AREAL GEOLOGY
OF THE
LODGEPOLE QUADRANGLE

STATE OF SOUTH DAKOTA
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STATE GEOLOGICAL SURVEY
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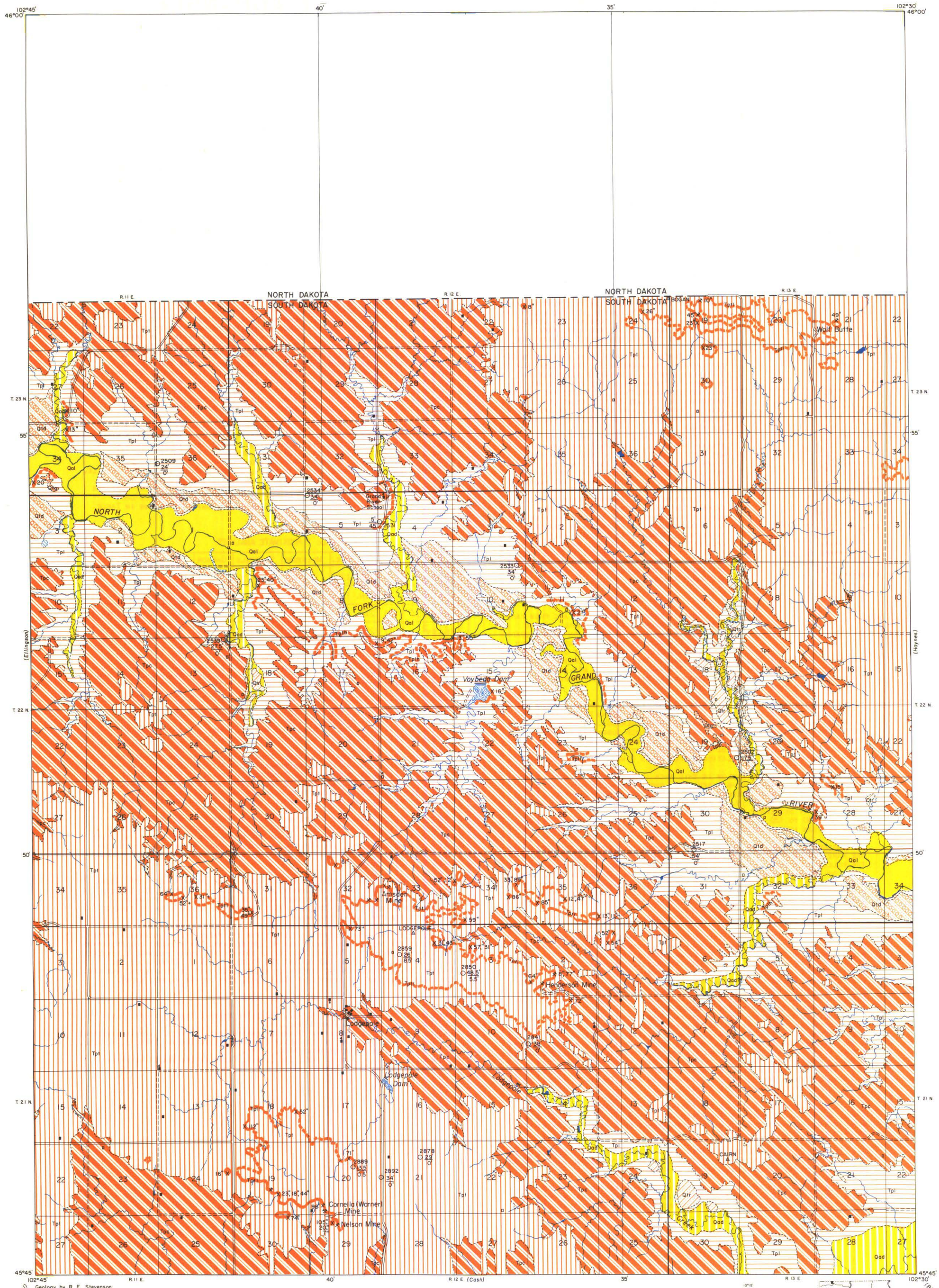

EXPLANATION

SEDIMENTARY ROCKS

RECENT

Qal — Alluvium
(Floodplain deposits of silt, sand, and gravel in major stream valleys.)

Qad — Alluvial Deposits
(Floodplain and low terrace deposits of angular gravel, silt, and clay of local derivation.)

PLEISTOCENE

Qtd — Terrace Deposits
(Terrace deposits of fluvial silt, sand, and gravel along the North Fork Grand River.)

Qtr — Terrace Rubble
(Terrace deposits of fluvial angular gravel and silt of local derivation.)

Qtg — Terrace Gravels
(High terrace deposits of fluvial subarkosic silt, sand and gravel.)

