SUMMARY REPORT

on the

OCCURRENCES

of

PHOSPHATE, POTASH, COAL, OIL AND GAS

in

SOUTHWESTERN WYOMING

COMPILED

by

THE GEOLOGICAL SURV EY OF WYOMING

UNIVERSITY OF WYOMING

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INTRODUCTION

The data contained in this report have been taken, for the most part, from publications of the United States Geological Survey. This Survey has been the chief fact finding agency in regard to the occurrences and character of the deposits. In the preparation of this report, all described occurrences of phosphate rock and potash rock were visited by representatives of the Geological Survey of Wyoming. All data, however, as to location, thickness, character and extent of the deposits have been taken from published reports of the United States Geological Survey. These reports contain additional information not cited in this report.

The occurrences of phosphate rock in the Sublette Mountain area were, for the most part, not open for inspection when visited, owing to the cavings and slumping of old workings (tunnels and open cuts). The phosphate rock of the Cokeville area is exposed in several tunnels up to 1,000 feet long. The phosphate rock of the Beckwith Hills area is exposed in numerous open cuts and short tunnels. Only those phosphate rock occurrences which lie adjacent to rail communications are treated with in this report. A large area of western Wyoming is known to be underlain with the phosphate bearing formation (Phosphoria). The approximate extent of these occurrences are shown on United States Geological Survey Bulletin 795, Plate 10, a copy of which is included in this report. Knowledge as to the extent, character and available tonnage of phosphate rock

throughout much of western Wyoming must await extensive field and laboratory investigations.

The potash rock of the Leucite Hills, north of Superior, is extensively exposed over large areas.

The location of the phosphate, potash, coal, oil and gas deposits, together with railroads and pipe lines are shown on the accompanying index map.

For more detailed information on the occurrences of phosphate and potash rocks of western Wyoming the reader is referred to the following publications of the United States Geological Survey:

Preliminary report on the phosphate deposits in southwestern Idaho and adjacent parts of Wyoming and Utah, by H. S. Gale and R. W. Richards. Bulletin No. 430, pp. 457-535, Washington, 1909.

A reconnaissance for phosphate in the Salt River Range, Wyoming, by G. R. Mansfield, Bulletin No. 620, pp. 331-349, Washington, 1916.

A geological reconnaissance for phosphate and coal in southeastern Idaho and western Wyoming, by A. R. Schultz, Bulletin No. 680, 80 pp., Washington, 1918.

Potash-bearing rocks of the Leucite Hills, Sweetwater County, Wyoming, by A. R. Schultz and Whitman Cross, Bulletin No. 512, 39 pp., Washington, 1912.

PHOSPHATE

Sublette Mountain Phosphate Area

Location and accessibility.- The phosphate deposits are located in the west edge of the Sublette Mountains in secs. 18, 19, and 31, T. 27 N., R. 119 W., and in secs. 6, 7 and 18, T. 26 N., R. 119 W. All of the exposures are within 1 to 1½ miles east of Wyoming Highway 91, which is suitable for heavy trucking. There are no improved roads from the highway to the phosphate deposits. The nearest rail point is Border Junction on the Union Pacific Railroad. From here the distance to the southernmost phosphate rock exposures is approximately 5 miles and to the northernmost 12 miles.

Attitude of beds.- The phosphate beds strike almost due north and dip at angles from 60° to 90°. The beds are cut by a number of steep-sided canyons, which drain westward. In crossing spurs from canyon to canyon the eroded edges of the phosphate beds are, in some places, as much as 500 feet above the canyon bottoms. In mining by running tunnels from canyons and stoping upward there would be no expense of pumping.

Composition.- The following sections arranged in order from north to south are given by Gale and Richardson in United States Geological Survey Bulletin 430.

Section of phosphatic beds in sec. 19, T. 27 N., R. 119 W.*

	P_2O_5	Equivalent to $Ca_3(PO_4)_2$.	Thickness	
	Per cent	Per cent	Ft.	In.
Phosphate rock, grayish black, oolitic	38.6	84.5	6	0
Interval, concealed			8+	
Limestone, grayish black, hard, fossils	7.1	15.5	3	4
Shale, black, in part oolitic, soft	19.8	43.4		9
Shale, black, in part oolitic	15.1	33.1	1	8
Shale, black, in part oolitic massive	12.2	26.7	2	6
Limestone			1	6
Phosphatic rock, black, coarsely oolitic, soft	18.4	40.3	3	4
Limestone				4
Shale, black, soft, oolitic	21.9	48.0	3	6
Shale, brownish black, oolitic	28.6	62.6	3	4

Partial section of phosphatic beds in Raymond Canyon, northern part of sec. 6, T. 26 N., R. 119 W.**

	P_2O_5	Equivalent to $Ca_3(PO_4)_2$.	Thickness	
	Per cent	Per cent	Ft.	In.
Shale, grayish brown	8.9	19.5	4	5
Limestone			6	
Phosphate, massive, compact, black, oolitic	32.0	70.1	3	1
Limestone, dark, fine grained	9.3	20.4	5	
			18	6

*U. S. Geol. Survey Bull. 430, p. 500
**U. S. Geol. Survey Bull. 430, p. 501

Section in Coal Canyon near the southern boundary of sec. 6, T. 26 N., R. 119 W.*

	P_2O_5	Equivalent to $Ca_3(PO_4)_2$.	Thickness	
	Per cent	Per cent	Ft.	In.
Cherty limestone, massive, *Productus* abundant			1	9
Limestone, shaly and shattered			3	2
Limestone, blocky			1	10
Limestone, shaly, oolitic, crushed			9	8
Limestone, black, shattered, fossils, (Chonetes)				5
Phosphate rock, shaly, oolitic, impure			7	8
Limestone, black, coarse, and shale in part sandy			1	8
Limestone, black, hard, with 3 inches of crushed shale, fossils			5	10
Phosphate rock, oolitic (in Francis Canyon, 3'4", 7.2 per cent)			2	1
Limestone, dark gray, blocky, fossils			3	9
Shale, brownish-black, somewhat oolitic	27.0	51.1	1	
Limestone, gray, fossils			8	8
Shale, brownish black, calcareous	16.3	35.7	2	
Limestone, dark gray, hard, fossils			2	
Shale, brown with oolitic layers	Trace	Trace	1	
Limestone			1	3
Shale, soft brown, calcareous	11.9	26.1	4	
Limestone, gray, massive, fossils			8	
Shale, black and brown, thin bedded	16.8	36.8	4	
Limestone, gray, shattered, oolitic at base				
Shale, grayish brown, calcareous, oolitic, medium to fine, in part sandy	16.4	35.9	6	

*U. S. Geol. Survey Bulletin 430, p. 502

Section in Coal Canyon cont'd.

