
STATE OF SOUTH DAKOTA
Sigurd Anderson, Governor

STATE GEOLOGICAL SURVEY
E. P. Rothrock, State Geologist

REPORT OF INVESTIGATIONS

No. 67

WELL BORINGS IN SOUTH DAKOTA, 1948-1950

by

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Introduction

This is a continuation of the series of Reports of Investigations 57 and 61 and completes the study of all borings made previous to the end of the year 1950, for which cuttings are available. There has been added as a foreword a list of formation thicknesses arranged in order beginning in the northwest, thence to southwest, and thence eastwards in the State. Some thicknesses given in Reports of Investigations 57 have been revised and corrected, notably those in Stanley County borings, the occurrence of the Black River bentonitic green shale in which necessitates assignment to Middle and Upper Ordovician of what was formerly referred to Lower Ordovician.

Chart 1.--THICKNESSES OF CRETACEOUS FORMATIONS

<u>Well</u>	<u>Pierre</u>	<u>Niobrara</u>	<u>Carlile</u>
State Royalty	1640	260	440
Newell Exp. Station	800/	190	390
Seyler Anderson	433/	312	343
Amerada Carlson	400/	240	330
Amerada Snyder	885/	270	250
Rapid City Airport	630/	210	350
Amerada Bertelsen	790/	215	395
Amerada Olson	900/?	125?	375?
Amerada Brehm	850/	340	305
Palensky Smith	-	-	-
Buffalo Gap	-	-	150/
Morton Government #1	-	-	-
Hollingsworth Childers	-	-	-
U. S. Army, Provo	-	-	200/
Pacific Western	-	90/	550
Woodward Schmidt	-	60/	365
Amerada Moody	1090/	100	520
Amerada Agricultural College	840/	60	440
Amerada Vorhees	385	170	440
Amerada Red Eagle	-	-	-
Gypsy Hunter	1807	120	330
Kadoka	1550/	130	380
Midland	945/	200	275
Cosden Zeal	1198/	522	295
Cosden Tanberg	1360	240	337
Red Scaffold	1150/	135	430
Irish Creek	1540	205	465
Carter #1	790/	120	330
Carter #2	685/	95	265
Phillips Dakota	1185/	85	315
Phillips State School	755/	180	255
Phillips Lang	820/	150	330
U. S. Army, Pierre	550/	140	320
U. S. Indian Service, Rosebud	1020	140	300
Red Butte Burkhardt	500/	200	220
Kucera Biskeborn	225/	140	200
Omaha Williams	162/	143	365
U. S. Army, Pickstown	-	145	255
State Fish and Game	-	-	-
Tyndall	-	100/	320
Viborg	-	120/	210
Huron	-	25/	210
Aberdeen	95/	130	200
Canton	-	-	-
Yankton	-	-	-
Miller	-	150	100
Indian Service, Cherry Creek	990/	140	320

THICKNESSES OF CRETACEOUS FORMATIONS

<u>Greenhorn</u>	<u>Graneros</u>	<u>Dakota</u>	<u>Fuson</u>	<u>Lakota</u>
30	1035	70	50	80
30	990	40	115	105
50	1050	50	150	60
70	950	105	30/	-
105	840	50	-	-
100	830	80	57	44
100	855	35/	-	-
80	865	110	75	135
110	815	50/	-	-
-	290/	170	180	180
20	920	40	200	150?
-	-	30	120	200?
-	220/	135	95	130
80	808	160	100	100
20	667	93	144	146
55	780	40	100	150
30	845	20	85	95
35	775	50	170	330
30	825	70	75	120
30	855	150	160	139
75	405	80	270	90
30	277	93	110	110
30	285	35	-	-
216	213	128	148	105
203	365	20	202	68
130	320	65	55	-
70	260/	-	-	-
90	260	140	80	90
65	266	44	100	145
40	285	155	115	60
60?	390	40	10	100
30	270	140	15	90
50	350	100	10	10
60	100	60	180	262
30	160	290	120	258
45	150	535	2	-
75	135	90	255	85
30	170	85/	-	-
30	110	80	50	230
55	30	40	70	23/
20	40	60	140	95
30	250	100	110	170
50	250	110	70	232
55	143	40/	-	-
20	200	60	60	75
80	290	-	-	-
35	280	120/	-	-

Chart 2.--THICKNESSES OF MESOZOIC AND PALEOZOIC FORMATIONS

Well	M o r r i s o n	S u n d a n c e	S p e a r f i s h	M i n n e k a h t a
State Royalty	140	600	535(460)	45
Northern Ordnance Government #1	-	-	-	-
Newell Experiment Station	160	490(700)	920(710)	60
Seyler Anderson	230	380	440	50
Weller Weisman	295	415	530	45
Kucera Gingras	-	-	460	60
Rapid City Airport	150	570	340	50
Amerada Olson	155	305	345	45
Palensky Smith	330	465	430	120
U. S. Army Provo	150	437	337	54
Pacific Western	262	500	139	47
Bell #1	320	365	390	75
Continental	70	380	420	50
Hollingsworth Childers	110	425	375	45
Woodward Schmidt	60	450	200	50
Morton Government	90	470	235	45
Amerada Moody	268	419	196	50
Amerada Agricultural College	290	205	305	55
Amerada Vorhees	315	280	290	35
Amerada Red Eagle	106	255	240	35
Gypsy Hunter	160	187	183	30
Cosden Tanberg	181	285	76	-
Carter #1	0	250	0	0
Carter #2	95	205	0	0
Phillips Dakota	170	215	0	0
Phillips State School	60	355	0	0
Phillips Lang	180	210	0	0
U. S. Army, Pierre	0	600	0	0

