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STRATIGRAPHIC SECTIONS OF THE PHOSPHORIA FORMATION 1953 AND 1954

By R. W. Swanson, L. D. Carswell, R. P. Sheldon, and T. M. Cheney

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Trace Elements Investigations Report 570

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UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

STRATIGRAPHIC SECTIONS OF THE PHOSPHORIA FORMATION

1953 and 1954*

By

R. W. Swanson, L. D. Carswell,
R. P. Sheldon, and T. M. Cheney

October 1955

Trace Elements Investigations Report 570

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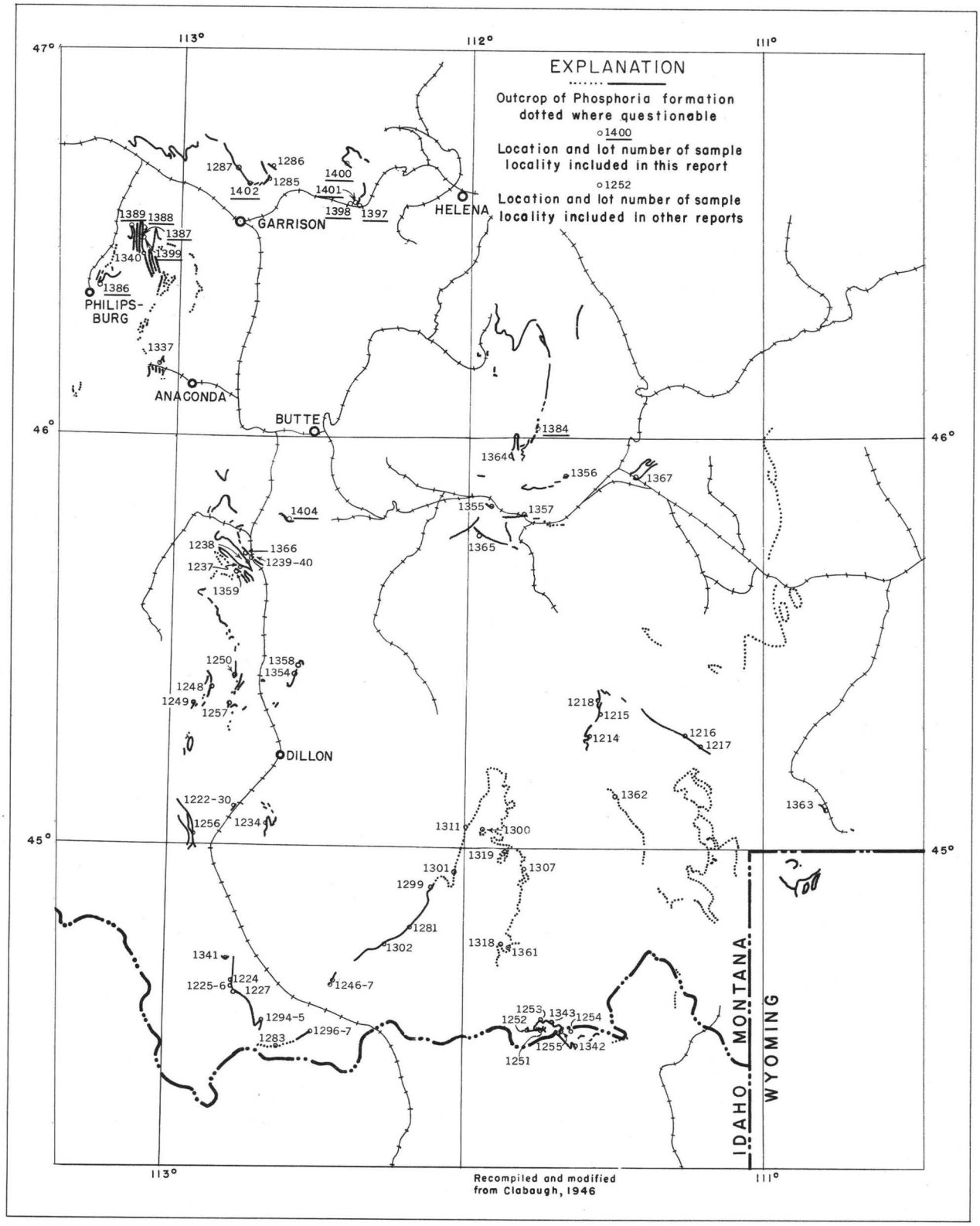
STRATIGRAPHIC SECTIONS OF THE PHOSPHORIA FORMATION, 1953 and 1954

By R. W. Swanson, L. D. Carswell,
R. P. Sheldon, and T. M. Cheney

INTRODUCTION

Since 1947, the U. S. Geological Survey has measured and sampled phosphatic parts of the Permian Phosphoria formation and its partial stratigraphic correlatives at many localities in Montana, Idaho, Wyoming, and Utah. Preliminary data on the thickness of the beds and their composition at localities sampled prior to 1952 have been issued already in TEI-183, 184, 185, 186, 187, 188, 360, 361, 362, 363, 364, 365, 375, 376, 377, and 378. This report presents similar data on the localitites sampled in 1953 and 1954 (figs. 1, 2, and 3). 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. E. T. Ruppel, G. Abele, R. Hughes, J. A. Peterson, and Z. S. Altschuler participated in the description of the 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 L. F. Rader, Jr. The P_2O_5 and acid-insoluble analyses were made for the Survey by the U. S. Bureau of Mines at the Northwest Electro-development laboratory, Albany, Oreg., under the direction of S. M. Shelton and M. L. Wright. The Al_2O_3, Fe_2O_3, and loss-on-ignition analyses were made in the laboratory of the Geological Survey in Washington, D. C., under the direction of Irving May, by chemists I. Barlow, B. Ingram, R. Smith, and W. Tucker. The radioactivity analyses were made in this laboratory under the direction of May and F. Flanagan by J. Budinsky, E. Campbell, M. Delevaux, J. H. Goode, C. Johnson, B. A. McCall, P. Moore, and A. Smith. The chemical uranium analyses were made in this laboratory under the direction of May by Budinsky, Campbell, Delevaux, Goode, C. Hoy, Johnson, R. Moore, and A. Smith.



GURE I. OUTCROPS OF PHOSPHORIA FORMATION IN MONTANA AND LOCALITIES SAMPLED

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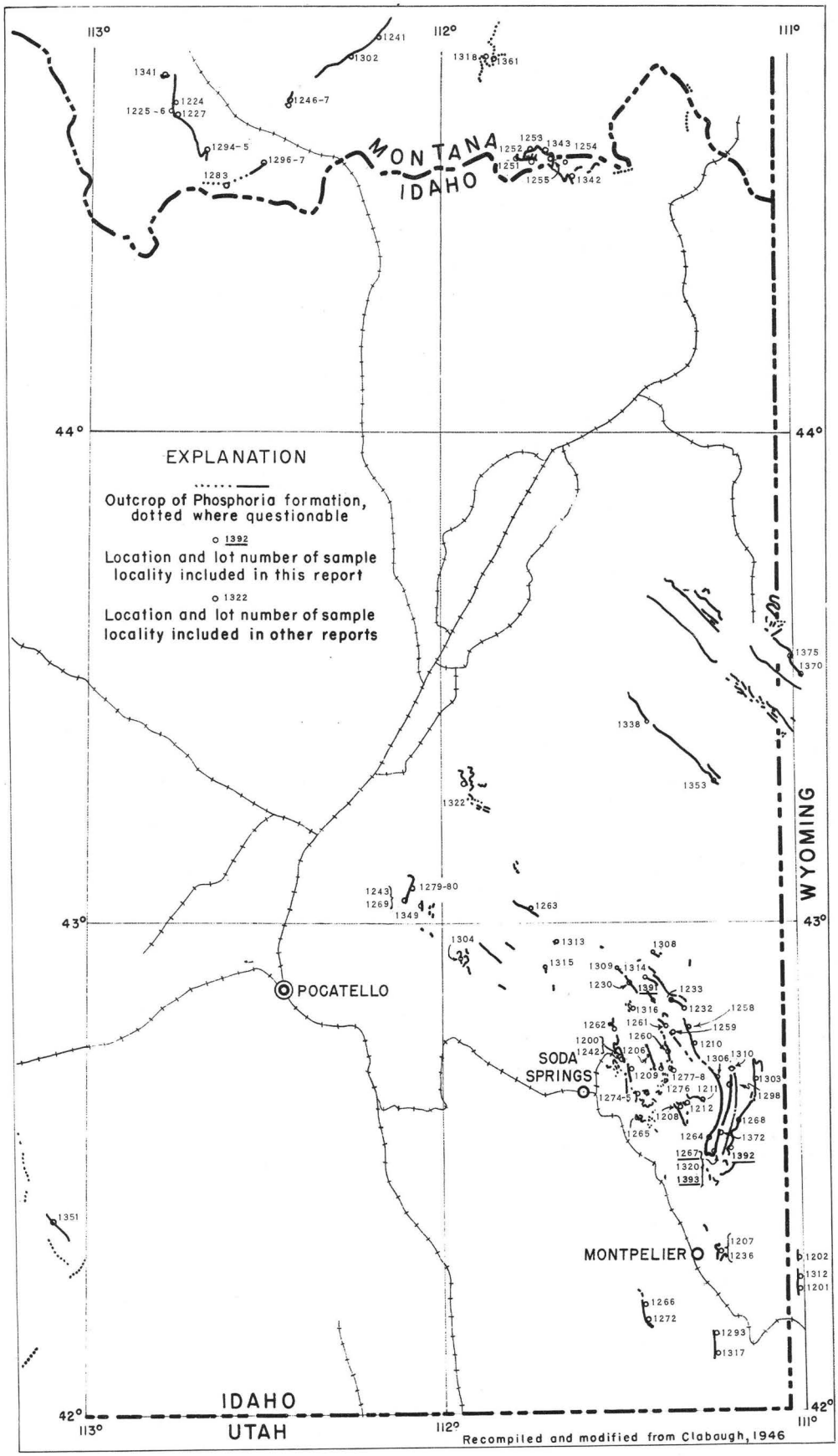