Shale, grayish brown, calcareous, sandy	12.0	16.3	4	
Phosphate rock, coarse, oolitic	26.0	56.9	4	6
Phosphate rock, oolitic in part	19.6	42.9	5	6
Limestone, grayish black, sandy	10.3	22.3	5	
Interval covered to underlying limestone (about)			90	
Total phosphate series (about)			184	

In describing exposures farther south Gale and Richards* state,

"A 'main bed' of rock phosphate, 4 feet 6 inches thick, in Jackson Canyon, about one-fourth of a mile south of Coal Canyon, was sampled, showing 32.7 per cent of phosphoric acid, equivalent to 71.6 per cent of tricalcium pho sphate.

"Prospects on the north side of York Canyon, in the NE ¼ SW. ¼ sec. 18, revealed a bed of phosphate 4 feet thick, which showed on test 34.3 per cent of phosphoric acid, equivalent to 75.1 percent of tricalcium phosphate. A prospect on the south side of the same canyon opens a bed of phosphate 5 feet 10 inches thick, giving 35.0 per cent of phospheric acid, equivalent to 76.7 per cent of tricalcium pho sphate.

"A considerable series of beds was sampled and tested from prospects and exposures in Francis Canyon, in the NW. ¼ NE. ¼ sec. 19. Here two beds 3 feet 4 inches and 2 feet 4 inches thick ran 32.5 and 32.8 per cent of phospheric acid (equivalent to 71.2 and 71.8 per cent of tricalcium phosphate). They are separated by an interval of 57 feet 6 inches. Numerous other beds contain more or less phosphatic material similar to that in the Coal Canyon section."

Tonnage.- Gale and Richards** estimate on the basis of length of outcrops and the assumption of mining 5 feet of high grade phosphate rock to a depth of 2,000 feet that the Sublette Mountain area contains somewhat over 32,000,000 long tons.

*U. S. Geol. Survey Bull. 430, p. 502
**U. S. Geol. Survey Bull. 430, pp. 503

Workings.- The phosphate beds have been prospected at all the localities for which sections are given above and also at Jackson, York and Francis Canyons. The only one at which the phosphate beds are well exposed is Coal Canyon, where a trench on the south side of the canyon cuts across approximately 40 feet of phosphatic beds. At the other localities the tunnels have caved in and the open pits have slumped so that good exposures of the phosphate beds are not available.

Phosphate Area near Cokeville

Location and accessibility.- The phosphate deposits are located in the SW¼ sec. 35, T. 25 N., R. 119 W. and the NW¼ sec. 4, T. 24 N., R. 119 W. less than 2½ miles from the Union Pacific Railroad at Cokeville. All of the road from the deposits to the railroad is suitable for heavy trucking and is nearly level. Less than one mile is gravelled road and the remainder is oiled road.

Attitude of the beds.- In Rocky Point, the hill north of Smiths Fork, a bed of phosphate rock more than 5 feet thick stands nearly vertically and strikes about N. 20° W. The crest of the hill where the phosphate bed crosses is some 300 to 400 feet above the flood plain of Smiths Fork. The bed can be traced northward along strike from the place where it is covered by the alluvium of the valley of Smiths Fork for about 3,000 feet to the place where the bed is covered by the alluvium of the valley of Bear River.

Composition.- The section* below measured by G. H. Girty gives details of lithology and composition of the phosphatic zone which includes the main bed of phosphate rock.

*U. S. Geol. Survey Bull. 430, p. 505.

Bed	P_2O_5	Equivalent to $Ca_3(PO_4)_2$	Thickness	
	Per cent	Per cent	Ft.	In.
Shale, calcareous, sandy, massive in part			5	3
Limestone, oolitic, in part shaly	22.2	48.6	1	11
Limestone, black, oolitic, hard, weathers brown	18.6	39.7	1	6
Phosphate rock, black, oolitic, hard	37.0	81.0	3	0
Phosphate rock, grayish-black, hard	33.2	72.7	2	4
Shale, grayish-brown, soft	29.5	53.7	1	4
Shale, brown, sandy, thin-bedded				6
Limestone, brown, earthy, massive			2	1
Phosphate rock, gray, medium, oolitic	33.4	73.1	1	0
Shale, brown somewhat oolitic	19.5	42.7		(11
Shale, brown				(3
Shale, grayish-black, oolitic	25.6	56.1		7
Shale, somewhat oolitic			1	6

Tonnage.- Gale and Richards* state: "The length of the traced outcrop of the main phosphate bed on the east side of the anticline north of Smiths Fork is approximately 3,000 feet. A consideration of the tonnage of the bed, based on a recovery of 5 feet of thickness to a depth of 2,000 feet along the bed, yields a total of 2,400,000 tons of 2,240 pounds as the available quantity of phosphate in the Cokeville area. This represents a minimum estimate of the tonnage of high-grade phosphate rock in the area and excludes that portion of the ore lying above the water level in and about the mine".

Assuming that the crest of the hill rises 350 feet above Smiths Fork, a length of outcrop of 3,000 feet, and recovery of 5 feet of phosphate rock, the tonnage originally in the block above the level of Smiths Fork was approximately 210,000 tons. It is reported that the lower tunnel along the phosphate bed extends 1,000 feet along strike. Even though all phosphate rock above this tunnel had been stoped out, there would be about 150,000 tons left in the hill in a position where it could be mined without the expense of pumping.

*H. S. Gale and R. W. Richards, U. S. Geol. Survey Bull. 430, p. 508.

Workings.- At least three tunnels have been driven northward along the strike of the phosphate bed from the hillside north of Smiths Fork. It is reported that the lower one is approximately 1,000 feet long. The phosphate rock was mined by overhead stoping and was delivered to the lower tunnel, from which it was removed to the mill at the lower tunnel mouth. The mill is a frame building which once contained various crushing and drying machinery, which is now of no value. It is reported that small shipments from the mine were made as late as 1935. It is probable that the tunnels could be put into safe condition at small expense.

Beckwith Hills Phosphate Area

Location and accessibility.- The phosphate beds are located in secs. 2, 3, 10 and 15, T. 21 N., R. 120 W., in an area of low hills. The deposits in secs. 10 and 15 are from $\frac{1}{4}$ mile to $1\frac{1}{2}$ miles northwest of Wyoming Highway 65 and less than 4 miles from the Union Pacific Railroad at Sage. Trucking of the rock to the railroad would be over nearly level country. Over the present roads the deposits in secs. 2 and 3 are approximately 9 miles from Sage. They are, however, only 2 miles by air line from the railroad. The intervening territory has very little relief.

Attitude of the beds.- The phosphate beds are horizontal or dip at angles up to 10 degrees and crop out around the edges of hills near the crests. The methods used in mining flat or nearly flat coal beds could be used and it is probable that most of the area of the phosphate beds lies above the water table. The rocks above and below the phosphate beds are well consolidated shales and limestones. It is unlikely that there would be trouble with plastic floors and roofs pinching into the workings during mining.