THICKNESSES OF MESOZOIC AND PALEOZOIC FORMATIONS

O p e c h e	M i n n e l u s a	M a d i s o n	O r d o v i c i a n	B l a c k R i v e r	S t. P e t e r	D e a d w o o d
80	1035?(414)	595?	790	90	90/	-
-	1000(760)	500(730)	580	50	48/	-
80	-	-	-	-	-	-
70	610	740	340	90	110	249/
117	648	490	200	68	47	130/
90	620	380	60	37	-	-
110	685	400/	-	-	-	-
160	575/	-	-	-	-	-
135	790(895 in Buffalo Gap)	-	-	-	-	-
172	1040	275	-	-	-	-
144	1067	133/	-	-	-	-
130	874/	-	-	-	-	-
80	970	-	-	-	-	-
125	777/	-	-	-	-	-
-	-	-	-	-	-	-
170	820	184/	-	-	-	-
110	980	165	-	-	-	-
115	784	96/	-	-	-	-
135	880	0	-	-	-	-
150	823	0	-	-	-	-
102	749	170/	-	-	-	-
-	-	-	-	-	-	-
0	370	490	350	100	20	-
0	590	525	520	100	0	-
0	580	425	435	95	20	-
0	300	0	60?	130	-	-
0	145	0	0	0	0	-
0	135	55	55	0	0	-

BON HOMME COUNTY

CITY OF TYNDALL
Sec. 6, T. 49 N., R. 59 W.

Completed, 1949

0-	5	Soil.
5-	25	Yellow boulder clay.
25-	95	Grey boulder clay.
95-	195	<u>Niobrara</u> chalk.
195-	215	<u>Carlile</u> shale.
215-	280	<u>Codell</u> sandstone, <u>Carlile</u> formation.
280-	335	Shale, <u>Carlile</u> formation.
335-	350	Sandstone, <u>Carlile</u> formation.
350-	515	Shale, <u>Carlile</u> formation.
515-	570	Shelly lime, <u>Greenhorn</u> formation.
570-	600	<u>Graneros</u> shale.
600-	640	<u>Dakota</u> sandstone.
640-	710	<u>Fuson</u> , shale and manganese pellets.
710-	733	<u>Lakota</u> sand.

Rainbow in the mud at 620' (oil show).

BROWN COUNTY

CITY OF ABERDEEN

Completed, August, 1949

0-	10	Soil.
10-	40	Grey sand.
40-	60	Gravel.
60-	80	Fine gravel.
	90	Gravel.
	100	Coarse gravel.
110-	120	Fine gravel.
130-	190	Coarse gravel.
200-	210	Top <u>Niobrara</u> chalk.
	330	Base <u>Niobrara</u> chalk.
330-	530	Shale.
530-	580	<u>Greenhorn</u> .
580-	720	Shale.
	720	Sand layer.
730-	830	Shale.
830-	940	<u>Dakota</u> sand.
	940	Top of <u>Fuson</u> , manganese pellets.
	970	<u>Fuson</u> .
	970	Total depth.

BRULE COUNTY

KUCERA-BISKEBORN No. 1
Winkler Drilling Company
N. W. $\frac{1}{4}$, Sec. 14, T. 103 N., R. 71 W.
Altitude 1682'
Completed May 20-June 4, 1950

- 0- 30 Glacial drift, crystalline and Cretaceous detritals, selenite.
- 33- 36 Gravel, considerable dolomite pebbles.
- 36- 50/ Glacial drift.
- 55 Pierre (Sully) bentonitic clay, weathered olive drab, with black oxidized pyrolusite nodules. Many small brown grey crystalline pellets, numerous forams including RHAPYDIONINA.
- 55- 60 Clay, bentonitic, light blue grey, manganese carbonate nodules from size of small sand grains to large, light grey.
- 60- 70 Clay, bentonitic, blue grey.
- 70- 85 Clay, bentonitic, blue grey, with fine silt and manganese-bearing concretions and pellets.
- 85- 100 Clay, bentonitic, blue grey, CRISTELLARIA and TEXTULARIA.
- 100- 110 Silt, fine, limy cement.
- 110- 120 TEXTULARIA and INOCERAMUS prisms.
- 120- 125 Limestone, light grey, buff, fine powdery texture, INOCERAMUS.
- 125- 150 Manganese carbonate concretions, light grey buff. AMMODISCUS in clay.
- 150- 160 Clay with TEXTULARIA.
- 160- 170 Crow Creek marl, fine grained, sandy, bentonitic light blue grey. Many forams, TEXTULARIA, GLOBIGERINA, some CRISTELLARIA.
- 170- 180 Larger manganese-bearing concretions, white bentonite with biotite flakes.
- 180- 190 Larger manganese-bearing concretions, drab.
- 190- 200 Clay, light blue grey, bentonitic, AMMODISCUS.
- 200- 220 Manganese concretions, light grey, a little hauerite.
- 220- 230 Sandstone, fine to medium, the fine angular, the medium rounded, lime and sulphide cement. Large amount worn and transported hauerite, pyrite crystallized in place, a little copper sulphide.
- 230 Manganese concretions, size of small sand grains, light grey, INOCERAMUS.