QUATERNARY

Tpt / Tptl — Tongue River Formation
(Gray to buff, fine to medium-grained, semi-consolidated cross-bedded subgraywacke sand with abundant calcareous cementations. Interbeds of gray clay and silty clay. Tptl-Lodgepole facies: 1 or more seams (3 1/2' to 105' thick) of black blocky lignite with associated clays, sandy clays, and peat-clays.)

PALEOCENE

Tpc — Cannonball Formation
(Gray to tan silty clay and clayey fine sand containing abundant dark gray dense limestone concretions. A few white calcareous fine sandstone ledges. Marine invertebrate fossils. Interfingers with upper Ludlow.)

Tpl / Tplh — Ludlow Formation
(White to buff, fine to medium-grained subgraywacke sand with local irregular calcareous cementations, silty sands, and gray to buff silty clay. Occasional ledge-forming interbeds of white fine calcareous sandstone. Abundant crossbeds and oscillation ripples. Tplh-Hilen facies: 1 to 3 seams (13" to 50" thick) of black blocky or fissile lignite and associated beds of clay, peat-clay, and white fine sand.)

TERTIARY

DRAINAGE
Intermittent Streams
Lakes

CULTURE
Buildings
(House, church, and school)
Roads and Trails
B.M. 2800
Bench Marks
(Monuments marking points of known altitude.)
CAIRN
Triangulation Stations
(U.S. Coast & Geodetic and/or U.S. Geological Survey monuments marking points of exact geographic location.)
Operating
Abandoned
Lignite mines
x 36"
Lignite Thickness
(Exposed)
2850 Top Hole
Altitude
485 Overburden
5.5 Thickness (Lignite)
Drill Holes

Geology by R. E. Stevenson.
Assisted by C. E. Dodson, Jr., H. D. Erickson, J. T. Kalkman.
Surveyed in 1954. Drafted by P. Rist.
Coal-Test Holes Drilled in 1955.

Base Map by South Dakota State Geological Survey.

Scale = 1/62500
½ 0 1 2 3 4 MILES

Vermillion, South Dakota
1956

APPROXIMATE MEAN DECLINATION 1954
13°15' TRUE NORTH MAGNETIC NORTH

Quadrangle Location

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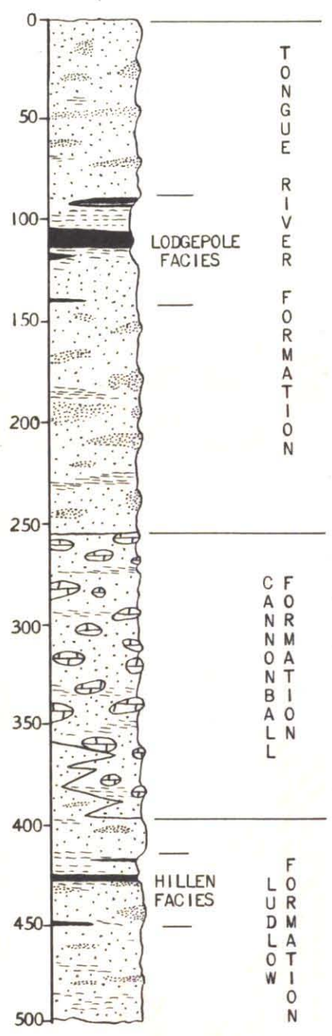
By
Robert E. Stevenson

GENERALIZED COLUMNAR SECTION



INTRODUCTION

The mapping of the Lodgepole quadrangle was done in 1954 as part of the State Geological Survey's coal resources program. Exploratory drilling for buried coal was done the following year.

LOCATION

The quadrangle lies in the northwest part of Perkins County along the North Dakota line. The area is approximately 150 miles northwest of Pierre and 125 miles north of Rapid City.

GEOGRAPHY

Rolling, well-grassed prairie lands with a number of buttes and butte-like ridges characterize the topography of the region.

Near Lodgepole (south-central part of the quadrangle) and to the west is a plateau-like area drained by the head-waters of Lodgepole Creek and surrounded by "breaks". A butte-like ridge extends east from this plateau north of Lodgepole. To the north lies the valley of North Fork Grand River, from which a gentle slope leads north to another butte area. The total relief in this quadrangle is about 430 feet.

The North Fork Grand River meanders southeast across the quadrangle. Its valley, 0.4 to 1.3 miles wide has a narrow flood plain that is confined to the width of the meanders and two well defined depositional terraces are present approximately 15 and 25 feet above mean river level. There are also scattered remnants of a third, high level terrace about 60 feet above the river.

Lodgepole Creek is the only other major stream in the area, but there are many intermittent tributaries to the North Fork Grand River. Permanent water bodies are the Voybeda and Lodgepole Reservoirs in the central and southern parts of the quadrangle and numerous stock dams.