Composition.- Gale and Richards* give the following data:

"A number of prospects on the south side of the hill in sec. 2 indicate that the thickness of the bed here averages about 6 feet and that it consists of a gray, coarsely oolitic phosphate rock containing 36.6 per cent of P_2O_5, or 80.2 per cent of bone phosphate. The prospect on the north side of the same hill shows a totally different section, apparently of a lower bed, which is as follows:

Partial section of phosphate beds in sec. 2, T. 21 N., R. 120 W.

	P_2O_5	Equivalent to $Ca_3(PO_4)_2$	Thickness	
	Per cent	Per cent	Ft.	In.
Clay, with fragments of phosphate rock			1	2
Phosphate rock, gray, coarsely oolitic	34.7	76.0		6
Shale, red and yellow				3
Shale, gray, soft				3½
Shale, reddish gray				4
Phosphate rock, brownish gray, soft	27.3	59.8	1	
Limestone			1	7
Phosphate rock, coarsely oolitic, soft	31.5	70.0	1	6
Phosphate rock, shaly, gray, brown, soft	10.0	21.9		9
Phosphate rock, dark gray, oolitic	28.4	62.2	2	6
Phosphate rock, shaly, brown	10.6	23.2		6

"The small hill in the SE. ¼ sec. 3 has been prospected by several entries, and the following section is a combination of the measurements obtained in the two eastern prospects:

Partial section of phosphate beds in sec. 3, T. 21 N., R. 120 W.

		P_2O_5	Equivalent to $Ca_3(PO_4)_2$	Thickness	
		Per cent	Per cent	Ft.	In.
Shale, gray, soft		23.5	51.5	1	6
Shale, gray, shaly, soft		2.7	5.9		11
Phosphate rock, gray, oolitic, soft		33.3	72.9		10
Phosphate rock, light gray oolitic, soft		23.7	51.9	1	7
	Ft. In.				
Phosphate rock, coarsely oolitic	4)				
Phosphate rock, gray, hard, grading to black, pebbly at base	2 3)	25.8	56.5	2	7

*U. S. Geol. Survey Bull. 430, pp. 511 and 512.

"A large number of prospects have been opened on the hill immediately south of the Twin Creek gap. One of the best sections exposed is the following, measured in a tunnel in the NW. ¼ SW. ¼ sec. 10:

Partial section of phosphate beds in sec. 10, T. 21 N., R. 120 W.

	P_2O_5	Equivalent to $Ca_3(PO_4)_2$	Thickness	
	Per cent	Per cent	Ft.	In.
Phosphate rock, mostly soil-like, but contains some oolitic material	28.4	62.2	3	2
Shale, red and gray, fine grained				7
Phosphate rock, gray, oolitic) Phosphate rock, reddish gray, fine-grained) Phosphate rock, gray, oolitic)	25.7	56.3	1	8 10 10

"The southernmost of the prospects, in the SE. ¼ sec. 15, shows a better and perhaps a more typical section:

Partial section of Phosphate beds in sec. 15, T. 21 N., R. 120 W.

	P_2O_5	Equivalent to $Ca_3(PO_4)_2$	Thickness	
	Per cent	Per cent	Ft.	In.
Phosphate rock, dark gray to black, oolitic, hard) Shale, brown, earthy, thin, black) Pebble bed)	13.9	30.5		4 5 1
Phosphate rock, dark gray to black, massive, hard)	36.0	78.8	2	11
Phosphate rock, fine grained, oolitic, hard	23.7	51.9		6
Phosphate rock, black coarsely oolitic	34.7	76.0		11
Phosphate rock, light gray, sandy and shaly) Shale, soft, iron-stained)	34.9	76.4		10 1

Tonnage.- The main phosphate bed underlies the following acreage*:

Section	Acres
2	27
3	8
10 and N part of 15	101½
S part of 15	25
	161½

On the basis of an average thickness of 5 feet of workable phosphate rock, this acreage would yield approximately 2,800,000 long tons.

Workings.- Operations have been confined to trenching and the driving of short tunnels. Since there are no extensive talus slopes above the openings, the beds are well exposed in numerous open cuts and tunnels.

POTASH

The Zirkel Mesa Potash Rock Deposit

Location and accessibility.- Zirkel Mesa, a succession of leucite-bearing lava flows, occupies an area of approximately five square miles in T. 21 N., R. 101 and 102 W. at an elevation of approximately 7,500 feet. The nearest rail point is South Superior on a branch line of the Union Pacific Railroad at an elevation of 7,000 feet. From the southwest side of the Mesa at the abandoned quarry in the SW¼ sec. 14, T. 21 N., R. 102 W., a road extends 3.7 miles southwestward to the railroad at South Superior. The portion of the road beginning a mile southwest of the quarry descends more

than 400 feet in a road distance of $1\frac{1}{2}$ miles. The road is not gravelled and is not in proper condition for heavy trucking. The expense of improving the road for trucking would not be great.

Geologic and petrographic description.- Zirkel Mesa consists of a succession of lava flows surmounted by a few volcanic cones. The surface of the mesa has almost no soil. The edge of the area of flows forms a scarp providing excellent quarry sites. The extrusive igneous rocks are massive and vesicular porphyritic wyomingite. The rock consists of phenocrysts of the bronze-colored mica, phlogopite, which are visible with the naked eye, embedded in a fine-grained groundmass consisting of leucite, diopside and a siliceous glass.

Composition.- The analysis given below* is that of a sample collected on the east side of the Mesa near Fifteenmile Spring.

SiO_2	53.70 %
TiO_2	1.92
Al_2O_3	11.16
Fe_2O_3	3.10
FeO	1.21
MgO	6.44
CaO	3.46
Na_2O	1.67
K_2O	11.16
H_2O	3.41
P_2O_5	1.75
SO_3	.06
F	.44
Other constituents	.92
	100.40%

Specific gravity . 2.627

Potash tonnage.- Schultz and Cross** estimate that the flows and cones contain 1,042,341,276 tons of rock and 104,234,127 tons of potash (K_2O).

* U. S. Geol. Survey Bull. 512, p. 11, analysis 4.
**A. R. Schultz and Whitman Cross, U. S. Geol. Survey Bull. 512, p. 27

Ownership.- Records in the United States Land Office as of September 2 and 3, 1937, show the following vacant public lands:

	Acres Vacant
Township 21, Range 101	
Section 18	636.57
Township 21, Range 102	
Section 10	640.00
Section 12	480.00
Section 14	640.00
Section 24	640.00

Section 19 in Township 21, Range 101, and Sections 11, 13 and 15 in Township 21, Range 102 are Union Pacific lands.

Other deposits.- Within a few miles to the east, north, and west of Zirkel Mesa there are other masses of leucite-bearing rock which are estimated to contain nearly as large a potash tonnage as Zirkel Mesa. Details of these may be obtained from United States Geological Survey Bulletin 512.