- 230- 240 Larger manganese concretions, light grey, hauerite, INOCERAMUS, CRISTELLARIA.
- 240- 250 Largely INOCERAMUS prisms, cemented with hauerite, GLOBIGERINA, ROTALIA and other forams.
- 250- 260 Marcasite in long slender branching rods, some hauerite, in clay, Sharon Springs?
- 260- 270 Same, but some small spherical marcasite concretions.
- 270- 278 A little chalky marl.
- 278- 280/ Sharon Springs shale, very dark blue grey, bituminous, flaky, sparse chalk pellets, fish remains, gas show.
- 280- 300 Smoky Hill chalk pellet marl, light grey, pellets flattened. GLOBIGERINA.
- 300- 330 Less chalky and more bentonitic, light slate grey, small black spheres, a few bornite cubes.
- 330- 400 Marl, more chalky.
- 400- 420 Fort Hays, purer chalky, light grey.
- 420- 460 Carlile marl, blue grey, with a few chalk pellets and bentonite, biotite flakes and fish remains.
- 460- 470 Many TEXTULARIA and GLOBIGERINA in clay, a little angular quartz sand and black hornstone, pyrite, marcasite and bornite.
- 476
(Circulated) Limestone, grey, containing silt and bentonite.
- 476- 480 Codell, some angular sand, some copper sulphide.
- 480- 490 Brown bentonite, sand, all size grains, considerable selenite.
- 490- 500 Brown bentonite, sand, all size grains, considerable selenite.
- 500- 520 Marl, bentonitic, medium grey, with veins of brown and white calcite.
- 520- 530 Minute pellets, considerable medium grained subround sand.
- 530- 540 Rod sulphide concretions, marcasite spheres, minute light grey pellets.
- 540- 605 Sand, fine grained, angular, well sorted, light grey continues to about 605' with some clay, hauerite, copper sulphide, marcasite and minute brown pellets. Upper 10' purer sand.
- 605- 610 Some limestone beds like Greenhorn, INOCERAMUS.
- 610- 620 Shale, bentonitic, slate grey, sandy INOCERAMUS.

- 620- 630 Greenhorn limestone, grey, largely INOCERAMUS
- 630- 640 Largely slate grey shale with flattened white forams, some limestone.
- 645- 665 Greenhorn limestone, brown to chalk spotted dark grey, at 650' with black films; limestone mainly composed of INOCERAMUS and GLOBIGERINA.
- 665- 690 Graneros shale, bentonitic, grey, with some fine sand and silt, apparently mostly fine sand at 670 -680'.
- 690- 700 Sandstone, fine grained and siltstone, grey. Much detrital sulphide and INOCERAMUS prisms cemented by CaCO₃, mostly hauerite, considerable copper sulphide, fish remains, a few fairly large sand grains.
- 700- 710 Mainly clay, bentonitic, slate grey.
- 710- 720 Largely sand, detrital bornite.
-
- 730- 740 Clay and light grey bentonite, fine sand and very minute pellets.
- 740- 750 Clay, dark slate grey.
- 750- 760 Clay, dark slate grey, with grey bentonite.
- 760- 770 Limestone, medium grey, very silty and bentonitic, copper sulphide.
- 770- 780 Clay, silty, dark grey.
- 780- 790 Clay, silty, dark grey and a little light grey siltstone.
- 790- 800 Clay, dark grey.
- 810- 820 Clay, dark grey, siltstone, light grey, bentonite grey.
- 815?-820 Considerable sandstone, limy cement, fine grained, also siltstone and clay, harder drilling from 815' down. Siltstone turns black in closed tube and yields a small amount of very light yellow oil.
- 820- 830 Sandstone, fine-grained, limy cement with the same sulphides.
- 830- 840 Siltstone, muscovitic, light grey, and sandstone.
- 840- 860 Shale with a little fine sand.
- 860- 865 Mainly brown concretionary limestone.
- 865- 870 A little sandstone, abundant sulphide, a little of which is detrital.
- 870- 875 Sandstone, carbonaceous, cemented with sulphides and CaCO₃.
- 875- 885 Considerable sand, much iron sulphide and some copper sulphide.
- 885- 890 Much less sandstone.
- 890- 895 Sandstone, carbonaceous, cemented with FeS₂