FIGURE 2. OUTCROPS OF PHOSPHORIA FORMATION IN IDAHO AND LOCALITIES SAMPLED

10 0 10 20 30 40 MILES

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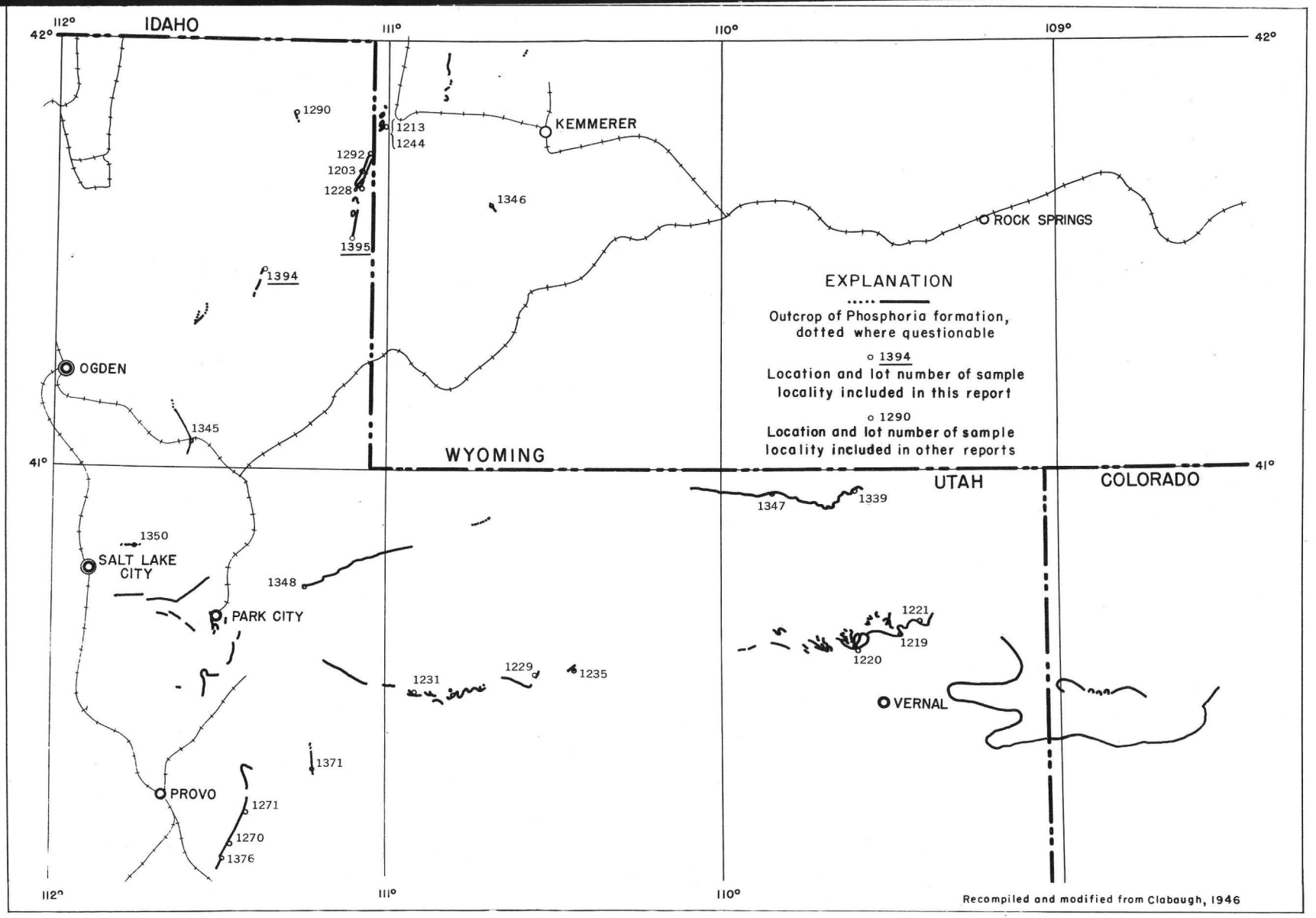

FIGURE 3. OUTCROPS OF PHOSPHORIA AND PARK CITY FORMATIONS IN UTAH AND LOCALITIES SAMPLED

10 0 10 20 30 40 MILES

91119

ACKNOWLEDGMENTS

Special thanks are due V. E. McKelvey and A. E. Weissenborn, who gave much advice and help in carrying out the field program. The cost of the field and laboratory investigations has been borne in part by the Department of the Interior program for development of the Missouri River basin and in part 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 operating phosphate companies who furnished information and services and gave access to property.

STRATIGRAPHY OF THE PHOSPHORIA FORMATION IN MONTANA

In southwestern Montana the Phosphoria formation has been divided into five members: two phosphatic shale members, provisionally termed the B and D members, and three hard members, provisionally termed the A, C, and E members (fig. 4). The lower two hard members, A and C, are dominated by limestone and the top, E member, by chert and sandstone or quartzite. Most of the members can be identified over a large part of the area of outcrop, though member correlation toward the northeast is more difficult. The formation ranges in thickness from less than 100 to more than 800 feet.

The A member is best developed toward the west and southwest and consists of limestone or dolomite, sandstone, mudstone, and chert. It has a maximum thickness of nearly 350 feet, overlies the Quadrant formation of Pennsylvanian age, and probably is partly equivalent to the upper part of the Wells formation of southeastern Idaho and adjacent Wyoming and Utah (McKelvey, 1949).

Near the southwest corner of the state the lower phosphatic shale or B member, is 25 to 50 feet in thickness; it thins markedly to the north and east and pinches out a few miles north of Dillon. In the Centennial Mountains it contains a rich bed of minable phosphate.

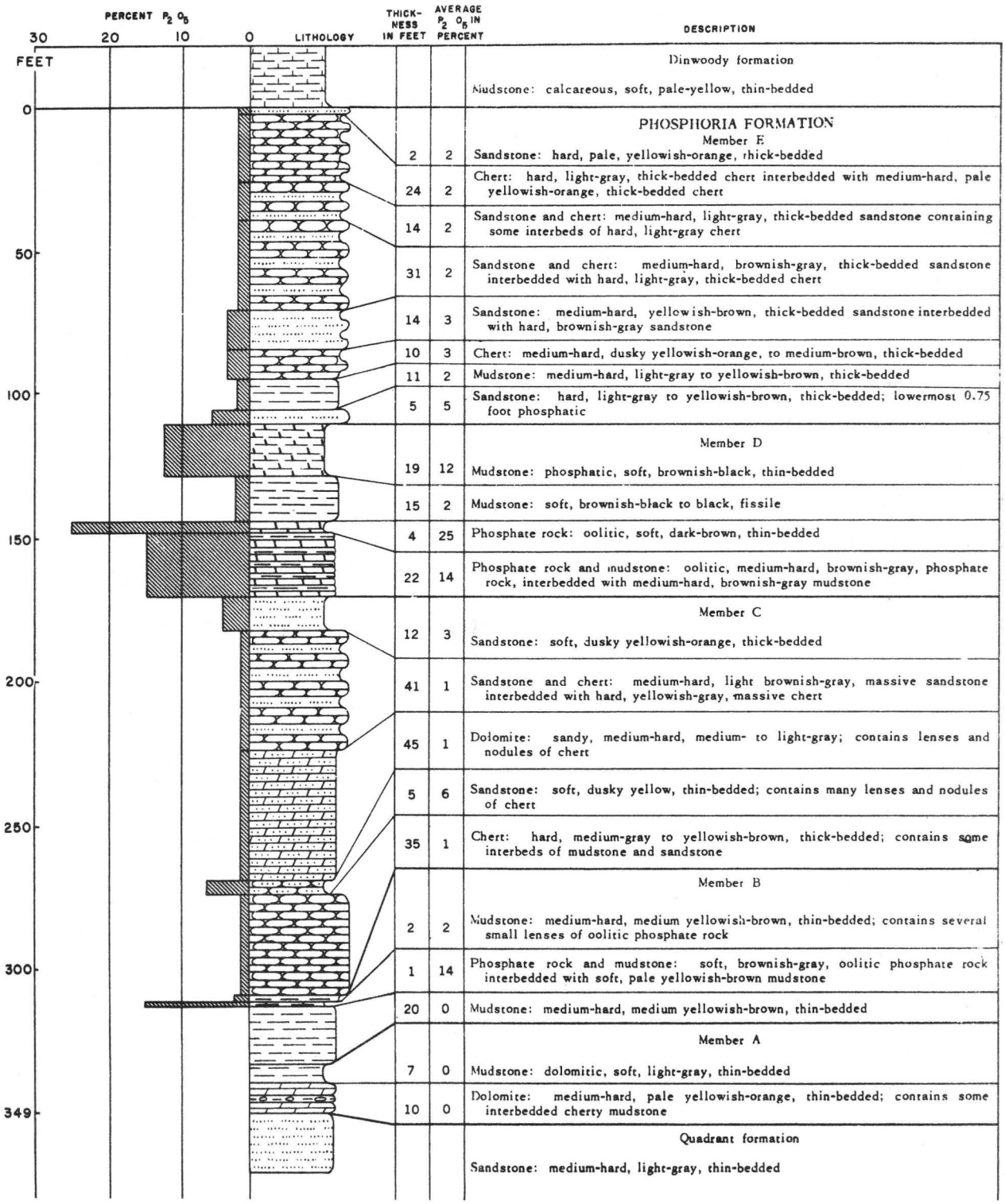

Figure 4.–Generalized section of the Phosphoria formation at Sheep Creek, Montana (lot no. 1234).

The C member consists of 40 to 200 feet of limestone, chert, and sandstone. The upper phosphatic shale or D member is similar to and much more uniform and widespread than the B member, though it contains minable phosphate only toward the north end of the area where in places the full thickness of the phosphatic zone consists of a single 3- to 5-foot bed of high-grade phosphate rock.

The E member is the most widespread and uniform; it averages about 100 feet in thickness and consists chiefly of siliceous rocks--quartzitic sandstone, chert, and siltstone. In the greater part of the area it is overlain by the Dinwoody formation of Triassic age, but toward the north and northeast it is unconformably overlain by the Ellis group of Jurassic age.

STRATIGRAPHY OF THE PHOSPHORIA FORMATION IN IDAHO AND NORTHERN UTAH

At its type locality in southeastern Idaho (Richards and Mansfield, 1912), the Phosphoria formation consists of a lower member, the phosphatic shale, about 180 feet thick and an upper member, the Rex chert, about 240 feet thick (fig. 5). The upper 80 feet of the Rex consists of cherty mudstone and black shale (McKelvey, 1949); although it varies in thickness, it is recognizable over most of southeastern Idaho and westernmost Wyoming. The phosphatic shale member thins progressively northward to a thickness of about 60 feet in the Caribou Range (lots 1338 and 1353).

The stratigraphy of the Phosphoria formation in the Crawford Mountains at the northeastern corner of Utah, near the Idaho-Wyoming corner (Smith and others, 1953), is similar to that in the adjacent states. It consists of the phosphatic shale member, about 210 feet thick, and the Rex chert member, about 220 feet thick. The upper shale member, present in the adjacent region to the north, is not well-defined in this area. Farther south in Utah the middle shale member of the Park City formation is equivalent in major part to the phosphatic shale of the Phosphoria formation in Idaho, and the upper limestone member is probably equivalent to the Rex chert member of the Phosphoria formation to the north (McKelvey, 1949).