COAL

Coal is being mined in southwestern Wyoming in the Kemmerer, Rock Springs and Evanston districts. For location of these districts the reader is referred to the index map accompanying this report.

The Kemmerer Coal District

Lincoln County

Coal mined in the Kemmerer District comes from the Frontier (Benton of Veatch) formation. In 1936, 450,000 tons of coal were mined in this district. The principal producers were the Kemmerer Coal Company (340,760 tons), the Diamond Coal and Coke Company (65,206 tons) and the Lincoln Star Coal Company (22,814 tons). The Kemmerer district is on the Union Pacific Railroad.

Quality and Classification of the Kemmerer Coals.- Veatch* gives the following analyses of samples of coals from this district. According to Veatch, "The analyses were made at the United States Geological Survey coal-testing plant, St. Louis. The samples were taken with great care, were pulverized and quartered in the mine and were sent in sealed cans to the laboratory."

Analyses of coals from southern Uinta County, Wyo., made at United States Geological Survey's coal-testing plant, St. Louis, Mo., 1905.

	VI	VII	VIII	LX
Loss of moisture on air drying	1.30	2.40	2.00	1.40
Analyses of samples as received:				
Proximate: Moisture	5.13	5.89	5.86	3.96
Proximate: Volatile matter	40.51	37.59	39.49	36.16
Proximate: Fixed carbon	49.75	49.01	51.00	55.11
Proximate: Ash	4.61	7.51	3.65	4.77
Proximate: Sulphur	.49	1.39	1.07	.77
Ultimate: Hydrogen	5.63	5.28	5.57	5.17
Ultimate: Carbon	72.95	68.48	72.96	76.03
Ultimate: Nitrogen	1.18	1.07	1.08	1.31
Ultimate: Oxygen	15.14	16.27	15.67	11.95
Calorific value determined:				
Calories	7,202	6.870	7,102	7,501
British thermal units	12,964	12,366	12,784	13,502
Analyses of air-dried samples:				
Proximate: Moisture	3.38	3.57	3.94	2.59
Proximate: Volatile matter	41.04	38.52	40.30	36.68
Proximate: Fixed carbon	50.41	50.21	52.04	55.90
Proximate: Ash	4.67	7.70	3.72	4.83
Proximate: Sulphur	.50	1.42	1.09	.78
Ultimate: Hydrogen	5.56	5.15	5.46	5.09
Ultimate: Carbon	73.91	70.18	74.45	77.11
Ultimate: Nitrogen	1.20	1.09	1.10	1.33
Ultimate: Oxygen	14.16	14.46	14.18	11.86
Calorific value determined:				
Calories	7,297	7,039	7,247	7,607
British thermal units	13,130	12,664	13,044	13,694
Thickness of coal bed sampled, in feet	7	9	6½	3
Name of coal bed	Main Kemmerer		Lower Kemmerer	Willow Creek
Geologic age	Frontier (Benton)			

*Veatch, A.C., Geography and Geology of a Portion of Southwestern Wyoming, United States Geological Survey Professional Paper No. 56, pp. 136-137, Washington, 1907.

Veatch* states, "According to these analyses and the general physical character of the coals, the Benton (Frontier) coals are to be regarded as high grade bituminous ... "

"According to the carbon-hydrogen nitro classification of coals ... these coals fall in the following groups:

"The Willow Creek coal, of Benton (Frontier) age, falls in group G, which includes upper Freeport and Pittsburg coals of northern West Virginia, Kanavoha Valley coals, high-grade Kentucky coals, and Alabama coals.

"The Kemmerer (Benton coal) belongs to group H, which includes Indian territory coals, Kansas coals, high-grade Illinois, Iowa and Missouri coals and second-grade Kentucky coals."

Further Veatch states, "On the whole, the Benton (Frontier) coals of the Uinta (now Lincoln) County may be said to belong to the group containing the best bituminous coals of the Rocky Mountain region.

For further analyses of coals from the Kemmerer District, the reader is referred to "Analyses of Wyoming Coals", U.S. Bureau of Mines Technical Paper 484, pp. 54-55, Washington, 1931.

*Veatch, A.C., Geography and Geology of a Portion of Southwestern Wyoming, United StatesGeological Survey Professional Paper No. 56, pp. 136-137, Washington, 1907.

The Rock Springs District*

Sweetwater County

The coal mined in the Rock Springs district comes from the Mesaverde formation of Upper Cretaceous age. In 1936 three and one half million tons of coal were mined in this district. The principle producer in this district is the Union Pacific Coal Company whose mines are located at Rock Springs, Superior, Winton, and Reliance. Other producers are the Colony Coal Company, Central Coal and Coke Comp any, McGeath Coal Company and the Gunn-Quealy Coal Company. The Rock Springs District is on the Union Pacific Railroad.

Quality and Classification of the Rock Springs Coal.- The Mesaverde coals of the Rock Springs district are divided into two groups: The coal beds occurring in the lower portion of the formation are referred to the Rock Springs group and those occurring in the upper portion belong to the Almond Coal group. The Rock Springs group is the most important as it contains the highest grade coal in the district. The coal from the Rock Springs group is bituminous, while the coal from the Almond group is sub-bituminous.

The following are representative analyses of the coal from the Rock Springs group as given by Schultz**:

* For a detailed discussion of the Rock Springs district, the reader is referred to "The Northern Part of the Rock Springs Coal Field, Sweetwater County, Wyo.", by A. R. Schultz, United States Geological Survey Bulletin No. 341, pp. 256-282, Washington, 1907.