and CaCO₃, a little muscovite.
895- 905 Much muscovite, considerable sand, carbonaceous.
905- 910 Much sand and cemented sandstone, considerable lignite, marcasite, bornite and muscovite.
910- 920 Considerable detrital copper sulphide and some cementing sand.
920- 930 Less sand and that fine grained.
925- 938 Some dark blue covellite cementing sand.
950- 955 Much yellow copper sulphide.
955- 995 Sandstone, angular, medium to fine grained, light grey cemented with marcasite and CaCO₃, carbonaceous and lignitic.
995-1020 Sandstone with small pyrite cubes, a little muscovite, some grains from Sioux quartzite.
1020-1025 Some concretionary light brown siderite cementing sand.
1025-1030 Mostly sand, some muscovite.
1045-1050 Sandstone, calcite cemented, carbonaceous, yellow copper sulphide.
1062 Detrital copper sulphide and also as cement for sand.
1062-1065 Sandstone, grey, calcite cemented, poorly sorted, etched grains, carbonaceous, some coarse grains, some covellite and perhaps chalcocite. Some Sioux quartzite pink grains.
1065-1070 Yellow copper sulphide.
1070-1075 Sandstone, largely coarse rounded to subround grains.
1075-1080 Much loose coarse sand. Much pyrite and some marcasite cement. A little yellow copper sulphide.
1077-1079 Same with chalcopyrite and bornite.
1079-1110 Loose sand, coarse, buff, subangular to subround, some etched, some citrine and Sioux quartzite grains.
1110-1120 Considerable sulphide cemented sandstone, rest loose sand, large quantity chalcopyrite and bornite.
1120-1145 Much grit, angular to subround, etched.
1145-1150 Grit up to 1/16 inch in size.
1150-1155 Sand, finer but coarse grained.
1160-1170 Sandstone, medium grained, mostly calcite cement, carbonaceous, mostly angular to subround grains, some round and etched.
1170-1175 Sand, light grey, fairly coarse, angular, subangular and rounded, some pinkish to yellow, has dark grey clay matrix, pebbly light grey bentonite clay, some sand cemented with marcasite, larger grains etched.
1175-1190 Sand, grey, poorly cemented with calcite

- and marcasite. Larger grains etched and mostly angular. Some carbonized wood, a little muscovite, some grains larger than sand size, some grains partly recrystallized.
- 1190-1200 Sand and cemented sandstone, medium to fine grained, buff chalcopryrite, calcite and other sulphide cement, carbonaceous.
- 1200-1210 Large amount marcasite cement, much loose sand.
- 1215-1260 Much sulphide cemented sandstone, some chalcopryrite and covellite. Sand rather coarse, buff.
- 1260-1265 Grit up to 1/16 inch in size, mostly angular to subround, some Sioux quartzite grains.
- 1265-1300 Coarse sand with small Sioux quartzite pebbles, cemented with very small brown yellow siderite pellets, marcasitized wood, a little chalcopryrite.
- 1305-1310 Limestone, light brown fine grained, some cementing sandstone.
- 1310-1315 Bentonite, light blue.
- 1315-1325 Some large pitted sandgrains.
- 1325-1335 Lignite, some marcasitized, light blue with white bentonite, sand a little chalcopryrite. Oil show at base.
- 1351-1353 Fuson manganese bearing pellets in blue white bentonite.
- 1353-1365 Fine Sioux quartzite pebbles, etched.
- 1365 Sioux quartzite in place, probably reached at 1359'. Core shows sericite in fractures, harder drilling, cemented beds 860-935', 960-980', especially hard 995-1825' and 1045-1065', also hard 1170-1185', 1195-1210', 1260-1265', 1305-1325.

BUTTE COUNTY

SEYLER-CARL ANDERSON No. 1

Wm. Seyler, Inc., owner

J. D. Frizzell, driller

1650' N. and 2310' W. of the SE. corner
of Sec. 12, T. 8 N., R. 5 E.

Altitude 2887'

Completed December 11, 1949

0- 220	No cuttings, <u>Pierre</u> dark blue grey bentonitic clay.
220- 393	<u>Pierre</u> dark blue grey bentonitic clay, sticky, shell fragments.
393- 403	Same, many shell fragments.
403- 503	<u>Niobrara</u> marl, dark blue grey chalk spotted, firm, fish remains.
503- 523	Marl, blue grey, flaky, quite bentonitic.
523- 747	Marl, spotted, as above.
747- 830	<u>Carlile</u> clay, dark blue grey, bentonitic, some limy.
830- 880	Clay, lighter grey and silty, small biotite flakes, quite limy.
880- 890	Sandstone, fine angular grains, somewhat arkosic, limy, with biotite and glauconite.
890-1020	Clay with considerable shell fragments, silty in upper part.
1020-1040	Largely fine arkosic sand with a little glauconite.
1040-1050	Some light grey pure bentonite small biotite flakes, grey fine sand or silt interbeds.
1050-1090	Clay, dark blue grey with small soft limy spots.
1090-1140	<u>Greenhorn</u> limestone, light grey, abundant GLOBIGERINA, INOCERAMUS prisms and some fish remains.
1140-1210	<u>Belle Fourche (Graneros)</u> clay, ashy grey, with many GLOBIGERINA.
1210-1270	Marl, grey with minute white specks and forams.
1270-1280	Clay, flaky, bentonitic, grey slaking when wet.
1280-1290	Same with some light grey bentonite.
1290-1870	Clay, very dark blue grey, flaky, very small white mica flakes, more shaly downwards.
1870-1890	Silt, light grey.
1890-1900	<u>Newcastle</u> sandstone, fine angular grained, grey.