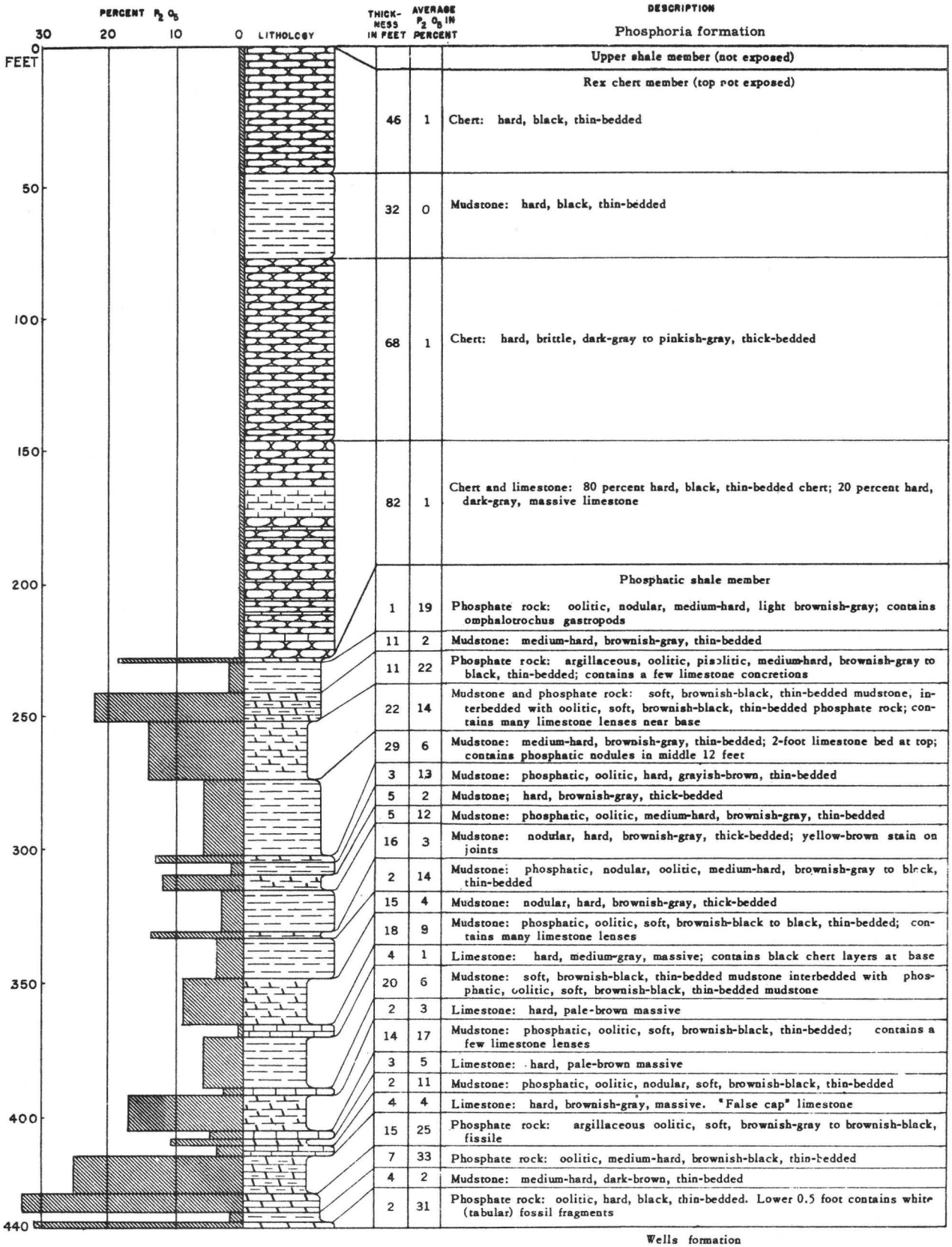

Figure 5.—Generalized section of the Phosphoria formation at Trail Canyon, Idaho (lot no. 1206).

In southeastern Idaho most of the phosphatic beds are in the phosphatic shale member, and it is on this member that most of the studies have been focused. It consists of many thin layers, some of which persist over the whole area, including northern Utah and westernmost Wyoming. They may be grouped into several broad units, as shown in figure 5.

In southeastern Idaho and northern Utah, the Phosphoria formation overlies the Wells formation of Pennsylvanian age, the upper part of which consists chiefly of cherty gray fossiliferous limestone that contains some thin phosphatic layers and may be the partial correlative of the lowermost member (A member) of the Phosphoria formation in Montana and the lower limestone member of the Park City formation in Utah (McKelvey, 1949). The Phosphoria is overlain in this region by the Dinwoody formation of Triassic age, consisting of limestone, calcareous siltstone, and sandstone.

More detailed correlations of the strata within individual states as well as over the entire area of the western phosphate field will be discussed in subsequent publications.

STRATIGRAPHIC SECTIONS

Analytical data and abstracts of stratigraphic sections measured at 18 localities plus additional information at three previously reported localities follow. Their locations as well as the locations of sections previously reported in these states are shown in figures 1, 2, and 3.

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Trout Creek, Mont., lot 1400

Part of Phosphoria formation measured and sampled 90 feet from surface at breast of small adit opened by Russell Luke $\frac{1}{4}$ mile northwest of Trout Creek in SW$\frac{1}{4}$ of SW$\frac{1}{4}$ of sec. 35, T. 10 N., R. 7 W., Powell County, Mont., by R. W. Swanson in July 1954. Beds strike N. 45° W. and dip 45° NE on the northeast flank of the Elliston anticline. 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU[1]	Uranium content (percent) Chem. U	Thickness x percent chem. U (cumulative)
	E member of Phosphoria formation—basal bed only									
E-1	Quartzite	--	0.2	--	--	--	--	--	--	--
	D member of Phosphoria formation									
D-5	Mudstone and phosphatic mudstone	7508-RWS	0.7	7.10	65.7	0.7	4.97	0.004	0.002	0.001
D-4	Quartzite, phosphatic, and mudstone	7507-RWS	.7	14.4	58.2	1.4	15.05	.004	.004	.004
D-3	Phosphate rock, quartzitic	7506-RWS	2.0	24.5	36.0	3.4	64.05	.005	.006	.016
D-2	Phosphate rock	7505-RWS	2.5	36.8	6.5	5.9	156.05	.011	.011	.044
D-1	Sandstone, phosphatic	7504-RWS	1.1	9.55	72.7	7.0	166.55	.002	.003	.047
	C member of Phosphoria formation—upper part only									
C-4	Sandstone	--	2.4	--	--	2.4	--	--	--	--
C-3	Conglomerate	--	1.0	--	--	3.4	--	--	--	--
C-2	Sandstone	--	.5	--	--	3.9	--	--	--	--
C-1	Sandstone	--	.8	--	--	4.7	--	--	--	--

[1] Equivalent uranium

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Garrison Warm Springs Creek, Mont., lot 1402

Most of Phosphoria formation measured and sampled from natural exposures on northwest side of valley about 300 feet above Warm Springs Creek in SE¼ of NW¼ of sec. 19, T. 10 N., R. 9 W., Powell County, Mont., by R. W. Swanson in July 1954. Beds strike about N. 55° W. and dip 65° SW on southwest flank of Garrison anticline. 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Uranium content (percent) Chem. U	Thickness x percent chem. U (cumulative)
	E member of Phosphoria formation—top not exposed									
E-3	Quartzite and chert	--	23.0	--	--	23.0	--	--	--	--
E-2	Chert, quartzitic	--	3.5	--	--	26.5	--	--	--	--
E-1	Quartzite, cherty	--	1.6	--	--	28.1	--	--	--	--
	D member of Phosphoria formation									
D-9	Quartzite, contains phosphate	7522-RWS	1.1	5.50	83.0	1.1	6.05	0.002	0.001	0.001
D-8	Quartzite, phosphatic, and quartzitic phosphate rock	7521-RWS	2.4	10.6	69.0	3.5	31.49	.005	.004	.011
D-7	Phosphate rock, sandy, contains fluorite	7519-RWS	.75	28.1	24.0	4.25	42.57	.009	.009	.017
D-6	Phosphate rock, contains fluorite	7518-RWS	.75	30.4	14.0	5.00	65.37	.010	.010	.025
D-5	Phosphate rock, siliceous, contains fluorite	7517-RWS	.25	23.2	28.7	5.25	71.17	.008	.007	.027
D-4	Phosphate rock, contains fluorite	7516-RWS	1.3	29.5	19.0	6.55	109.52	.010	.009	.038
D-3	Phosphate rock, contains fluorite	7515-RWS	.85	31.5	12.7	7.40	136.29	.010	.011	.048
D-2	Phosphate rock, sandy, and phosphatic mudstone	7514-RWS	.4	22.4	34.4	7.80	145.25	.010	.009	.051
D-1	Quartzite, and sandy phosphate rock	7520-RWS	1.1	6.90	75.7	8.90	152.84	.004	.004	.056
	C member of Phosphoria formation									
C-3	Quartzite	--	2.9	--	--	2.9	--	--	--	--
C-2	Chert, quartzitic, and cherty quartzite	--	26.0	--	--	28.9	--	--	--	--
C-1	Siltstone	--	1.0	--	--	29.9	--	--	--	--
	Quadrant formation—upper part only									
--	Quartzite	--	80.0	--	--	--	--	--	--	--

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Newman Brothers, Elliston, Mont., lot 1398

Part of Phosphoria formation measured and sampled in bulldozer trench dug by Newman Brothers of Elliston in NE¼ of NE¼ of sec. 2, T. 9 N., R. 7 W., Powell County, Mont., by R. W. Swanson in June 1954. Beds strike north and dip 20° W. and occur in a small fault block at southwest corner of Elliston anticline. 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Uranium content (percent) Chem. U	Thickness x percent eU (cumulative)
	E member of Phosphoria formation—lower part only									
E- 9	Chert	--	4.0	--	--	4.0	--	--	--	--
E- 8	Chert, quartzitic	--	1.8	--	--	5.8	--	--	--	--
E- 7	Chert	--	.4	--	--	6.2	--	--	--	--
E- 6	Chert	--	.4	--	--	6.6	--	--	--	--
E- 5	Carbonate rock, siliceous	--	.7	--	--	7.3	--	--	--	--
E- 4	Chert	--	1.2	--	--	8.5	--	--	--	--
	Steep fault, beds not correlated across.									
E- 3	Chert	--	1.2	--	--	1.2	--	--	--	--
E- 2	Chert	7490-RWS	2.5	4.40	85.1	3.7	--	--	0.001	0.002
E- 1	Chert	7489-RWS	.6	2.70	87.6	4.3	--	--	.001	.003
	D member of Phosphoria formation									
D-14	Mudstone, cherty, and carbonate rock	7488-RWS	1.0	3.65	58.7	1.0	3.65	0.002	0.002	0.002
D-13	Chert, phosphatic	7487-RWS	.55	12.0	65.4	1.55	10.25	.004	.005	.003
D-12	Siltstone	7486-RWS	.5	1.30	81.3	2.05	10.90	.003	.002	.004
D-11	Carbonate rock	7485-RWS	.6	1.60	12.9	2.65	11.86	.0005	.001	.004
D-10	Quartzite, phosphatic	7484-RWS	2.5	12.8	65.1	5.15	43.86	.003	.004	.014
D- 9	Sandstone and phosphate rock	7483-RWS	.6	17.7	45.8	5.75	54.48	.005	.005	.017
D- 8	Phosphate rock, carbonatic	7482-RWS	1.3	21.2	12.7	7.05	82.04	.005	.006	.025
D- 7	Phosphate rock	7481-RWS	2.1	36.0	9.27	9.15	157.64	.011	.011	.048
D- 6	Phosphate rock, cherty	7480-RWS	.6	24.4	36.6	9.75	172.28	.009	.010	.054
D- 5	Mudstone and phosphate rock	7479-RWS	.4	7.95	70.2	10.15	175.46	.006	.005	.056
D- 4	Siltstone, carbonatic	7478-RWS	.8	1.20	63.0	10.95	176.42	.0005	.002	.058
D- 3	Chert	7477-RWS	1.0	2.45	78.0	11.95	178.87	.002	.002	.060
D- 2	Chert and mudstone	7476-RWS	.6	2.90	85.5	12.55	180.61	.002	.002	.061
D- 1	Phosphate rock, sandy	7475-RWS	.3	27.4	29.5	12.85	188.83	.006	.008	.063

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Newman Brothers—Continued

Bed no.	Rock description	Sample no.	Thickness (feet)	Chemical analyses (percent) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Uranium content (percent) Chem. U	Thickness x percent eU (cumulative)
	C member of Phosphoria formation—upper part only									
C- 5	Quartzite	--	2.5	--	--	2.5	--	--	--	--
C- 4	Quartzite	--	.8	--	--	3.3	--	--	--	--
C- 3	Carbonate rock and chert	--	2.7	--	--	6.0	--	--	--	--
C- 2	Sandstone, carbonatic	--	.2	--	--	6.2	--	--	--	--
C- 1	Chert	--	.4	--	--	6.6	--	--	--	--

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Senecal Incline, Mont., lot 1401