**Op. cit., p. 270.

Analyses of coal samples from the Rock Springs field, Wyoming

Name of formation . . .	Lower part of Mesaverde					
Name of coal group . .	Rock Springs					
Laboratory No.	5365	5926	5366	5806	5695	5805
Sample as received:						
Proximate: Moisture. . .	10.46	10.55	9.75	13.65	13.67	13.59
Proximate: Volatile matter	36.41	34.79	34.32	34.83	32.43	34.99
Proximate: Fixed carbon.	50.90	50.42	52.50	50.08	51.00	48.12
Ultimate: Ash	2.23	4.24	3.43	1.44	2.90	3.30
Ultimate: Sulphur . .	.87	.86	1.00	.98	.72	1.02
Ultimate: Hydrogen. . .	5.37	5.66	5.77	6.05	5.83	5.89
Ultimate: Carbon . . .	68.98	67.12	68.39	64.53	65.93	64.12
Ultimate: Nitrogen. . .	1.32	1.27	1.22	1.18	1.19	1.27
Ultimate: Oxygen . . .	21.23	20.85	20.19	25.82	23.43	24.40
Calories.	6,817	6,756	6,810	6,590	6,424	6,396
British thermal units .	12,271	12,161	12,258	11,862	11,563	11,513
Loss of moisture on air drying	4.00	4.80	3.50	4.90	6.30	5.30
Air-dried sample:						
Proximate: Moisture. . .	6.73	6.04	6.48	9.20	7.87	8.75
Proximate: Volatile matter	37.93	36.54	35.56	36.63	34.61	36.96
Proximate: Fixed carbon.	53.02	52.96	54.42	52.66	54.43	50.81
Ultimate: Ash	2.32	4.46	3.54	1.51	3.09	3.48
Ultimate: Sulphur . .	.91	.90	1.04	1.03	.77	1.08
Ultimate: Hydrogen . .	5.14	5.39	5.58	5.79	5.48	5.60
Ultimate: Carbon . . .	71.85	70.50	70.87	67.86	70.36	67.71
Ultimate: Nitrogen. . .	1.37	1.33	1.27	1.24	1.27	1.34
Ultimate: Oxygen . . .	18.41	17.42	17.70	22.57	19.03	20.79
Calories.	7,101	7,097	7,057	6,929	6,856	6,754
British thermal units .	12,782	12,774	12,703	12,473	12,340	12,157
Ratios:						
C + H	13.96	13.09	12.70	11.71	12.81	12.10
C + (O + Ash)	3.43	3.22	3.31	2.81	3.18	2.79
Thickness of coal . . .	Ft. In. - -	Ft. In. 6 6	Ft. In. 6 3	Ft. In. 6	Ft. In. 8	Ft. In. 4 9

For additional analyses of coal from the Rock Springs District see "Analyses of Wyoming Coals", U.S. Bureau of Mines, Technical Paper 484, pp. 68-74, Washington, 1931.

Evanston District

Uinta County

Coal mined from the Evanston District comes from the Evanston formation of lower Eocene age. In 1936, 16,000 tons of coal were mined in this district. The Bear River Coal Company was the principal p roducer. The district is on the Union Pacific Railroad.

Quality and Classification of the Evanston Coal.-- The Almy bed is the only bed clean enough to work. It yields a subbituminous coal. According to Veatch* the Evanston coals belong to Group I. The following are analyses given by Veatch:

Analyses of coals from southern Uinta County, Wyo., made at United States Geological Survey's coal-testing plant, St. Louis, Mo., 1905.

		I	II
Loss of moisture on air drying		6.90	6.70
Analyses of samples as received:			
Proximate	Moisture	14.11	14.43
	Volatile matter	35.34	36.81
	Fixed carbon	34.40	41.54
	Ash	16.15	7.22
	Sulphur	4.45	.21
Ultimate	Hydrogen	5.30	5.37
	Carbon	48.91	59.97
	Nitrogen	.82	1.15
	Oxygen	24.37	26.08
Calorific value determined:			
Calories		4,898	5,804
British thermal units		8,816	10,447
Analyses of air-dried samples:			
Proximate	Moisture	7.74	8.29
	Volatile matter	37.96	39.45
	Fixed carbon	36.95	44.52
	Ash	17.35	7.74
	Sulphur	4.78	.22
Ultimate	Hydrogen	4.86	4.97
	Carbon	52.53	64.28
	Nitrogen	.88	1.23
	Oxygen	19.60	21.56

*Veatch, A. C., Geography and Geology of a portion of Southwestern Wyoming, U.S. Geol. Survey Prof. Paper No. 56, pp. 139, Washington, 1907

Evanston District analyses cont'd.

Calorific value determined:		
Calories	5,261	6,220
British thermal units	9,469	11,197
Thickness of coal bed sampled, in feet	4	24
Name of coal bed	Almy	
Geologic age	Evanston	

OIL

LaBarge Field

Lincoln and Sublette Counties

Location.- T. 27 and 28 N., R. 113 and 114 W. Thirty miles north of Opal.

Production.- The production of oil from this field for the past three years has averaged 430,000 bbls. During the first six months of 1937 the p roduction was 194,106 bbls.

Gravity of oil.- The gravity of the oil from this field varies from 20.3 A.P.I. to 45.8 A.P.I. The average gravity of production 20.3 to 34.0 A.P.I.

This field was discovered in 1923 and has been in active production for the past ten years. The oil is piped from the field to Opal where it is loaded into tank cars. Opal is on the Union Pacific Railroad.

There is a small production of 20 bbls. per day from the Spring Valley field east of Evanston.

GAS

The North Baxter Basin, South Baxter Basin and part of the Hiawatha gas fields are located in Sweetwater County. The following table gives location and production of natural gas from these fields.

Field	Location	Production to Jan 1, 1937, in cubic feet.
North Baxter	T. 19 N., R. 104 W.	10,031,008,000
South Baxter	T. 16 and 17 N., R. 104 W.	13,612,620,000
Hiawatha (Wyoming side)	T. 12 N., R. 100 W.	7,389,433,000

Gas from these fields is piped via Green River to Salt Lake. For location of gas lines, see accompanying index map. The gas reserves in these fields are believed to be large.

ROAD LOGS

To Potash rocks

Rock Springs to Zirkel Mesa quarry:

0.0	Fire Station No. 2 in Rock Springs. Go E. along U.S. Highway 30
16.7	Junction of oiled road to Superior with U.S. 30. Take left branch.
23.8	Sign on right side of road. "Town-of-So-Superior: No Cut-Outs". A black and white enameled sign on the wooden signboard reads "Speed limit 25 miles". Turn right up the abandoned railroad grade.
24.5	Bridge over gulch and road fork a few feet beyond. Take the right branch up the E. branch of the main gulch.
26.0	Road fork near the crest of the hill. Take left branch.
26.4	Road fork. Take right branch.
26.6	Road fork. Take left branch.
27.2	Road fork. Take right fork.
27.5	Zirkel Mesa quarry

To Phosphate rocks

Cokeville to Cokeville Phosphate Mine:

0.0	Filling station on U.S. 30 at the junction with the main street of Cokeville leading W. from the railroad station. Go N. along U.S. 30.
0.7	White house with spruce trees. Turn right off highway N. of the trees.
0.8	Bridge over irrigation ditch.
1.1	Bridge over irrigation ditch.
1.5	Phosphate mine.

Sublette Mountain Phosphate Area Border to Francis Canyon:

0.0	Junction of U.S. 30 N. and Wyo. 91. Go. N. along Wyo. 91.
1.5	Row of cottonwood trees along E. side of highway. Turn right at the N. end of the row of trees along a lane with a row of trees on the S. side.
1.6	Go through barbed wire gate.
1.7	Ford irrigation ditch.
2.0	Go through wire gate at end of lane. Take right branch. Go ESE up alluvial cone.
2.2	Go through wire gate
2.4	Sheep corral.
	The phosphate rock is approximately 400 feet up the canyon.