1900-2190	<u>Thermopolis (Skull Creek)</u> shale, light blue grey, clay ironstone, fish scales, bentonitic, silty layers below 2100'.
2190-2240	<u>Dakota</u> sandstone, light grey, very fine grained, white mica flakes, some pyritic cement.
2240-2260	<u>Fuson</u> bentonite with small manganese bearing pellets.
2260-2280	Bentonite, light grey.
2280-2300	Clay, salmon, bentonitic.
2300-2390	Considerable drab bentonite.
2390-2420	<u>Lakota</u> sand, coarse, subround to subangular partly etched grains.
2420-2440	Sand, coarse, with very light grey bentonite, all sizes of grains.
2450-2470	<u>Morrison</u> bentonite, light sea green.
2470-2480	<u>Morrison</u> bentonite, tawny.
2480-2530	Bentonite, varicolored, silty largely green, darker below, small part red brown.
2530-2550	Bentonite light grey, with numerous OSTRACODS.
2550-2580	Sandstone, fine grained, light grey, bentonite matrix.
2580-2610	Bentonite, green and grey.
2610-2680	Siltstone, light grey, with magnesian limestone cement, largely cavings.
2680-2850	<u>Sundance</u> siltstone, grey to light green, limy cement, very little glauconite in minute specks, fine white mica flakes, interbeds of grey bentonitic clay and grey limestone, OSTRACODS.
2850-2890	Bentonite, very silty, light green grey glauconitic.
2890-2940	Siltstone, terra cotta (red brown) with bentonite.
2940-2960	Anhydrite, light grey, silty.
2960-2970	Siltstone, light grey.
2970-3010	Bentonite, green.
3010-3020	Limestone, light cream, porcellaneous.
3020-3050	Bentonite, silty, light grey green.
3050-3060	Siltstone, bentonitic, limy cement, green grey.
3060-3070	<u>Spearfish</u> siltstone, dark red brown.
3070-3100	Anhydrite, grey to white.
3100-3120	Siltstone, limy, light red brown.
3120-3260	Siltstone, dark salmon, with some mudstone below 3200'.
3260-3270	Anhydrite, pink.
3280-3310	Siltstone, dark salmon.

3310-3320 Anhydrite, pink and grey
 3320-3330 Siltstone and mudstone, dark salmon,
 3330-3350 Anhydrite, pink and grey.
 3350-3500 Siltstone, dark salmon

 3500-3520 Minnekahta dolomite, pink cream to brown
 grey, very finely crystalline with
 anhydrite.
 3520-3550 Limestone, fairly coarsely crystalline,
 pink-stained cream.

 3550-3560 Opeche, siltstone, dark red.
 3560-3570 Sandstone, pink cream, fine angular grains,
 magnesian limestone cement.
 3570-3610 Siltstone, dark dull salmon.
 3610-3620 Siltstone, dark dull salmon, sandy.

 3620-3650 Minnelusa dolomite, pink cream.
 3670-3720 Sandstone, pink cream, porous, fine angular
 etched and a few larger grains.
 3720-3800 Anhydrite, pink stained.
 3800-3860 Sandstone, white, some limy cement, white
 kaolin-like matrix.
 3860-3900 Dolomite, pink, fine powdery texture, grayer
 below 3880'.
 3905-3910 Anhydrite, white.
 3910-3920 Dolomite, cream, very finely crystalline.
 3920-3930 Sandstone, fine grained, poorly sorted,
 silty, salmon pink.
 3930-3940 Shale, bright red, red marker.
 3940-3960 Anhydrite, pink.
 3960-3980 Red marker shale, finely fissile, lavender,
 red and purple.
 3980-4010 Limestone, grey, finer texture, shale
 cavings.
 4010-4070 Sandstone, cream, fine grained, white pow-
 dery, matrix.
 4070-4130 Dolomite, light brown grey, fine granular,
 vuggy, partly sandy and silty.
 4130-4140 Shale, bright brick red, lavender and purple.
 4140-4170 Dolomite, pink to grey, finer granular.
 4170-4180 Shale, brick red, top of laterite zone.
 4212 Sandstone, fine grained and shale, maroon and
 purple, sand grains recrystallized.

 4230-4250 Madison dolomite, fairly large crystals, pink
 cream, quite porous.
 4250-4351 Limestone, cream, fine granular. Returns
 were lost in cavity 4351-4400'.
 4370-4540 Dolomite, light pink grey, medium crystal-
 line, vuggy.
 4540-4640 Limestone, light brown grey, vuggy, fine
 crystals.

- 4640-4700 Limestone, darker grey, finer sugary, some fluorescent.
- 4700-4890 Limestone, light brown grey, oolitic, fossils.
- 4890-4930 Limestone, changing from brown to grey.
- 4930-4950 Limestone, magnesian, light pink, lithographic, Englewood (?)
- 4950-4970 Limestone, magnesian, cream, chalky texture.
- 4970-5280 Trenton (?) Ordovician (?) dolomite, light grey, vuggy to dense, vitreous and finely crystalline, changes to light brown and well crystallized with vitreous luster farther down.
- 5280-5310 Limestone, light brown, fine sugary, silty.
- 5310-5330 Transition to Black River, limy silt faintly green.
- 5330-5400 Black River metabentonite, talcose greasy flaky, green with small particles of black detrital phosphate. Slakes greatly into thin flakes.
- 5400-5440 St. Peter sandstone, fine grained, some fluorescent with a little glauconite and some marcasite and pyrite cement, interbedded at top with green metabentonite.
- 5440-5510 Sandstone, a little coarser grains angular, deep pink.
- 5510-5570 Deadwood sandstone with detrital glauconite, light green grey, limy.
- 5570-5630 Sandstone, glauconitic, dull cinnabar (cochineal or crimson) limy, some epidote.
- 5630-5660 Sandstone, glauconitic, green grey.
- 5660-5715 Sandstone, coarse, limy, etched grains.
- 5715-5759 Limestone, light brown grey.