Part of Phosphoria formation measured and sampled on north wall about 75 feet from portal of old 125-foot incline on property of Mrs. Kathryn Senecal in SW¼ of NW¼ of sec. 6, T. 9 N., R. 6 W., Powell County, Mont., about 1 mile northeast of Elliston by R. W. Swanson in July 1954. Beds strike about N. 25° E. and dip 15° NW. in a fault block near the nose of the Elliston anticline. 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Uranium content (percent) Chem. U	Thickness x percent eU (cumulative)
	D member of Phosphoria formation—middle part only									
D-8	Mudstone	--	0.7	--	--	0.7	--	--	--	--
D-7	Carbonate rock, cherty	--	.4	--	--	1.1	--	--	--	--
D-6	Quartzite, phosphatic	7513-RWS	1.0	18.9	48.0	2.1	18.90	0.004	0.004	0.004
D-5	Phosphate rock, argillaceous	7512-RWS	1.0	29.5	21.9	3.1	48.40	.006	.007	.011
D-4	Phosphate rock	7511-RWS	1.1	36.0	7.67	4.2	88.00	.011	.012	.024
D-3	Phosphate rock, siliceous	7510-RWS	.5	29.5	21.9	4.7	102.75	.009	.009	.029
D-2	Carbonate rock, argillaceous, cherty	7509-RWS	.6	1.60	52.8	5.3	103.71	.0005	.001	.029
D-1	Chert and mudstone	--	3.0	--	--	8.3	--	--	--	--

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East Elliston, Mont., lot 1397

Part of Phosphoria formation measured and sampled in Billings-Spokane pipeline trench 1 mile east of Elliston in NW$\frac{1}{4}$ of sec. 6, T. 9 N., R. 6 W., Powell County, Mont., by R. W. Swanson in June 1954. Beds strike N. 30° E. and dip 30° NW. near the nose of the Elliston anticline. 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Uranium content (percent) eU	Uranium content (percent) Chem. U
	E member of Phosphoria formation—basal beds only							
E-3	Chert	--	1.7	--	--	1.7	--	--
E-2	Carbonate rock	--	.4	--	--	2.1	--	--
E-1	Chert	--	1.0	--	--	3.1	--	--
	D member of Phosphoria formation							
D-7	Mudstone	--	0.7	--	--	0.7	--	--
D-6	Quartzite, phosphatic	7474-RWS	.7	14.1	47.3	1.4	0.003	0.005
D-5	Phosphate rock	7473-RWS	2.4	28.7	19.3	3.8	.008	.009
D-4	Chert and mudstone	--	1.5	--	--	5.3	--	--
D-3	Chert	--	2.4	--	--	7.7	--	--
D-2	Chert and mudstone	--	1.2	--	--	8.9	--	--
D-1	Phosphate rock, sandy	7472-RWS	.3	28.2	27.0	9.2	.007	.007
	C member of Phosphoria formation—upper part only							
C-3	Quartzite	--	2.8	--	--	2.8	--	--
C-2	Carbonate rock	--	1.5	--	--	4.3	--	--
C-1	Chert and carbonate rock	--	1.1	--	--	5.4	--	--

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Edgar Mine East Adit, Mont., lot 1389

D member of Phosphoria formation measured and sampled about 85 feet from portal of adit on east limb of Princeton anticline, NW¼ sec. 36, T. 9 N., R. 13 W., Granite County, Mont., by R. W. Swanson in September 1953. Beds strike about N. 25° W. and dip 30° NE. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements Section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	E member of Phosphoria formation—basal bed only												
E- 1	Sandstone	--	0.1	--	--	--	--	--	--	--	--	--	--
	D member of Phosphoria formation												
D-11	Phosphate rock, sandy	5960-RWS	0.5	24.1	1.8	2.72	1.92	33.3	0.5	12.05	0.006	0.006	0.003
D-10	Phosphate rock, sandy	5959-RWS	2.9	24.5	1.2	1.02	2.28	34.2	3.4	83.10	.007	.007	.023
D- 9	Phosphate rock	5958-RWS	2.1	36.2	1.1	.56	2.50	5.0	5.5	159.12	.012	.011	.046
D- 8	Phosphate rock and mudstone	5957-RWS	1.3	30.1	4.5	1.88	3.50	16.4	6.8	198.25	.010	.009	.058
D- 7	Phosphate rock	5956-RWS	.7	32.5	2.2	1.48	2.82	12.2	7.5	121.00	.012	.011	.066
D- 6	Phosphate rock and mudstone	5955-RWS	.8	19.2	8.4	2.58	4.48	35.4	8.3	136.26	.010	.010	.074
D- 5	Mudstone, phosphatic	5954-RWS	1.7	11.0	10.2	3.76	4.80	54.2	10.0	154.96	.006	.005	.082
D- 4	Mudstone and phosphate rock	5953-RWS	1.4	15.7	9.1	3.82	5.00	41.3	11.4	176.94	.007	.006	.091
D- 3	Phosphate rock	5952-RWS	.6	29.7	2.5	1.00	3.32	17.6	12.0	194.76	.007	.007	.095
D- 2	Mudstone and phosphate rock	5951-RWS	1.1	13.1	7.9	3.58	4.12	50.5	13.1	209.17	.006	.004	.099
D- 1	Conglomerate and phosphate rock	5950-RWS	.6	14.0	--	--	--	61.3	13.7	217.57	.005	.005	.102
	C member of Phosphoria formation—not measured												

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Douglas Creek no. 3 North mine, Mont., lot 1388

D member of Phosphoria formation measured and sampled at end of adit level about 1,650 feet north of portal of International Minerals and Chemical Corporation Douglas Creek no. 3 North mine, sec. 31, T. 9 N., R. 12 W., Granite County, Mont., by R. W. Swanson in September 1953. Beds strike about N. 5° W. and dip about 50° E. on east limb of Douglas Mountain anticline. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements Section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	E member of Phosphoria formation—basal bed only												
E- 1	Quartzite	--	1.4	--	--	--	--	--	--	--	--	--	--
	D member of Phosphoria formation												
D-14	Phosphate rock	5949-RWS	0.8	32.8	1.0	0.96	1.88	15.3	0.8	26.24	0.009	0.008	0.006
D-13	Phosphate rock	5948-RWS	.5	35.7	1.3	.72	2.66	4.7	1.3	44.09	.012	.012	.012
D-12	Phosphate rock and mudstone	5947-RWS	.3	19.6	9.2	2.78	4.14	36.1	1.6	49.97	.012	.010	.016
D-11	Phosphate rock	5946-RWS	.5	35.5	1.6	.64	2.48	6.9	2.1	67.72	.012	.010	.021
D-10	Carbonate rock	5945-RWS	.4	5.8	4.5	11.2	28.42	10.2	2.5	70.04	.003	.003	.022
D- 9	Phosphate rock	5944-RWS	1.45	31.9	2.5	1.16	2.58	14.7	3.95	116.30	.012	.011	.038
D- 8	Phosphate rock, argillaceous	5943-RWS	.7	16.8	8.4	2.04	3.94	41.0	4.65	128.06	.011	.009	.044
D- 7	Mudstone	5942-RWS	.45	3.1	12.8	3.36	4.14	69.6	5.10	129.46	.007	.004	.046
D- 6	Mudstone and phosphate rock	5941-RWS	.7	13.7	10.1	2.62	4.32	47.2	5.80	139.05	.011	.009	.052
D- 5	Mudstone, phosphatic	5940-RWS	.8	9.7	11.2	2.34	3.94	57.4	6.60	146.81	.009	.007	.058
D- 4	Phosphate rock, argillaceous	5939-RWS	.95	20.6	7.4	1.72	3.74	32.6	7.55	166.38	.012	.010	.067
D- 3	Phosphate rock	5938-RWS	.5	34.5	1.5	.68	2.66	9.5	8.05	183.63	.009	.008	.071
D- 2	Mudstone and phosphate rock	5937-RWS	.6	11.4	9.2	3.48	4.18	53.5	8.65	190.47	.006	.004	.074
D- 1	Quartzite and phosphate rock	5936-RWS	.3	31.4	1.0	2.40	2.80	17.6	8.95	199.89	.009	.009	.076
	C member of Phosphoria formation—upper part only												
C- 5	Quartzite	--	0.7	--	--	--	--	--	0.7	--	--	--	--
C- 4	Conglomerate	--	.5	--	--	--	--	--	1.2	--	--	--	--
C- 3	Limestone, cherty	--	.9	--	--	--	--	--	2.1	--	--	--	--
C- 2	Conglomerate	--	.6	--	--	--	--	--	2.7	--	--	--	--
C- 1	Limestone	--	.8	--	--	--	--	--	3.5	--	--	--	--

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Gird Creek West Limb, Mont., lot 1387

D member of Phosphoria formation measured and sampled in hand trench about 1,000 feet north of Gird Creek, sec. 7, T. 8 N., R. 12 W., Granite County, Mont., by R. W. Swanson in September 1953. Beds strike about N. 10° W. and dip about 85° W. on west limb of Douglas Mountain anticline. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements Section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	E member of Phosphoria formation—basal bed only												
E- 1	Quartzite	--	0.9	--	--	--	--	--	--	--	--	--	--
	D member of Phosphoria formation												
D- 9	Sandstone, phosphatic	5935-RWS	0.1	10.6	2.7	3.56	1.86	66.7	0.1	1.06	0.003	0.002	0.000
D- 8	Phosphate rock	5934-RWS	.9	29.6	1.3	.88	1.40	9.4	1.0	27.70	.010	.009	.008
D- 7	Phosphate rock and mudstone	5933-RWS	.75	26.8	5.8	3.88	3.50	16.8	1.75	47.80	.008	.008	.014
D- 6	Phosphate rock	5932-RWS	1.4	34.0	2.2	.96	2.10	9.3	3.15	95.40	.010	.010	.028
D- 5	Phosphate rock, argillaceous	5931-RWS	1.2	18.6	8.7	1.78	3.76	37.8	4.35	117.72	.009	.008	.038
D- 4	Mudstone, phosphatic	5930-RWS	1.8	9.1	11.5	2.44	3.96	55.0	6.15	134.10	.007	.005	.047
D- 3	Phosphate rock, argillaceous	5929-RWS	1.35	16.5	9.0	1.92	3.88	41.6	7.50	156.38	.007	.006	.055
D- 2	Phosphate rock	5928-RWS	.45	28.4	2.0	1.32	2.20	10.3	7.95	169.16	.008	.007	.058
D- 1	Phosphate rock and mudstone	5927-RWS	.9	23.8	5.4	2.14	2.90	28.5	8.85	190.58	.007	.006	.064
	C member of Phosphoria formation—top bed only												
C- 1	Quartzite	--	1.0	--	--	--	--	--	--	--	--	--	--

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Gird Creek East Limb, Mont., lot 1399

D member of Phosphoria formation measured and sampled in bulldozer trench of Montana Phosphate Products Company about 1,500 feet north of Gird Creek, NE¼ sec. 7, T. 8 N., R. 12 W., Granite County, Mont., by R. W. Swanson in July 1954. Beds strike north and dip 63° E. on east limb of Douglas Mountain anticline. 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Uranium content (percent) Chem. U	Thickness x percent eU (cumulative)
	E member of Phosphoria formation—basal bed only									
E- 1	Quartzite	--	5.5	--	--	--	--	--	--	--
	D member of Phosphoria formation									
D-11	Phosphate rock and quartzite	7503-RWS	0.6	20.2	46.6	0.6	12.12	0.005	0.005	0.003
D-10	Phosphate rock	7502-RWS	.85	38.7	2.66	1.45	45.02	.009	.009	.011
D- 9	Phosphate rock and phosphatic mudstone	7501-RWS	.85	29.2	16.9	2.30	69.84	.008	.007	.017
D- 8	Phosphate rock	7500-RWS	1.25	33.0	12.0	3.55	111.09	.010	.009	.028
D- 7	Mudstone, phosphatic	7499-RWS	.6	17.4	44.9	4.15	121.53	.009	.006	.031
D- 6	Mudstone, phosphatic	7498-RWS	.5	8.10	67.7	4.65	125.58	.006	.004	.033
D- 5	Mudstone, phosphatic	7497-RWS	.4	13.2	49.5	5.05	130.86	.009	.007	.036
D- 4	Mudstone, phosphatic	7496-RWS	.7	9.15	62.0	5.75	137.26	.006	.004	.039
D- 3	Phosphate rock, argillaceous	7495-RWS	.5	21.0	36.8	6.25	147.31	.009	.008	.043
D- 2	Phosphate rock, argillaceous	7494-RWS	.95	28.6	20.9	7.20	174.48	.007	.006	.049
D- 1	Phosphate rock, argillaceous	7493-RWS	.5	26.7	32.0	7.70	187.83	.006	.007	.052
	C member of Phosphoria formation—top bed only									
C- 1	Quartzite	--	2.0	--	--	--	--	--	--	--