Border to York Canyon:

	Follow the route given for Francis Canyon to
2.0	Take left branch.
2.3	Wire gate. A few feet beyond the gate is a gulch which can't be crossed by a car. Phosphate dumps visible about ¼ mi. to the NE.

Border to Coal Canyon:

0.0 Junction of U.S. 30 N. and Wyo. 91. Go N. on Wyo. 91.
2.6 Turn E. along a road between wire fences toward a house in a clump of trees with a cabin and corral to the N. of it.
3.1 Go through wire gate and SE up the alluvial cone.
3.5 Turn N. along a faint track at a point about 200' W. of house
3.6 Go through wire gate.
4.6 3 board houses and one wrecked house. The canyon mouth is about ¼ mi. E.

Border to Jackson Canyon:

Same route as to Coal Canyon, but stop about ¼ mi. S. of the houses. From here the canyon is about ¼ mi. E.

Border to Raymond Canyon:

0.0 Junction of U.S. 30 N. and Wyo. 91. Go N. on Wyo. 91.
4.3 Highway turns at right angles to W. Take the road E toward the mountains.
4.9 Yellow ranch house to N. of road.
5.2 Fence corner. It is not advisable to take a car beyond here. The phosphate bed is 1,000 feet up the canyon.

Border to sec. 19, T. 27 N., R. 119 W.

0.0 Junction of U. S. 30 N. and Wyo. 91. Go N. on Wyo. 91
7.8 Turn E. along the section line road. Sheet iron grain bin about 200' SE of the road junction.
8.5 Go through wire gate and ENE through grain field.
8.7 Edge of grain field.
8.9 Two abandoned log cabins.
9.0 Wire gate. The best exposures of phosphate rock are on the spur and gulch about ¼ mi. SE.

Beckwith Hills Phosphate Area

Sage to sec. 15, T. 21 N., R. 120 W.

0.2 Bridge
1.0 Junction highway U.S. 30 N. and Wyoming 65. Take Wyoming 65 (left road), crossing Union Pacific R.R. tracks and 2 bridges over Twin Creek.
3.6 Crest of hill.
3.7 Side road leading to phosphate quarries on hillside 0.5 mi. to right of road.
4.2 Bottom of hill. Turn right (west) onto dirt road.
4.4 Joined from left by abandoned road.
4.9 Road junction. Stay on well-defined road, which swings to right (north).
5.0 Corner of fence.

6.0 Fence, gate, road fork. Take right road, parallel to fence.
6.1 Road junction. Take sharp right-hand cut back onto road leading southeast.
6.2 Road fork. Take dim left hand road.
6.3 Point within 100 feet of prospect pits, which are visible on left (north) side of road.

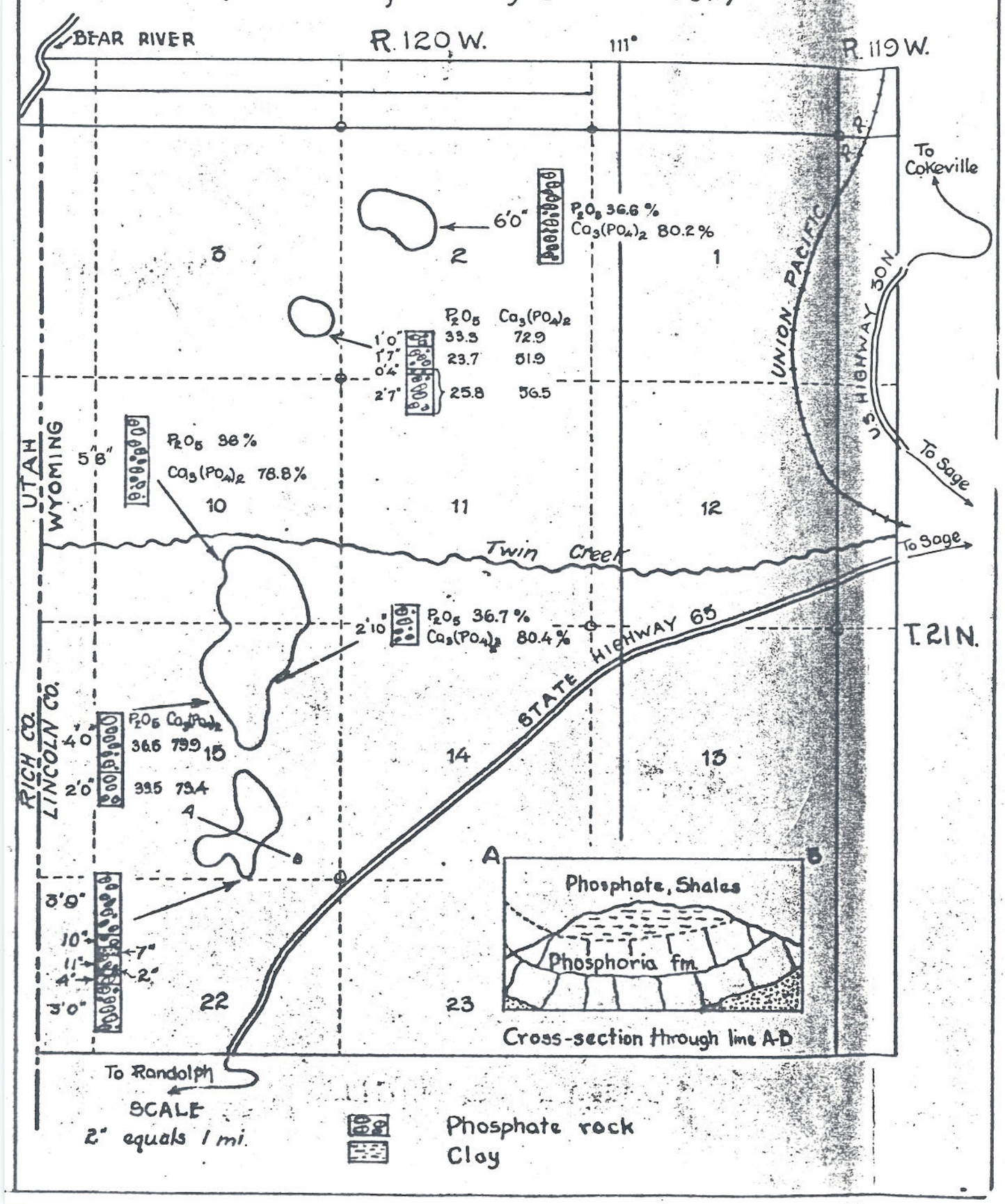
Note: By returning to the road junction at 6.1 and continuing northward 0.5 miles, additional prospect pits can be seen from the road on the right (east).

Sage to SE cor. sec. 3, T. 21 N., R. 120 W.