CHARLES MIX COUNTY

NICK GUIKEISEN FARM
Wave Drilling Company
NW $\frac{1}{4}$ of Sec. 11, T. 99 N., R. 70 W.
Altitude 1502'
Completed July, 1949
Correlated by Lloyd A. Carlson

- 0- 35 Alluvium, clayey silt, sandy silt, some gravel fragments.
- 35- 50 Gravel, rather coarse, unbroken particles rounded and subrounded.
- 50- 76 No cuttings.
- 76-185 $\frac{1}{2}$ Pierre, bentonitic grey clay.
- 185-210 Sharon Springs, dark grey fissile shale.
- 210-330 Niobrara, chalk, light grey.
- 330-440 Carlile bentonitic marly shale, grey, pyrite, and marcasite.
- 440-480 Codell (?) fine quartz sand, some grains frosted, mostly loose, but some cemented with pyrite or marcasite.
- 480-490 Shale, bentonitic, grey.
- 490-510 Limestone, crystalline, grey, looks like Greenhorn.
- 510-590 Shale, bentonitic, somewhat marly, numerous INOCERAMUS prisms.
- 590-645 Greenhorn limestone, crystalline, grey INOCERAMUS prisms and forams abundant.
- 645-730 Graneros bentonitic shale, light grey, much Greenhorn limestone in samples.
- 730-770 Dakota dirty quartz sand, grains subangular and subrounded.
- 770-820 Fuson, manganese pellets, bentonitic clay mostly lost by washing.
- 820-870 Lakota, fine quartz sand, angular, subangular and subrounded, some grains etched.

Remarks: Much trouble in drilling due to caving of gravel.

CHARLES MIX COUNTY

H. E. SCHOENROCK FARM WELL
Wave Drilling Company
SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 17, T.10Q N., R. 68 W.
Altitude 1635'

- 20- 80 Glacial till.
80- 230 Stream gravel and sand.
- 230- 270 Sharon Springs black bituminous shale.
- 270- 390 Niobrara chalk spotted marl, light grey.
- 390- 660 Carlile clay, numerous ROTALIA and TEXTULARIA
at top, perhaps with Codell sand.
- 660- 690 Greenhorn limestone, light grey, made up of
INOCERAMUS prisms and GLOBIGERINA.
- 690- 810 Graneros shale, blue grey.
- 810- 970 Dakota sandstone, light grey, fine angular
grained, in part cemented.

CHARLES MIX COUNTY

STATE GAME AND FISH COMMISSION NO. 1
Buxton and Dodds Drilling Company
NE $\frac{1}{4}$ Sec. 7, T. 96 N., R. 64 W.
Completed 1946

- 0- 20 Sand and gravel, clayey, much muscovite.
- 20- 30 Sand with Niobrara chalk fragments.
- 30- 70 Sand with Pierre clay and Niobrara chalk fragments. Sioux quartzite, pre-Cambrian rocks.
- 70- 90 Sand coarse, grey, with gravel.
90-170 Sand fine, grey, much marl, sand largely angular, black hornstone.
- 170-270 Gravel, fine to 200' depth, coarser below, with fine sand 240-270'. Evidently section down to 270' is the deposit of a former glacial meltwater spillway.
- 270-340 Some oolitic brown goethite pellets, polished on outside, cemented to form a grit conglomerate with sand. Highly polished pebbles 310-320'.
- 340-360 Sand grains cemented with lime, pyrite and marcasite, a little chalcopyrite, may be Codell.
- 360-380 Codell (?) sand, coarser and angular grained, some rounded and etched, hauerite.
- 380-390 Considerable light grey concretionary limestone, also occurring from 340' downwards.
- 390-400 Sand with carbonized wood.
400-420 Sand.
- 420-440 Sand and INOCERAMUS prisms, Carlile clay, light grey.
- 440-450 Some hauerite.
- 450-480 Greenhorn limestone, light grey, with INOCERAMUS prisms and GLOBIGERINA.
- 500-520 Graneros shale, blue grey, flaky, bentonitic.
520-530 AMMODISCUS.
530-540 Cavings of Greenhorn limestone.
540-590 Bituminous black films, flattened chalk particles, fish remains.
- 590-600 Sandstone, fine to medium grains, angular grains, pyrite and chalcopyrite cement.
- 600-610 Shale, grey, flaky, bentonitic.
610-620 Shale, with carbonized wood.

620- 630 Sand, fine grained.
 630- 640 Shale, medium grey.
 640- 650 Siltstone to fine sandstone, limy cement,
 muscovitic and glauconitic.
 650- 670 Considerable chalcopyrite and bornite ce-
 ment and replacing sand, Dakota sand,
 with shale 590-670'.
 670- 680 Shale, blue grey.
 680- 690 Fuson abundant manganese iron pellets, light
 grey and brown.
 690- 720 Shale bentonitic.
 720- 850 Lakota sand, fine angular, carbonized wood.
 850- 890 Cement and sand.
 890- 910 Sand, buff, coarse angular, in part etched.
 910- 950 Kaolin or bauxite, white and terra cotta,
 some grains Sioux quartzite, many manganese
 pellets in lower part.
 950- 960 Sioux quartzite, pinkish.