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Dissett Mine, Mont., lot 1386

Part of D member of Phosphoria formation measured and sampled in Dissett Mine, NE¼ sec. 24, T. 7 N., R. 14 W., Granite County, Mont. All but two samples collected in sub-level about 35 feet above drift, samples 5917-5921 and 5924-5926 from about 10 feet south of raise 700 feet from portal, and samples 5922-5923 from about 60 feet south of raise; remainder of section measured in raise and along east wall of drift north of raise. Samples 7491-7492 collected in drift 20 feet north of raise. Beds in sub-level strike about N. 10° E. and dip about 40° W. on east limb of Wyman Gulch syncline, but beds in drift dip more gently and are complicated by faulting. Section measured by R. W. Swanson and sampled by Swanson and G. Abele in August and September 1953 and July 1954. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements Section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	D member of Phosphoria formation—top not exposed												
D-21	Mudstone	--	1.4	--	--	--	--	--	1.4	--	--	--	--
D-20	Mudstone, phosphatic	5923-RWS	1.0	10.0	6.5	3.16	2.98	61.2	2.4	10.00	0.004	0.002	0.002
D-19	Mudstone	5922-RWS	.95	3.3	7.9	3.12	2.76	75.2	3.35	13.14	.002	.001	.003
D-18	Phosphate rock, argillaceous	5917-RWS	1.9	29.4	1.5	2.08	1.92	21.6	5.25	69.00	.005	.004	.011
D-17	Mudstone, phosphatic	5918-RWS	.5	10.3	9.5	3.80	3.22	55.7	5.75	74.15	.006	.006	.014
D-16	Phosphate rock	5919-RWS	.6	35.4	1.6	1.38	1.92	6.9	6.35	96.39	.004	.003	.016
D-15	Mudstone	5920-RWS	.45	7.7	5.3	5.52	6.40	64.2	6.80	99.85	.002	.001	.016
D-14	Phosphate rock and mudstone	5921-RWS	1.1	26.0	5.1	1.90	2.80	22.2	7.90	128.45	.006	.004	.020
D-13	Phosphate rock	5924-RWS	.8	33.7	2.5	1.62	2.62	16.3	8.70	155.41	.004	.003	.023
D-12	Mudstone	5925-RWS	.45	7.1	4.1	4.72	4.62	58.5	9.15	158.60	.004	.004	.025
D-11	Phosphate rock	5926-RWS	1.1	29.0	4.1	1.52	2.22	19.0	10.25	*190.50	.007	.006	*.031
D-10	Mudstone and phosphate rock (shear zone near top)	--	1.1?	--	--	--	--	--	11.35	--	--	--	--
D- 9	Mudstone	--	.5	--	--	--	--	--	11.85	--	--	--	--
D- 8	Mudstone and phosphate rock (shear zone at base)	--	.5	--	--	--	--	--	12.35	--	--	--	--
D- 7	Mudstone	--	.6	--	--	--	--	--	12.95	--	--	--	--
D- 6	Mudstone (poorly exposed)	--	1.0?	--	--	--	--	--	13.95	--	--	--	--
D- 5	Mudstone, phosphatic (sheared and drag folded)	--	2.5?	--	--	--	--	--	16.45	--	--	--	--
D- 4	Mudstone	--	1.5	--	--	--	--	--	17.95	--	--	--	--
D- 3	Covered interval	--	3.0?	--	--	--	--	--	20.95	--	--	--	--
D- 2	Mudstone and phosphate rock	7492-RWS	1.0	14.6	--	--	--	51.8	21.95	--	.008	.007	--
D- 1	Phosphate rock, argillaceous	7491-RWS	1.0	27.5	--	--	--	24.7	22.95	--	.006	.006	--
	C member of Phosphoria formation—upper part only												
C- 4	Conglomerate	--	1.2	--	--	--	--	--	1.2	--	--	--	--
C- 3	Mudstone	--	.2	--	--	--	--	--	1.4	--	--	--	--
C- 2	Quartzite	--	1.3	--	--	--	--	--	2.7	--	--	--	--
C- 1	Limestone?, cherty	--	4.+	--	--	--	--	--	6.7	--	--	--	--

* Cumulative data incomplete because of missing information.

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White Gulch, Mont., lot 1403

Section of carbonaceous carbonate rock and mudstone reported as "Phosphoria (?) formation" in U. S. Geological Survey Bulletin 972 measured and sampled in part from outcrop and old mining prospect near White Gulch in SW¼ of NE¼ of sec. 19, T. 10 N., R. 2 E., Broadwater County, Mont., by R. W. Swanson in August 1954. Strata occur in fault block between quadrant formation to southwest and Madison group to northeast and are assumed to be not overturned; they strike N. 50-55° W. and dip 75-80° NE. Beds on northwest side of gulch (51-65) are about on strike with those to southeast but no correlation could be established. The strata were judged "non-Phosphoria" by J. Steele Williams during a visit in early September, and it is suggested here that they may be part of the Big Snowy group. 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Uranium content (percent) eU	Uranium content (percent) Chem. U
	Big Snowy group (?)—section on northwest side of gulch							
65	Carbonate rock	--	11.6	--	--	11.6	--	--
64	Carbonate rock and chert	--	8.0	--	--	19.6	--	--
63	Carbonate rock	--	3.6	--	--	23.2	--	--
62	Carbonate rock	--	.9	--	--	24.1	--	--
61	Covered interval	--	4.4	--	--	28.5	--	--
60	Carbonate rock	--	3.2	--	--	31.7	--	--
59	Carbonate rock	--	3.2	--	--	34.9	--	--
58	Covered interval	--	2.0	--	--	36.9	--	--
57	Carbonate rock	--	2.2	--	--	39.1	--	--
56	Carbonate rock and sandstone	--	7.0	--	--	46.1	--	--
55	Carbonate rock, cherty	--	1.3	--	--	47.4	--	--
54	Carbonate rock, argillaceous	--	1.4	--	--	48.8	--	--
53	Carbonate rock	--	1.1	--	--	49.9	--	--
52	Carbonate rock	--	4.9	--	--	54.8	--	--
51	Carbonate rock	--	2.9	--	--	57.7	--	--
	Section on southeast side of gulch							
25	Carbonate rock	--	4.8	--	--	4.8	--	--
24	Carbonate rock	--	3.4	--	--	8.2	--	--
23	Carbonate rock	--	8.0	--	--	16.2	--	--
22	Carbonate rock	--	2.8	--	--	19.0	--	--
21	Carbonate rock, argillaceous	--	4.1	--	--	23.1	--	--
20	Carbonate rock and mudstone	7526-RWS	.8	1.02	17.8	23.9	0.002	0.002
19	Carbonate rock, argillaceous	--	.8	--	--	24.7	--	--
18	Mudstone, carbonatic	7525-RWS	1.1	1.15	26.2	25.8	.003	.003
17	Carbonate rock, cherty, and mudstone	7524-RWS	.4	1.00	45.7	26.2	.0005	.002
16	Carbonate rock, cherty	--	.8	--	--	27.0	--	--
15	Mudstone, carbonatic, cherty	7523-RWS	.4	1.00	35.5	27.4	.002	.003
14	Carbonate rock and chert	--	1.9	--	--	29.3	--	--

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14a	Carbonate rock	--	(1.3)	--	--	--	--	--
13	Carbonate rock, cherty	--	1.7	--	--	31.0	--	--
13a	Carbonate rock	--	(1.2)	--	--	--	--	--
12	Carbonate rock	--	2.8	--	--	33.8	--	--
11	Carbonate rock	--	1.8	--	--	35.6	--	--
10	Carbonate rock	--	.9	--	--	36.5	--	--
9	Carbonate rock	--	4.9	--	--	41.4	--	--
8	Carbonate rock	--	1.8	--	--	43.2	--	--
7	Carbonate rock	--	3.0	--	--	46.2	--	--
6	Carbonate rock	--	1.5	--	--	47.7	--	--
5	Carbonate rock (coquina)	--	.5	--	--	48.2	--	--
4	Carbonate rock (coquina)	--	1.5	--	--	49.7	--	--
3	Carbonate rock	--	1.7	--	--	51.4	--	--
2	Covered interval	--	4.3	--	--	55.7	--	--
1	Chert	--	.3	--	--	56.0	--	--

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Wheatland School, Mont., lot 1384

Phosphoria formation measured and sampled near Wheatland School, SW¼ of SE¼ sec. 7, T. 3 N., R. 1 W., Broadwater County, Mont., at southeastern corner of a major dome. Beds strike about N. 20° E. and dip 25° E. Section measured by E. T. Ruppel and sampled by Ruppel and D. E. Brambilla in June 1952. 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Uranium content (percent) Chem. U	Thickness x percent eU (cumulative)
		Swift sandstone—basal bed only								
S- 1	Conglomerate	--	3.7	--	--	--	--	--	--	--
		Phosphoria formation								
P-81	Chert	--	3.8	--	--	3.8	--	--	--	--
P-80	Quartzite	--	1.0	--	--	4.8	--	--	--	--
P-79	Chert	--	2.0	--	--	6.8	--	--	--	--
P-78	Quartzite	--	1.0	--	--	7.8	--	--	--	--
P-77	Quartzite and chert	--	10.8	--	--	18.6	--	--	--	--
P-76	Covered interval	--	17.0	--	--	35.6	--	--	--	--
P-75	Covered interval, contains phosphate rock float	--	14.3	--	--	*49.9	--	--	--	--
	Probable fault, unit below probably near top of Phosphoria formation. Beds above probably correlate in part with beds 17 through 19 and the upper part of bed 16.									
P-21	Covered interval	--	2.8	--	--	2.8	--	--	--	--
P-20	Sandstone	--	6.4	--	--	9.2	--	--	--	--
P-19	Chert	--	9.8	--	--	19.0	--	--	--	--
P-18	Quartzite	--	.8	--	--	19.8	--	--	--	--
P-17	Sandstone	--	8.1	--	--	27.9	--	--	--	--
P-16	Covered interval (chert at base)	--	45.0	--	--	72.0	--	--	--	--
P-15	Chert	--	2.0	--	--	74.0	--	--	--	--
P-14	Phosphate rock, argillaceous	52R-7c	2.7	26.1	24.4	76.7	70.47	0.007	0.006	0.016
P-13	Mudstone, phosphatic	52R-7b	.6	12.0	38.9	77.3	77.67	.004	.004	.019
P-12	Phosphate rock, argillaceous	52R-7b1	.2	21.0	20.8	77.5	81.87	.005	.004	.019
P-11	Phosphate rock, argillaceous	52R-7a	.5	24.9	26.0	78.0	**94.32	.006	.005	**.022
P-10	Chert	--	1.0	--	--	79.0	--	--	--	--
P- 9	Chert	--	13.2	--	--	92.2	--	--	--	--
P- 8	Chert, phosphatic	52R-8	.6	15.0	55.1	92.8	--	.005	.004	--
P- 7	Chert	--	8.1	--	--	100.9	--	--	--	--

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P- 6	Sandstone, phosphatic	--	1.2	--	--	102.1	--	--	--	--
P- 5	Covered interval	--	3.7	--	--	105.8	--	--	--	--
P- 4	Quartzite	--	1.3	--	--	107.1	--	--	--	--
P- 3	Covered interval	--	3.7	--	--	110.8	--	--	--	--
P- 2	Quartzite	--	.6	--	--	111.4	--	--	--	--
P- 1	Covered interval	--	10-20	--	--	126.4	--	--	--	--

Quadrant formation—top not exposed

* Cumulative data incomplete because of missing information.
** Note incompleteness of cumulative data.