0.2 Bridge
1.0 Junction highways U.S. 30 N. and Wyoming 65. Stay on U.S. 30 N (Sage-Cokeville highway).
4.5 Turn left onto graded, gravelled road.
4.7 Cross Union Pacific Railroad.
5.5 Bridge over irrigation ditch.
6.0 Gravelled road turns right through gate. Leave gravel and take dirt road west.
6.5 Fence corner and road junction. Take dim road to left (south).
6.9 Bridge over gully.
7.2 Road follows bank of large meander of Bear River.
9.3 Road crossing. Turn left.
9.4 Road turns right. Stop. Several prospect pits in view on left side of road.

Occurrence of Phosphate Rock in Beckwith Hills Area, Lincoln County, Wyo.

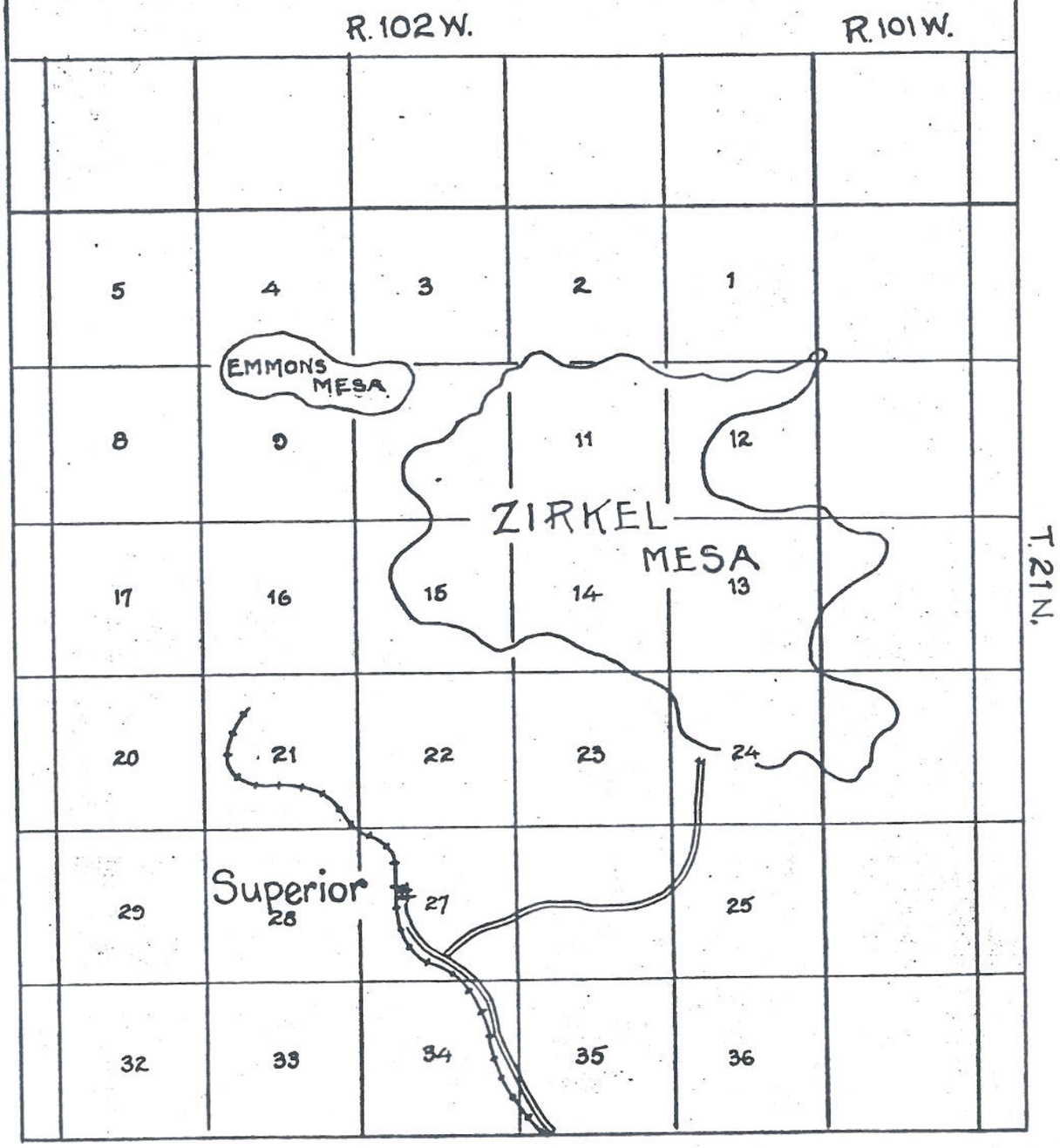
(After U.S. Geological Survey Bull. 430 Plate X)

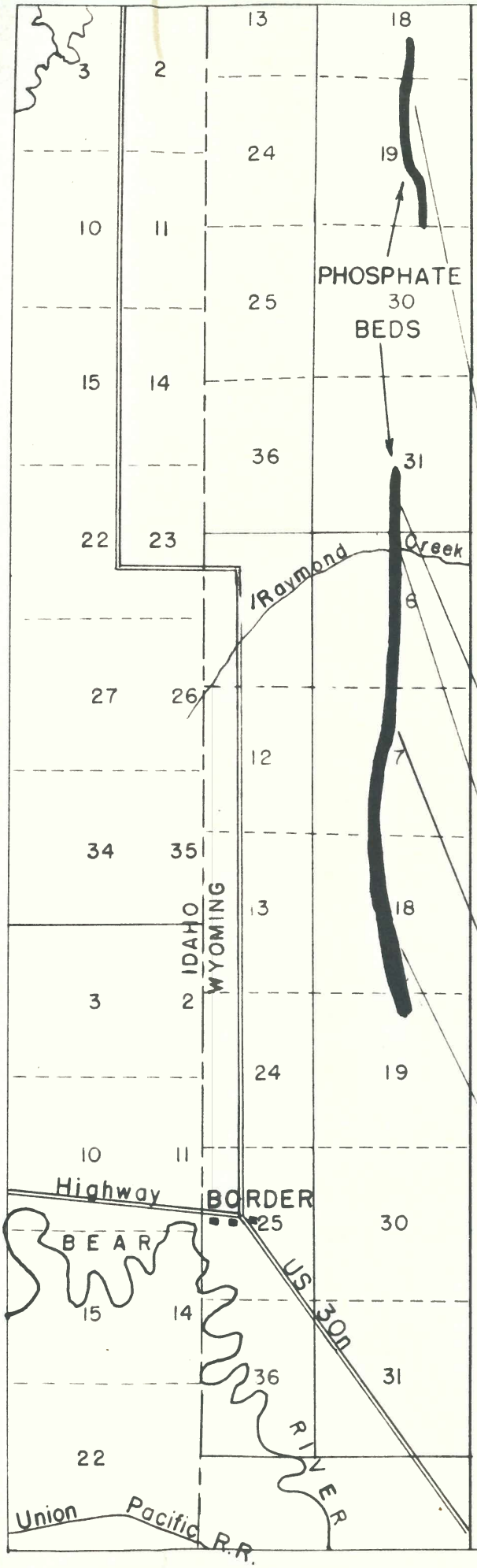


MAP SHOWING LOCATION OF POTASH-BEARING ROCKS OF ZIRKEL AND EMMONS MESAS, LEUCITE HILLS SWEETWATER CO, WYO.