CUSTER COUNTY

Von W. Smith No. 2
J. E. Palensky et al
Orville H. Parker, Driller
750' N. and 250' W. from SE Corner
SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 25, T. 4 S., R. 7 E.
Altitude 3392'
Completed October 20, 1949

- 0- 100 No cuttings; 98' surface and only casing run and (cemented) Graneros shale.
- 100- 290 Graneros shale, dark blue grey, fairly firm.
- 290- 310 Dakota sandstone, fine angular grained, light grey, muscovitic, carbonaceous.
- 310- 320 Less sandstone, but some present, interlam- inated with dark grey shale.
- 320- 350 Some sandstone.
- 350- 380 Shale.
- 380- 460 Some fine grained sandstone, brown grey, clay, grey, bentonitic.
- 460- 470 Fuson, large amount sandstone, manganese bear- ing pellets just appearing.
- 470- 480 Fuson manganese bearing pellets abundant, many large.
- 480- 500 Sand, medium sized grains, angular, mangan- ese pellets.
- 500- 530 Some minute green bentonite pellets in grey clay, also in fine sandstone, perhaps mostly grey bentonite.
- 530- 630 Sandstone, fine, carbonaceous, mostly clay, dark grey, bentonitic.
- 630- 640 Some chalcopyrite.
- 640- 700 Lakota sand with Indian red hematite matrix, angular.
- 700- 820 Sandstone, buff, fine angular, muscovitic below 685', some etched and recrystallized.
- 820- 860 Morrison drab bentonite, carbonaceous, finely divided hematite, sandy, with light grey fine grained sandstone.
- 860- 900 Bentonite, very light grey and yellow, with light grey fine grained sandstone, brown, purple, and lavender stained and mottled and veined.
- 900- 905 Bentonite, varicolored, some sandy.
- 905- 915 Siltstone, bentonitic, dark red brown.
- 915- 930 Bentonite and siltstone, varicolored, sandy.

- 930- 950 Same, with sandstone, some coarse grains, much sand with bentonite matrix throughout Morrison, etched grains.
- 950- 975 Bentonite, mostly light and dark grey, sandy and some sandstone interbeds, chalcopyrite; could call it Morrison sandy bentonite.
- 975-1010 Lavender and purple tints but mainly drab bentonite.
- 1010-1025 Bentonite, light grey (drab).
- 1025-1045 Unkpapa sandstone, light cream, carbonaceous, fine grained.
- 1045-1055 Mainly dark, bentonitic, possibly cavings.
- 1055-1070 All bentonite, drab grey.
- 1070-1090 Sandstone, light pink iron oxide matrix, some light yellow, fine grained, partly recrystallized.
- 1090-1125 Sandstone, buff, perhaps mostly drab bentonite.
- 1125-1150 Sandstone, pink, fine, etched, angular, recrystallized.
- 1150-1165 Sundance clay, grey, some glauconite pebbles.
- 1165-1195 Sandstone, white, fine grained, calcite cemented, varicolored bentonite, mostly grey, somewhat carbonaceous (both sandstone and clay).
- 1195-1230 Increase in white sandstone, somewhat coarser below, some pink grains.
- 1230-1270 Bentonite, grey, with purple stains, CHARA fruit.
- 1270-1350 More white sandstone, some asphaltic at 1300', considerable grey bentonite.
- 1350-1380 Sandstone, fine, glauconitic, sandstone still continues abundant.
- 1380-1435 Sandstone, white, fine to medium, angular and subangular, much etched, poorly sorted.
- 1435-1440 Considerable glauconite in fine sandstone.
- 1440-1450 Clay, glauconitic, grey and fine sandstone with glauconite, fairly abundant.
- 1450-1453 Sandstone, light grey, fine grained, glauconitic.
- 1453-1455 Clay, bentonite, grey, with siltstone, glauconitic.
- 1455-1460 (Core) same light grey fine glauconitic clay.
- 1460-1470 Mostly dark grey fine glauconitic clay with some sandstone and fine sand.
- 1470-1505 Increase in sandstone, light grey, fine glauconitic and muscovitic, probably nearly all sandstone.
- 1505-1595 A little dove colored limestone, milky quartz veining in lower sandstone with dark grey bentonitic clay becoming silty below. Some

