MAW	.7	25.6	14.7	28.2	147.70
P-56	Carbonate rock, argillaceous -----	6234-MAW	.9	6.58	22.6	29.1	153.62

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

Cumberland Trench—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent)		Cumulative thickness (feet)	Thickness x percent P ₂ O ₅ (cumulative) ⁵
				P ₂ O ₅	Acid insoluble		
P-18	Phosphate rock, argillaceous and phosphate rock; fos. col. no. 12568 -----	6196- RGW	1.0	18.7	38.6	83.6	486.89
P-17	Carbonate rock -----	6195- RGW	2.2	4.75	11.5	85.8	497.34
P-16	Mudstone and phosphatic mudstone; contains calcite geodes; fos. col. no. 12567- -----	6194- RGW	.7	15.0	41.8	86.5	*507.84
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	--
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	--
P-3	Mudstone -----	--	1.7	--	--	114.0	--
P-2	Mudstone -----	6191- RAS	.8	7.75	66.9	114.8	--
P-1	Mudstone, phosphatic; fos. col. no. 12663 -----	6190- RAS	.7	17.6	45.4	115.5	--

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	--
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.