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Mount Humbug, Mont., lot 1404

Part of D member of Phosphoria formation measured and sampled in a longitudinal bulldozer trench excavated by Antonioli and Martin near top of Mount Humbug in E½ of sec. 32, T. 1 N., R. 8 W., Silver Bow County, Mont., by R. W. Swanson in August 1954. Beds strike N. 70° W. and dip 40° NE. 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Uranium content (percent) Chem. U	Thickness x percent eU (cumulative)
	D member of Phosphoria formation—upper part only, top not exposed									
D-39	Mudstone and phosphate rock ----------	7541-RWS	0.4	5.40	61.9	0.4	2.16	0.004	0.003	0.001
D-38	Phosphate rock ----------	7540-RWS	1.1	32.8	13.9	1.5	38.24	.007	.007	.009
D-37	Phosphate rock, argillaceous ----------	7539-RWS	.7	26.1	23.3	2.2	56.51	.005	.005	.012
D-36	Phosphate rock ----------	7538-RWS	2.2	35.8	4.97	4.4	135.27	.005	.005	.023
D-35	Phosphate rock ----------	7537-RWS	.4	26.6	17.0	4.8	145.91	.003	.002	.024
D-34	Phosphate rock, argillaceous ----------	7536-RWS	.95	27.2	22.1	5.75	171.75	.005	.006	.030
D-33	Phosphate rock, argillaceous ----------	7535-RWS	1.0	22.3	33.9	6.75	194.05	.005	.005	.035
D-32	Phosphate rock ----------	7534-RWS	.95	34.0	8.10	7.70	226.35	.006	.007	.042
D-31	Phosphate rock ----------	7533-RWS	.85	29.5	17.0	8.55	251.43	.002	.003	.044
D-30	Phosphate rock, argillaceous ----------	7532-RWS	.95	25.5	24.3	9.50	275.65	.007	.007	.051
D-29	Phosphate rock, argillaceous ----------	7531-RWS	.9	26.6	21.8	10.40	299.59	.007	.007	.057
D-28	Phosphate rock, argillaceous ----------	7530-RWS	.85	26.2	22.8	11.25	321.86	.007	.007	.063
D-27	Mudstone, phosphatic ----------	7529-RWS	.7	11.9	39.6	11.95	330.19	.004	.005	.069
D-26	Mudstone, carbonaceous, phosphatic -----	7528-RWS	2.0	8.90	44.3	13.95	347.99	.004	.004	.077
--	Porphyry sill----------	--	1.0+	--	--	--	--	--	--	--
	Covered below									

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Logan, Mont., lot 1367

Bed P-11 of Phosphoria formation at Logan, Mont., sampled by R. W. Swanson in August 1954. For section at this locality see U. S. Geological Survey Circular 326, 1954. Sample 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) P_2O_5	Chemical analyses (percent) Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Uranium content (percent) Chem. U
	Phosphoria formation								
P-11	Quartzite, phosphatic	7527-RWS	1.1	8.70	71.5	--	--	0.002	0.002

Cave Creek, Mont., lot 1257

Base of D member and upper part of C member restudied at Cave Creek trench, Mont., (see U. S. Geological Survey Circular 260, p. 19-20, 1953) by R. W. Swanson, J. A. Peterson, and Z. S. Altschuler in September 1951. Samples analyzed by U. S. Bureau of Mines laboratory, Albany, Oreg.

	D member of Phosphoria formation—basal beds only								
D- 3	Cumulative figures carried forward	--	--	--	--	32.70	419.96	--	--
D- 2	Phosphate rock, argillaceous, sandy	5586-RWS	0.3	26.6	27.9	33.00	427.94	0.009	0.002
D- 1	Sandstone, phosphatic	5587-RWS	.9	13.5	61.3	33.90	440.09	.003	--
	C member of Phosphoria formation—top beds only								
C- 4	Sandstone, phosphatic	5588-RWS	2.2	9.6	70.7	2.2	21.12	0.003	--
C- 3	Sandstone	5589-RWS	.4	2.6	87.3	2.6	22.16	.001	--
C- 2	Sandstone, cherty	5590-RWS	.9	4.2	78.6	3.5	25.94	.004	--
C- 1	Sandstone, cherty	--	2.5	--	--	6.0	--	--	--

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Little Long Valley, Idaho, lot 1391

Phosphatic shale member of Phosphoria formation measured and sampled from bulldozer trench dug by J. A. Terteling and Sons on west side of Little Long Valley in NE¼ of sec. 10, T. 7 S., R. 43 E., Caribou County, Idaho, by R. P. Sheldon and L. D. Carswell in August 1953. Beds strike N. 30° W. and dip 50° SW. on east limb of Wooley Valley anticline. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements Section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	Rex chert member of Phosphoria formation—basal bed only												
R- 1	Chert	--	1.5	--	--	--	--	--	--	--	--	--	--
	Phosphatic shale member of Phosphoria formation												
P-61	Phosphate rock, argillaceous and mudstone	7410-RPS[2]	2.0	--	--	--	--	--	2.0	--	--	--	--
P-60	Mudstone	7409-RPS[2]	2.0	--	--	--	--	--	4.0	--	--	--	--
P-59	Mudstone	7408-RPS[2]	2.0	--	--	--	--	--	6.0	--	--	--	--
P-58	Mudstone	7407-RPS[2]	1.5	--	--	--	--	--	7.5	--	--	--	--
P-57	Mudstone	7406-RPS[2]	4.0	--	--	--	--	--	11.5	--	--	--	--
P-56	Phosphate rock	7405-RPS[2]	.7	--	--	--	--	--	12.2	--	--	--	--
P-55	Mudstone	7404-RPS[2]	4.2	--	--	--	--	--	16.4	--	--	--	--
P-54	Phosphate rock	7403-RPS[2]	1.9	--	--	--	--	--	18.3	--	--	--	--
P-53	Mudstone, phosphatic	7402-RPS[2]	1.1	--	--	--	--	--	19.4	--	--	--	--
P-52	Mudstone	7401-RPS[2]	.8	--	--	--	--	--	20.2	--	--	--	--
P-51	Phosphate rock	7400-RPS[2]	5.2	--	--	--	--	--	25.4	--	--	--	--
P-50	Phosphate rock and mudstone	7399-RPS[2]	1.5	--	--	--	--	--	26.9	--	--	--	--
P-49	Phosphate rock	7398-RPS	2.2	36.2	1.5	0.64	5.66	3.7	29.1	79.64	0.012	0.013	0.026
P-48	Phosphate rock, argillaceous and mudstone	7397-RPS	11.0	22.2	6.2	2.04	9.96	27.6	40.1	323.84	.011	.012	.147
P-47	Mudstone	7396-RPS	3.4	7.4	--	--	--	63.8	43.5	349.00	.004	--	.161
P-46	Mudstone	7395-LDC	1.3	4.2	--	--	--	73.6	44.8	354.46	.005	.005	.168
P-45	Mudstone and argillaceous phosphate rock	7394-LDC	14.0	14.5	--	--	--	48.5	58.8	557.46	.006	.006	.252
P-44	Mudstone	7393-LDC	2.0	4.3	--	--	--	82.6	60.8	566.06	.003	--	.258
P-43	Mudstone and argillaceous phosphate rock	7392-LDC	18.0	10.4	--	--	--	58.6	78.8	753.26	.005	.005	.348
P-42	Mudstone and phosphatic mudstone	7391-LDC	2.0	7.7	--	--	--	70.6	80.8	768.66	.004	--	.356
P-41	Mudstone	7390-LDC	3.0	1.7	--	--	--	83.8	83.8	773.76	.002	--	.362
P-40	Mudstone	7389-LDC	5.6	2.2	--	--	--	83.0	89.4	786.08	.002	--	.373
P-39	Mudstone	7388-LDC	3.6	3.4	--	--	--	81.9	93.0	798.32	.003	--	.384
P-38	Phosphate rock, argillaceous	7387-LDC	.4	22.9	5.8	2.12	4.90	34.9	93.4	807.48	.007	.007	.386
P-37	Mudstone	7386-LDC	.9	2.2	--	--	--	84.0	94.3	809.46	.003	.002	.389

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P-36	Mudstone, phosphatic	7385-LDC	1.0	13.7	--	--	--	52.1	95.3	823.16	.005	.005	.394
P-35	Mudstone	7384-LDC	2.0	1.1	--	--	--	88.3	97.3	825.36	.002	--	.398
P-34	Phosphate rock, argillaceous	7383-LDC	2.0	17.8	--	--	--	44.5	99.3	860.96	.004	--	.406
P-33	Mudstone	7382-LDC	1.0	1.1	--	--	--	88.0	100.3	862.06	.002	--	.408
P-32	Mudstone	7381-LDC	5.5	1.4	--	--	--	88.6	105.8	869.76	.003	--	.424
P-31	Phosphate rock, argillaceous	7380-LDC	1.8	18.9	--	--	--	37.2	107.6	903.78	.005	.005	.434
P-30	Mudstone	7379-LDC	2.0	1.9	--	--	--	85.9	109.6	907.58	.002	--	.438
P-29	Phosphate rock, argillaceous	7378-LDC	.8	24.3	--	--	--	29.0	110.4	927.02	.005	.006	.442
P-28	Mudstone	7377-LDC	.8	1.1	--	--	--	88.1	111.2	927.90	.002	--	.443
P-27	Phosphate rock	7376-LDC	1.5	28.7	--	--	--	17.7	112.7	970.95	.006	.007	.452
P-26	Mudstone, phosphatic	7375-LDC	1.8	8.6	--	--	--	63.2	114.5	986.43	.005	.004	.461
P-25	Mudstone	7374-LDC	2.6	2.7	--	--	--	80.1	117.1	993.45	.004	--	.472
P-24	Mudstone, phosphatic	7373-LDC	.5	7.8	--	--	--	63.6	117.6	997.35	.004	--	.474
P-23	Mudstone and argillaceous phosphate rock	7372-LDC	.8	13.5	--	--	--	47.0	118.4	1,008.15	.007	.007	.479
P-22	Mudstone	7371-LDC	.45	3.0	--	--	--	77.1	118.8	1,009.35	.004	--	.481
P-21	Mudstone	7370-LDC	.7	4.5	--	--	--	75.0	119.5	1,012.50	.003	--	.483
P-20	Mudstone, argillaceous phosphate rock and chert	7369-RPS	5.0	12.8	--	--	--	39.4	124.5	1,076.50	.008	.010	.523
P-19	Mudstone, phosphatic	7368-RPS	6.0	9.7	--	--	--	50.5	130.5	1,134.70	.004	--	.547
P-18	Mudstone	7367-RPS	1.4	2.7	--	--	--	75.6	131.9	1,138.48	.003	--	.551
P-17	Mudstone, phosphatic	7366-RPS	2.5	8.8	--	--	--	59.2	134.4	1,160.48	.004	--	.561
P-16	Mudstone	7365-RPS	1.0	2.6	--	--	--	80.0	135.4	1,163.08	.002	--	.563
P-15	Mudstone, phosphatic	7364-RPS	4.2	8.8	--	--	--	60.3	139.6	1,200.04	.003	--	.576
P-14	Mudstone and phosphatic mudstone	7363-RPS	5.0	15.8	--	--	--	43.8	144.6	1,279.04	.004	--	.596
P-13	Mudstone and phosphate rock	7362-RPS	4.8	15.7	--	--	--	43.7	149.4	1,354.40	.004	--	.615
P-12	Phosphate rock	7361-RPS	4.0	28.8	4.4	1.72	6.64	16.3	153.4	1,469.60	.005	.006	.635
P-11	Phosphate rock, argillaceous	7360-RPS	6.0	18.2	--	--	--	36.5	159.4	1,578.80	.010	.010	.695
P-10	Mudstone, phosphatic	7359-RPS	3.0	15.5	--	--	--	44.8	162.4	1,625.30	.005	.004	.710
P- 9	Phosphate rock	7358-RPS	5.3	34.6	1.7	.64	5.94	5.0	167.7	1,808.68	.012	.012	.773
P- 8	Phosphate rock, argillaceous	7357-RPS	.5	21.4	6.3	2.14	6.10	34.3	168.2	1,819.38	.008	.007	.777
P- 7	Phosphate rock	7356-RPS	6.0	33.3	2.1	.84	5.76	8.0	174.2	2,019.18	.013	.013	.855
P- 6	Mudstone	7355-RPS	.3	8.3	10.5	3.20	6.90	63.5	174.5	2,021.67	.006	.005	.857
P- 5	Phosphate rock	7354-RPS	4.5	26.8	4.7	1.02	7.72	18.5	179.0	2,142.27	.010	.009	.902
P- 4	Phosphate rock	7353-RPS	.2-.8	28.2	--	--	--	19.2	179.5	2,156.37	.005	.005	.905
P- 3	Phosphate rock	7352-RPS	5.8	32.4	1.5	.60	8.00	5.7	185.3	2,344.29	.015	.015	.992
P- 2	Mudstone and carbonatic mudstone	7351-RPS	3.3	1.5	--	--	--	48.3	188.6	2,349.24	.002	--	.998
P- 1	Phosphate rock	7350-RPS	.3	35.4	.9	1.38	3.34	4.5	188.9	**2,359.86	.012	.011	**1.002