The climate is semi-arid with an average rainfall of 14-17 inches. The principal agricultural occupations are dryland farming and stock-grazing. The region is sparsely inhabited (1 family per 5 square miles), the only settlement is Lodgepole, where there is a postoffice-store. Lodgepole is on a good gravel road connecting Bison, South Dakota and Hettinger, North Dakota. There are several good secondary roads.

STRATIGRAPHY

Surface formations range in age from early Tertiary to Recent. The Cannonball is the only completely exposed formation in the quadrangle. Contacts between the Cannonball and underlying Ludlow or between the Cannonball and the overlying Tongue River are conformable. The surficial sediments of Quaternary and Recent age overlie the Tertiary rocks with marked unconformity. With the exception of the marine Cannonball, all sediments mapped here were deposited under terrestrial conditions.

Ludlow Formation Lloyd and Hares 1915: Exposures of the Ludlow are restricted to the areas adjacent to the North Fork Grand River and major tributaries. This formation, though very heterogeneous, is principally buff to white medium- to fine-grained cross-bedded subgraywacke sand, and gray silty fine sand; it has occasional ledges and cementations of calcareous sandstone, interbeds of laminated gray silty clay, scattered limonitic concretions, oscillation ripple marks (index 10), and numerous laminae of peat-clay.

Near the top of the Ludlow in this area is the Hillen lignitic facies, about 35 feet of white fine-grained sand, brown peat-clay, buff and gray silty clay, with three intermittent seams of black blocky lignite. The middle one, 13 in. to 50 in. in thickness, is the most persistent. The other two vary between 0 in. and 23 in. in thickness.

Only 100 to 130 feet of the Ludlow formation is exposed here. The upper portion interfingers with the overlying Cannonball formation.

Cannonball Formation Lloyd 1914: Although outcrops of this formation are rare, fragments of its characteristic concretions are scattered over the rolling topography in the central, southwest, southeast, and northwest parts of the mapped area. These very abundant small to medium dense dark-gray limestone concretions, together with larger lenticular calcareous cementations occur in a laminated gray silty fine sand with occasional interbeds of a buff fine sand and light-gray shale. The limy rocks contain small marine pelecypods and gastropods.

The Cannonball in this area is 105 to 145 feet thick.

Tongue River Formation (Taff 1909): The sandstone ledges of this formation are found along the edges of the plateau-like area near Lodgepole, and the buttes in the southwest and northeast portions of the mapped area. With the exception of the lignitic facies, the formation is mostly light-brown to buff to white lensing and cross-bedded medium- to fine-grained subgraywacke sand with occasional interbeds of gray to buff silty slightly bentonitic clay. Calcareous sandstone ledges and cementations and several horizons of limonitic concretions are abundant. Approximately 250 feet of the formation is exposed in the quadrangle.

About 120 feet above the base of the Tongue River is the Lodgepole lignitic facies. There is one major seam of black blocky to fissile lignite varying from 24 to 112 inches in thickness (average is 65 inches), and four minor intermittent seams varying from 3½ to 33 inches in thickness. Interbedded with the lignites are brown peat-clays, brown to gray silty clays and slightly bentonitic clays, and a light gray siliceous silt with plant fragments. This latter silt is the source of some of the many "orthoquartzite" boulders strewn on the surface of northwestern South Dakota. The facies is 21 to 75 feet thick (average is 35 feet).

Terrace Gravels: South of the North Fork Grand River in sec. 34, T. 23 N., R. 11 E., and north of the river in sec. 19, T. 22 N., R. 13 E., are high terrace remnants covered with a thin veneer of a fairly clean subarkosic gravel, grit, and sand.

Terrace Deposits: Along the North Fork Grand River are a number of low terraces capped with 0 to 6 feet of interlensing silty subangular gravel and sand. Most of the material is foreign in origin.

Terrace Rubble: Low terrace deposits occur along the larger streams. The deposits consist of coarse angular gravel and clayey sand of local derivation, principally from the Cannonball and Tongue River formations.

Recent Deposits: Mapped as alluvium and alluvial deposits are the recent accumulations of silt, sand and gravel in the valleys of the major waterways in the quadrangle. Most of the material is floodplain deposits, but includes some low terraces along some tributary streams.

STRUCTURE

The area is characterized by a slight regional dip (12 feet per mile) northeastward toward the center of the Dakota (Williston) Basin. There are occasional small secondary faults and folds (dips less than 1°) whose amplitudes and displacements are usually less than 20 feet. There is no consistant direction of strike for these minor structures.

ECONOMIC GEOLOGY

At the present time gravel and lignite are being exploited in very small quantities in this quadrangle. There are several commercial deposits of lignite that are not being mined at present, as well as a small uranium deposit.

COAL: There are two lignite horizons in this area, the Hillen facies of the Ludlow formation, and the Lodgepole facies of the Tongue River formation. Both of these facies contain minable seams of lignite.