(After U.S Geological Survey Bull. 512, Pl. 1)

Scale 1 inch = 1 mile





OCCURRENCE OF PHOSPHATE ROCK IN THE SUBLETTE MOUNTAINS AREA, LINCOLN COUNTY, WYOMING

(Modified after U.S. Geological Survey Bull. 430, Plate VIII)

LEGEND

Phosphate Rock

Shale

Limestone

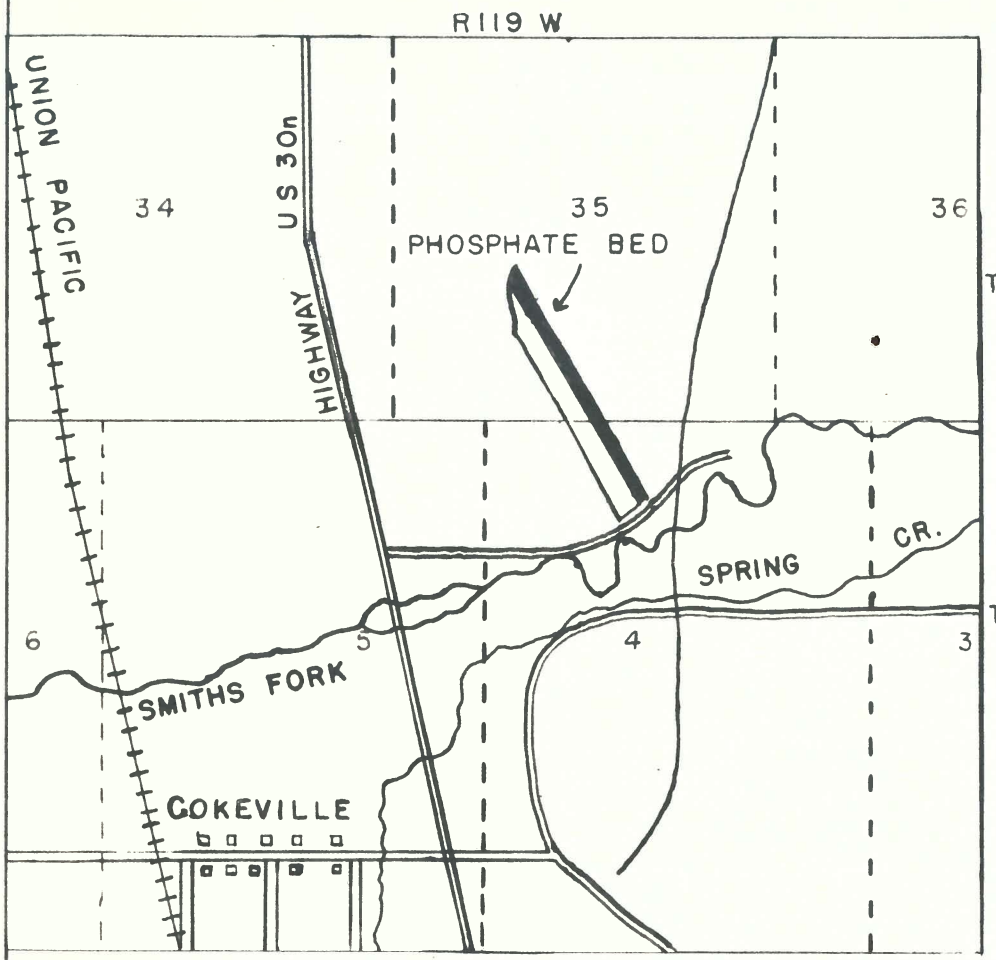
	P_2O_5	$Ca_3(PO_4)_2$
5'0"	38.6%	84.5%
4'6"	31.7	69.4
3'1"	32.0	70.1
4'6"	32.7	71.6
5'0"	21.9	48.0
3'8"	21.5	47.1
2'0"		
5'10"	35.0	76.7

Scale 1 : 62,500

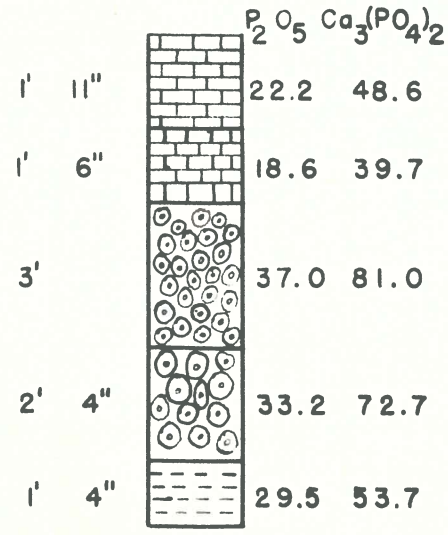
1 0 1 2 mi

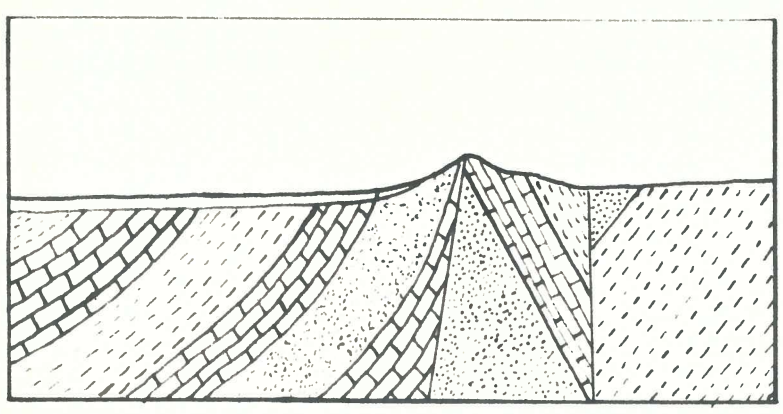
MR37-4

OCCURRENCE OF PHOSPHATE ROCK IN THE COKEVILLE AREA, LINCOLN CO., WYO. (AFTER U. S. G. S. BULL. 430.)



COLUMNAR SECTION OF RICHEST PORTION OF PHOSPHATE BED





CROSS-SECTION ALONG LINE A-B

MR37-4

INDEX MAP

SHOWING PHOSPHATE, POTASH, COAL, OIL AND GAS OCCURRENCES IN SOUTHWEST WYOMING

COMPILED BY THE GEOLOGICAL SURVEY OF WYOMING
SEPTEMBER 1ST, 1937