[2] Sample lost in shipment.

** Note incompleteness of cumulative data.

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Clear Creek, Idaho, lot 1392

Phosphatic shale member of Phosphoria formation sampled in bulldozer trench of Monsanto Chemical Company in SW¼ of SE¼ of sec. 16, T. 10 S., R. 45 E., Caribou County, Idaho. Beds strike N. 30° E. and dip 15° W. on the east limb of Webster syncline. Section measured by R. P. Sheldon and L. D. Carswell and sampled by Sheldon, Carswell and G. Abele in September 1953. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements Section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	Rex member of Phosphoria formation—basal bed only												
R- 1	Phosphate rock, cherty	7349-RPS	--	21.6	--	--	--	33.5	--	--	0.009	0.009	--
	Phosphatic shale member of Phosphoria formation—base not exposed												
P-55	Mudstone	7348-RPS	0.5	2.2	--	--	--	72.6	0.5	1.10	0.002	--	0.001
P-54	Mudstone	7347-RPS	10.5	3.0	--	--	--	69.5	11.0	32.60	.002	--	.022
P-53	Mudstone	--	.7	--	--	--	--	--	11.7	--	--	--	--
P-52	Carbonate rock	7346-RPS	1.2	1.8	--	--	--	16.0	12.9	*2.16	.0005	--	--
P-51	Phosphate rock, argillaceous	7345-RPS	.5	19.1	--	--	--	36.6	13.4	11.71	.007	0.006	*.004
P-50	Mudstone	7344-RPS	2.3	2.7	--	--	--	74.7	15.7	17.92	.002	--	.008
P-49	Phosphate rock and mudstone	7343-RPS	.7	24.6	5.0	1.84	6.94	23.5	16.4	35.14	.008	.008	.014
P-48	Mudstone	7342-RPS	2.9	1.5	--	--	--	76.9	19.3	39.49	.002	--	.020
P-47	Phosphate rock	7341-LDC	1.4	35.9	.9	.48	4.86	3.6	20.7	89.75	.011	.011	.035
P-46	Phosphate rock	7340-LDC	.9	36.4	.4	.24	2.76	5.9	21.6	122.51	.014	.014	.048
P-45	Mudstone	7339-LDC	1.6	5.8	--	--	--	69.0	23.2	131.79	.003	--	.052
P-44	Phosphate rock	7338-LDC	.9	23.6	2.8	1.16	11.92	17.2	24.1	153.03	.008	.007	.060
P-43	Mudstone, phosphatic	7337-LDC	.7	10.3	--	--	--	59.4	24.8	160.24	.004	--	.062
P-42	Phosphate rock	7336-LDC	2.4	31.6	2.1	1.02	4.98	13.7	27.2	236.08	.013	.012	.094
P-41	Phosphate rock	7335-LDC	2.3	32.9	1.7	.76	5.90	9.4	29.5	311.75	.018	.018	.135
P-40	Phosphate rock, argillaceous	7334-LDC	.8	18.2	--	--	--	41.8	30.3	326.31	.006	--	.140
P-39	Phosphate rock and mudstone	7333-LDC	1.4	27.8	3.3	1.22	7.90	18.7	31.7	365.23	.014	.014	.159
P-38	Phosphate rock	7332-LDC	.9	35.5	1.2	.48	5.26	5.0	32.6	397.18	.012	.011	.170
P-37	Phosphate rock	7331-LDC	2.6	36.0	.9	.36	6.48	3.1	35.2	490.78	.019	.021	.220
P-36	Phosphate rock	7330-LDC	4.5	27.9	2.8	1.04	13.42	12.6	39.7	616.33	.014	.015	.282
P-35	Phosphate rock	7329-LDC	2.5	25.8	3.4	1.12	16.00	15.7	42.2	680.83	.010	.011	.308
P-34	Phosphate rock, argillaceous	7328-LDC	2.6	18.3	--	--	--	31.4	44.8	728.41	.009	.009	.331
P-33	Mudstone and phosphatic mudstone	7327-RPS	1.5	6.0	--	--	--	68.8	46.3	737.41	.004	--	.337
P-32	Mudstone, phosphatic and argillaceous phosphate rock	7326-RPS	4.7	17.9	--	--	--	35.7	51.0	821.54	.006	.006	.365
P-31	Phosphate rock	7325-RPS	1.0	29.5	2.7	2.56	4.66	18.5	52.0	851.04	.005	.005	.370
P-30	Mudstone and argillaceous phosphate rock	7324-RPS	3.0	11.4	--	--	--	59.3	55.0	885.24	.004	--	.382
P-29	Mudstone and argillaceous phosphate rock	7323-RPS	3.3	8.8	--	--	--	50.5	58.3	914.28	.005	.004	.399

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P-28	Mudstone	7322-RPS	1.7	5.2	--	--	--	73.5	60.0	923.12	.004	--	.405
P-27	Mudstone and argillaceous phosphate rock	7321-RPS	2.2	7.9	--	--	--	62.1	62.2	940.50	.004	--	.414
P-26	Mudstone, phosphatic mudstone, and argillaceous phosphate rock	7320-RPS	6.6	11.5	--	--	--	59.9	68.8	1,016.40	.004	--	.441
P-25	Mudstone and carbonatic mudstone	7319-RPS	4.0	1.3	--	--	--	68.4	72.8	1,021.60	.002	--	.449
P-24	Mudstone and cherty, argillaceous phosphate rock	7318-RPS	3.4	12.2	--	--	--	52.8	76.2	1,063.08	.004	--	.462
P-23	Mudstone and argillaceous phosphate rock	7317-RPS	4.2	9.5	--	--	--	63.7	80.4	1,102.98	.004	--	.479
P-22	Mudstone	7316-RPS	.7	2.3	--	--	--	82.9	81.1	1,104.59	.002	--	.480
P-21	Mudstone and argillaceous phosphate rock	7315-RPS	7.4	11.6	--	--	--	39.6	88.5	1,190.43	.004	--	.510
P-20	Carbonate rock and mudstone	7314-RPS	4.0	1.7	--	--	--	41.7	92.5	1,197.23	.002	--	.518
P-19	Carbonate rock, argillaceous, mudstone, and chert	7313-RPS	5.2	1.0	--	--	--	40.5	97.7	1,202.43	.0005	--	.521
P-18	Mudstone	7312-RPS	7.0	3.9	--	--	--	75.9	104.7	1,229.73	.003	--	.542
P-17	Mudstone, phosphatic mudstone and argillaceous phosphate rock	7311-LDC	2.9	8.8	--	--	--	56.8	107.6	1,255.25	.003	--	.550
P-16	Mudstone	7310-LDC	1.0	6.9	--	--	--	67.7	108.6	1,262.15	.004	--	.554
P-15	Mudstone and argillaceous phosphate rock	7309-LDC	2.2	18.0	--	--	--	32.5	110.8	1,301.75	.004	--	.563
P-14	Mudstone	7308-LDC	1.2	5.8	--	--	--	69.6	112.0	1,308.71	.002	--	.566
P-13	Mudstone, phosphatic (highly weathered)	7307-LDC	5.0	11.7	--	--	--	46.9	117.0	1,367.21	.004	--	.586
P-12	Sample missing (highly weathered and faulted zone	--	7.0	--	--	--	--	--	124.0	--	--	--	--
P-11	Mudstone	--	1.4	--	--	--	--	--	125.4	--	--	--	--
P-10	Mudstone, phosphatic	7306-LDC	3.3	10.5	--	--	--	57.2	128.7	*34.65	.005	.004	*.016
P- 9	Carbonate rock, argillaceous	7305-LDC	2.4	.9	--	--	--	28.2	131.1	36.81	.001	--	.019
P- 8	Phosphate rock	7304-RPS	4.6	25.3	3.0	1.06	12.54	18.1	135.7	153.19	.010	.011	.065
P- 7	Mudstone, phosphatic	7303-RPS	1.2	16.5	--	--	--	45.0	136.9	172.99	.007	.008	.073
P- 6	Phosphate rock, argillaceous	7302-RPS	7.1	25.7	2.7	1.12	7.70	23.5	144.0	355.46	.008	.010	.130
P- 5	Carbonate rock	7301-RPS	1.0	4.8	--	--	--	11.7	145.0	**360.26	.002	--	**.132
P- 4	Phosphate rock, argillaceous	7300-RPS[3]	3.5	--	--	--	--	--	148.5	--	--	--	--
P- 3	Carbonate rock, phosphatic	7299-RPS	1.4	8.3	--	--	--	9.2	149.9	--	.001	--	--
P- 2	Phosphate rock	7298-RPS	4.0-6.0	33.7	1.2	.60	6.08	4.3	154.9	--	.017	.018	--
P- 1	Mudstone (base not exposed)	--	--	--	--	--	--	--	--	--	--	--	--

* Cumulative data incomplete because of missing information.
** Note incompleteness of cumulative data.
[3] Sample lost in shipment.