Hillen Facies: This coal was mined in the early 1900's and again in the 1930's. The one minable seam ranges in thickness from 13 to 50 inches. The lignite is black in color, brownish black in streak, brittle, blocky to fissile, banded and contains minor quantities of melanterite or jarosite and selenite, and marcasite. The lignite slacks upon drying (increasing its B.T.U. value) and is noncoking. A proximate analysis is shown in Table 1.

Reserves of Hillen lignite along the North Fork Grand River total 7,456,000 short tons measured (These tonnage estimates are computed on a minimum thickness of 2½ feet, a specific gravity of 1.25, and 1,700 tons per acre-foot. The two types of estimates are measured; within ½ mile of a measured section and indicated; ½ to 1½ miles from a measured section.) which can be mined either by strip or underground methods. Roof rock is either clay or sandstone and overburden is mostly sand and sandstone.

Lodgepole Facies: This coal has been mined on a small scale almost continuously since the 1900's. At the present time only the Carnella mine, 2½ miles south of Lodgepole, is in part-time operation. There is one major minable seam (44 to 112 inches thick), and one locally minable seam (31 to 45 inches thick), which is 5 to 25 feet above or below the main seam.

The lignite is banded, black in color, brownish black in streak, brittle, blocky and fissile, with minor amounts of marcasite balls, melanterite fragments, and selenite crystals. Occasionally there are thin clay partings within the seams. The lignite is noncoking, and slacks moderately upon drying. The chemical character of the Lodgepole lignites is shown in Table 1 and 2.

Table 1 PROXIMATE ANALYSES

Coal	Sec, Tps, Rge.	Moisture	Volatile	Carbon	Ash	Sulfur	B.T.U.
Lodgepole[2]	34 22N. 12E.	35.78%	43.62%	13.26%	7.34%	1.22%	6,027
Lodgepole[3]	29 21N. 12E.	33.30%	28.90%	27.30%	10.50%	0.76%	6,960
Lodgepole[4]	20 21N. 12E.	30.65%	29.91%	34.68%	4.76%	0.79%	7,045
Hillen[2]	17 22N. 12E.	41.84%	40.92%	11.81%	5.43%	0.51%	5,130

Table 2 ULTIMATE ANALYSES

Coal	Sec, Tps, Rge.	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Ash
Lodgepole[5]	34 22N. 12E.	6.30%	34.30%	0.50%	47.10%	0.90%	10.90%

1 - Analyses by State Chemical Laboratory, Vermillion, S. D.
2 - Analysis from Winchester, et. al. (1916)
3 - Analysis by South Dakota School of Mines (Connolly and O'Harra, 1929)
4 - Analysis by U. S. Bureau of Mines, Pittsburgh, Pa.

There are three areas of minable Lodgepole lignite. The first, south of Lodgepole contains an estimated tonnage of 7,427,000 short tons measured; the second, north and northeast of Lodgepole contains 13,591,000 short tons measured; and the third, adjacent to Wolf Butte in the northeast corner of the map contains 236,000 short tons measured and indicated. The total estimated tonnage reserve of Lodgepole lignite is 21,254,000 short tons.

SAND AND GRAVEL: Sand and gravel bars in the North Fork Grand River are being exploited. This material is best suited for concrete aggregate and road surfacing. Terrace deposits along the North Fork Grand River are suitable for road surfacing, and washing and sizing would provide sand for concrete aggregate. The terraces in this area contain about 11,000,000 cubic yards of silty gravel.

URANIUM: Much of the Lodgepole facies show a trace of radioactivity. However, in an area southwest of Lodgepole (SW¼ Sec. 19, T. 21 N., R. 12 E.), the main lignite seam has an average assay of 0.01% uranium, giving an estimate of 20 short tons (Densen, 1952) of uranium in the lignite tonnage calculated for that area (see above).

OIL AND GAS: The area has possibilities for oil production. Although there are no surface structures, there may be buried ones; furthermore stratigraphic traps may be present. Possible reservoir formations, which produce elsewhere in the Dakota (Williston) Basin, are the Paleozoic limes, especially the Mission Canyon formation (at depths of about 6,350 feet in this area) and the Red River formation (at depths of about 7,200 feet in the mapped area).

REFERENCES CITED

Connolly, J. R., and O'Harra, C. C., 1929; The Mineral Wealth of the Black Hills; S. Dak. Sch. Mines, Bull. 16

Densen, N. M., 1952; Summary of Uranium-bearing Coal, Lignite, and Carbonaceous Shale Investigations in the Rocky Mountain Region During 1951; U. S. Geol. Survey, Trace Elements Memo 341a, 43 pp.

Winchester, D. F., et. al., 1916; The Lignite Field of Northwestern South Dakota; U. S. Geol. Survey, Bull. 627, 165 pp.