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East Georgetown Canyon, Idaho, lot 1267a

Part of phosphatic shale member of Phosphoria formation measured and sampled in bulldozer trench of Central Farmers Fertilizer Cooperative on east side of Georgetown Canyon about 1,000 feet above Twin Creek in NE¼ of NW¼ sec. 30, T. 10 S., R. 45 E., Bear Lake County, Idaho, by L. D. Carswell in September 1953. Beds strike N. 10° E. and dip 70° W. on east limb of Georgetown syncline. Section measured represents the 40-foot covered interval in previously described section, lot 1267, published in Geological Survey Circular 262. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	Phosphatic shale member of Phosphoria formation—partial section												
P-20	Phosphate rock, argillaceous	7297-LDC	6.0	23.0	5.0	1.46	12.12	22.3	6.0	138.00	0.006	0.006	0.036
P-19	Phosphate rock	7296-LDC	.8	26.7	3.7	1.58	11.70	15.5	6.8	159.36	.005	.005	.040
P-18	Mudstone	7295-LDC	.6	4.1	--	--	--	69.3	7.4	161.82	.004	--	.042
P-17	Phosphate rock	7294-LDC	.9	28.6	2.6	1.48	10.60	12.7	8.3	187.56	.008	.008	.050
P-16	Phosphate rock, argillaceous	7293-LDC	1.2	19.0	4.9	2.08	16.98	27.1	9.5	210.36	.013	.013	.065
	Upper 0.4 foot of bed P-16 is black carbonaceous zone.												
P-15	Phosphate rock, argillaceous	7292-LDC	2.3	24.1	3.7	1.60	11.40	21.3	11.8	265.79	.012	.013	.093
P-14	Carbonate rock	7291-LDC	2.3	3.8	--	--	--	17.0	14.1	274.53	.002	--	.097
P-13	Mudstone, phosphatic	7290-LDC	3.0	11.3	--	--	--	50.7	17.1	308.43	.005	.004	.112
P-12	Carbonate rock, argillaceous	7289-LDC	2.4	1.1	--	--	--	20.1	19.5	311.07	.001	--	.115
P-11	Phosphate rock, argillaceous	7288-LDC	1.0	21.0	3.3	1.16	12.00	26.5	20.5	332.07	.004	--	.119
P-10	Phosphate rock, argillaceous	7287-LDC	1.0	25.4	3.4	1.16	8.76	22.9	21.5	357.47	.006	.006	.125
P- 9	Phosphate rock	7286-LDC	.5	27.2	2.6	0.54	12.24	15.8	22.0	371.07	.010	.010	.130
P- 8	Phosphate rock, argillaceous	7285-LDC	2.0	22.6	4.1	1.28	11.32	27.0	24.0	416.27	.009	.009	.148
P- 7	Phosphate rock, argillaceous	7284-LDC	1.6	24.0	3.5	1.34	10.80	23.3	25.6	454.67	.009	.009	.162
P- 6	Mudstone, phosphatic	7465-LDC	2.0	12.4	--	--	--	51.7	27.6	479.47	.006	.007	.174
P- 5	Phosphate rock	7464-LDC	2.8	26.9	3.0	1.32	9.66	18.2	30.4	554.79	.010	.008	.202
P- 4	Phosphate rock	7463-LDC	3.8	27.9	2.8	1.10	9.08	17.3	34.2	660.81	.010	.009	.240
P- 3	Phosphate rock, argillaceous	7462-LDC	.7	27.1	2.8	1.16	8.84	21.6	34.9	679.78	.012	.011	.249
P- 2	Mudstone, phosphatic	7461-LDC	.7	8.6	--	--	--	58.0	35.6	685.80	.006	.005	.253
P- 1	Phosphate rock, argillaceous	7460-LDC	1.8	22.1	4.0	1.38	10.04	24.4	37.4	725.58	.007	.007	.265

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Phosphoria Gulch, Idaho, lot 1393

Part of phosphatic shale member of Phosphoria formation measured and sampled 2,000 feet from portal of adit in Central Farmers Cooperative mine in Phosphoria Gulch in NW¼ of NW¼ of sec. 30, T. 10 S., R. 45 E., by L. D. Carswell in September 1953. Beds strike N. 15° E. and dip 45° W. on east limb of Georgetown syncline. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements Section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	Phosphatic shale member of Phosphoria formation—lower phosphate zone												
P-6	Mudstone, carbonatic	--	--	--	--	--	--	--	--	--	--	--	--
P-5	Phosphate rock	7415-LDC	1.5	31.6	1.4	0.50	7.44	6.5	1.5	47.40	0.014	0.015	0.022
P-4	Phosphate rock	7414-LDC	.9	34.0	.8	.42	7.10	2.7	2.4	78.00	.018	.018	.040
P-3	Phosphate rock	7413-LDC	.8	35.4	.6	.40	6.10	1.8	3.2	106.32	.019	.019	.055
P-2	Phosphate rock	7412-LDC	.7	30.3	1.7	.80	7.96	9.7	3.9	127.53	.010	.010	.062
P-1	Mudstone	7411-LDC	.5	5.6	--	--	--	57.3	4.4	130.33	.006	.005	.064

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South end Crawford Mountains, Utah, lot 1395

Rex member and upper part of phosphatic shale member of Phosphoria formation measured and sampled in SW¼ of sec. 1, T. 9 N., R. 7 E., Rich County, Utah, by T. M. Cheney in October 1953. Beds strike N. 10° E. and dip 80° E. on east limb of South Crawford anticline. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements Section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	Rex member of Phosphoria formation												
R-17	Sandstone, cherty, carbonatic	--	2.0	--	--	--	--	--	2.0	--	--	--	--
R-16	Sandstone, cherty	--	7.3	--	--	--	--	--	9.3	--	--	--	--
R-15	Sandstone, carbonatic	--	3.5	--	--	--	--	--	12.8	--	--	--	--
R-14	Carbonate rock	--	8.0	--	--	--	--	--	20.8	--	--	--	--
R-13	Carbonate rock and chert	--	8.0	--	--	--	--	--	28.8	--	--	--	--
R-12	Covered interval: predominantly chert float	--	35.0	--	--	--	--	--	63.8	--	--	--	--
R-11	Chert	--	21.0	--	--	--	--	--	84.8	--	--	--	--
R-10	Covered interval: float dominantly carbonate rock and chert	--	23.0	--	--	--	--	--	107.8	--	--	--	--
R- 9	Limestone	--	7.0	--	--	--	--	--	114.8	--	--	--	--
R- 8	Covered interval: float dominantly carbonate rock and silty carbonate rock	--	21.0	--	--	--	--	--	135.8	--	--	--	--
R- 7	Carbonate rock	--	4.5	--	--	--	--	--	140.3	--	--	--	--
R- 6	Sandstone	--	8.0	--	--	--	--	--	148.3	--	--	--	--
R- 5	Covered interval: float dominantly carbonate rock and chert	--	10.0	--	--	--	--	--	158.3	--	--	--	--
R- 4	Chert	--	4.0	--	--	--	--	--	162.3	--	--	--	--
R- 3	Carbonate rock	--	8.5	--	--	--	--	--	170.8	--	--	--	--
R- 2	Chert and cherty carbonate rock	--	25.0	--	--	--	--	--	195.8	--	--	--	--
R- 1	Chert	--	5.0	--	--	--	--	--	200.8	--	--	--	--
	Phosphatic shale member of Phosphoria formation—upper part only												
P- 9	Phosphate rock, cherty	--	0.7	--	--	--	--	--	0.7	--	--	--	--
P- 8	Chert and carbonate rock	--	2.6	--	--	--	--	--	3.3	--	--	--	--
P- 7	Phosphate rock, cherty, and cherty mudstone	7471-TMC	2.4	8.5	8.0	3.40	9.24	55.5	5.7	20.40	0.005	0.004	0.010
P- 6	Mudstone and carbonatic phosphate rock	7470-TMC	1.9	10.5	3.7	1.60	21.40	27.0	7.6	40.35	.003	.004	.017
P- 5	Phosphate rock	7469-TMC	3.7	33.6	.9	.64	5.46	4.0	11.3	164.67	.017	.016	.076
P- 4	Phosphate rock, argillaceous	7468-TMC	.9	22.2	3.9	1.60	9.38	23.1	12.2	184.65	.008	.007	.083
P- 3	Phosphate rock	7467-TMC	2.2	32.9	1.0	.56	6.30	4.1	14.4	257.03	.022	.022	.131
P- 2	Phosphate rock	7466-TMC	2.1	29.8	2.1	.80	6.62	10.2	16.5	319.61	.019	.018	.169
P- 1	Chert	--	8.0	--	--	--	--	--	24.5	--	--	--	--

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Sugar Pine Creek, Utah, lot 1394

Upper part of phosphatic shale member of Phosphoria formation measured and sampled in hand trench 150 yards north of Sugar Pine Creek in SE¼ sec. 4, T. 8 N., R. 5 E., Rich County, Utah. Beds are overturned and strike N. 25° E. and dip 55° NW. Section measured by T. M. Cheney and sampled by Cheney and Richard Hughes in September 1953. Samples analyzed for P_2O_5 and acid insoluble by U. S. Bureau of Mines laboratory, Albany, Oreg., and for other constituents by Trace Elements Section laboratory, U. S. Geological Survey, Washington, D. C.

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) P_2O_5	Al_2O_3	Fe_2O_3	Loss on ignition	Acid insoluble	Cumulative thickness (feet)	Thickness x percent P_2O_5 (cumulative)	Uranium content (percent) eU	Chem. U	Thickness x percent eU (cumulative)
	Rex member of Phosphoria formation—basal bed only												
R- 1	Chert	--	8.0	--	--	--	--	--	--	--	--	--	--
	Phosphatic shale member of Phosphoria formation—top and bottom parts only												
P-19	Phosphate rock	7443-TMC	1.1	32.4	1.80	1.60	5.76	8.1	1.1	35.64	0.003	--	0.003
P-18	Mudstone, phosphatic	7442-TMC	1.1	9.5	8.0	3.32	7.70	59.9	2.2	46.09	.005	0.004	.009
P-17	Phosphate rock	7441-TMC	1.1	29.4	2.9	1.32	8.30	13.1	3.3	78.43	.010	.010	.020
P-16	Mudstone, phosphatic	7440-TMC	.8	12.7	8.2	2.38	9.64	50.6	4.1	88.59	.007	.007	.025
P-15	Phosphate rock	7439-TMC	.5	30.4	2.9	.74	5.70	14.0	4.6	103.79	.009	.010	.030
P-14	Phosphate rock	7438-TMC	1.9	32.9	1.7	.24	4.62	9.7	6.5	166.30	.008	.009	.045
P-13	Phosphate rock and phosphatic mudstone	7437-TMC	.8	31.4	2.4	.46	6.38	12.1	7.3	191.42	.009	.010	.052
P-12	Phosphate rock	7436-TMC	2.8	30.3	2.2	.70	7.74	13.6	10.1	276.26	.010	.010	.080
P-11	Phosphate rock and phosphatic mudstone	7435-TMC	1.5	33.6	1.8	.20	5.20	9.2	11.6	326.66	.008	.010	.092
P-10	Phosphate rock	7434-TMC	1.5	35.3	1.2	.14	4.46	4.2	13.1	379.61	.010	.011	.107
P- 9	Phosphate rock and mudstone	7433-TMC	1.2	29.3	3.1	.26	5.22	16.4	14.3	414.77	.008	.008	.117
P- 8	Phosphate rock	7432-TMC	1.1	26.4	3.4	.58	10.28	17.9	15.4	443.81	.012	.012	.130
P- 7	Phosphate rock, argillaceous	7431-TMC	.8	19.8	5.6	1.16	13.30	29.7	16.2	459.65	.009	.011	.137
P- 6	Phosphate rock	7430-TMC	1.7	33.2	1.5	.40	6.84	6.9	17.9	516.09	.010	.011	.154
P- 5	Phosphate rock	7429-TMC	1.6	23.3	4.4	1.26	16.80	19.3	19.5	553.37	.012	.012	.174
	Possible fault zone, parallel to strike in upper 1.0 foot of bed P-5.												
P- 4	Mudstone, phosphatic	7428-TMC	1.1	11.3	8.4	2.84	13.64	45.6	20.6	565.80	.008	.008	.182
P- 3	Phosphate rock, argillaceous	7427-TMC	1.6	18.9	5.8	2.34	4.48	39.0	22.2	596.04	.005	.005	.190
P- 2	Mudstone	7426-TMC	.4	3.3	8.3	1.90	3.62	78.3	22.6	597.36	.002	--	.191
P- 1	Mudstone, phosphatic and mudstone	7425-TMC	1.5	11.7	7.2	3.26	4.28	55.3	24.1	614.91	.003	--	.196
	Wells formation—top bed only												
Cw-1	Sandstone	--	1.6	--	--	--	--	--	--	--	--	--	--

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