	purple and lavender.
1595-1615	Sandstone, fine, glauconitic, with fissile, sandy green grey bentonite and some terra cotta bentonite, dull.
1615-1690	<u>Spearfish</u> fine sandstone, light salmon, and clay, dark salmon mostly a siltstone with clayey matrix, considerable very fine angular sand.
1690-1730	From 1690' down are mostly <u>Morrison</u> and <u>Sundance</u> cavings (perhaps because drilling anhydrite with whole weight of drill stem on bottom); some anhydrite at 1700-5'.
1730-1745	Anhydrite, cream to light brown.
1745-1750	Anhydrite and siltstone, light salmon.
1750-1780	Siltstone, fine sandy, dark salmon.
1780-1800	Siltstone, fine sandy, dark salmon and anhydrite.
1800-1860	Siltstone with some clay, dark salmon.
1860-2035	Anhydrite with mostly cavings white and pink.
2035-2045	Siltstone, dark salmon, and clay with vugs of anhydrite.
2045-2165	<u>Minnekahta</u> limestone, buff to lavender, some brown with bitumen, fine powdery to fine crystalline 2160', quite fluorescent.
2165-2205	<u>Opeche</u> siltstone, sandy, dark dull purplish red, dark pink; below at 2185' maroon.
2205-2210	Siltstone with anhydrite.
2208-2228	Anhydrite, fine crystalline, white, some red stained.
2228-2250	Siltstone, maroon, clayey.
2250-2275	Siltstone, dark brown red, larger per cent claystone, some anhydrite.
2275-2300	Siltstone, dark maroon.
2300-2340	<u>Minnelusa</u> sandstone, dark salmon, all sized unassorted grains, large grains etched, sub-angular to subround.
2340-2350	Siltstone, dark salmon, sandy and with fine grained sandstone.
2350-2390	Sandstone, grains unassorted, dark salmon.
2390-2410	Anhydrite, pink stained.
2410-2440	Limestone, creamy, porous, crystalline, fluorescent, bituminous, silty.
2440-2450	Anhydrite and dark salmon sandstone.
2450-2460	Sandstone, light salmon, fine to medium, angular, poorly sorted, some large grains.
2460-2465	Sandstone, creamy, fine grained, limy cement.
2465-2470	Anhydrite, dark grey, bituminous, some black shale in thin laminae.

2470-2490 Limestone, earthy, medium grey, finely crystallized with vuggy anhydrite, black spotted limestone.

2490-2505 Anhydrite, grey.

2505-2510 Siltstone, dolomitic, lavender, muscovitic.

2510-2520 Siltstone, dolomitic, lavender, muscovitic, grey, anhydrite.

2520-2530 Limestone, magnesian, grey, fine crystalline, stylolitic, some anhydrite.

2530-2540 Limestone, lighter brownish grey.

2540-2550 Siltstone or fine sandstone, limy cement, pink stained grey grading down into fine grained sandstone.

2550-2575 Sandstone, pink, with some cream, porous, fine grained angular, recrystallized.

2575-2595 Dolomite, very fine grained, pink stained grey.

2595-2635 Anhydrite with much selenite, white.

2635-2640 Limestone, silty, light pink, very fine textured.

2640-2645 Sandstone, cream, fine grained, limy cement.

2645-2655 Limestone, lavender.

2655-2670 Sandstone, pink fine, angular to subround, partly recrystallized, poorly sorted.

2670-2675 Shale and siltstone.

2685-2690 Sandstone and siltstone.

2690-2700 Anhydrite.

2700-2715 Limestone, magnesian, lavender, fine grained.

2715-2720 Siltstone, lavender.

2720-2735 Anhydrite.

2735-2745 Dolomite, light lavender and grey.

2745-2750 Sandstone, pink cream, fine grained.

2750-2770 Red marker, shale, fissile, dark purple (mauve), muscovitic, with mudstone, dark salmon, silty.

2770-2785 Limestone, pink grey, very fine texture, silty.

2785-2790 Limestone, light grey, mixed with anhydrite.

2790-2830 Limestone, magnesian, light pink grey, fine texture, grades down into dolomitic limestone.

2830-2865 Sandstone, pink, limy cement, fine to medium, partly rounded and etched, porous, very poor sorting, likely interbedded with limestone, color changes below to pink creamy.

2865-2870 Limestone, grey, fine powdery texture, magnesian.

2870-2895 Sandstone, light grey, crystalline quartz in vugs, limy cement.

2895-2925 Limestone, magnesian, medium grey, fine texture, silty, somewhat porous and calcite veined.

- 2925-2950 Shale, black, very bituminous, in limestone as above.
- 2950-2975 Limestone, light grey, fine powdery, magnesian, at 2970' some fissile brown red shale, silty.
- 2975-3050 Limestone, dolomitic, pink, fine powdery, vuggy, secondary calcite changing to partly grey at 3000'.
- 3050-3060 Laterite zone, red silt and clay with some light grey limestone and sandstone.
- 3060-3070 Sandstone, very fine grained, pink stained cream, perhaps better terms quartzose silt.
- 3070-3090 Same with silt, dark salmon, some large sand grains, subrounded.
- 3090-3100 Madison limestone, weathered, some residual chert, fine grained creamy limestone with lithographic texture.
- 3100-3135 Limestone, as above, fresh, chert milky to light grey, pink stained on fractures.

Water Analysis
by Charles Bentley
State School of Mines and Technology
Depth, 2412-2824 feet.

Values in parts per million:

Sodium chloride, (NaCl)	16.5	Iron and Aluminum Oxides	1.0
Sodium sulphate, (Na ₂ SO ₄)	117.8	Silica (Si)	21.0
Calcium sulphate, (CaSO ₄)	1673.9	Volatile and Organic	65.8
Magnesium sulphate, (MgSO ₄)	97.2	Total solids	2174.0
Magnesium carbonate, (MgCO ₃)	180.8		

CUSTER COUNTY

STREETER No. 1
J. E. Palensky, et al
Vernon Baker, Driller
Sec. 15, T. 6 S., R. 6 E.
Completed December, 1950

0-	25	Gravel, some anhydrite.
25-	40	Gravel, quartzite, feldspar, limestone, etc.
40-	45	Gravel and <u>Opeche</u> siltstone, dark salmon, fine.
45-	94	<u>Minnelusa</u> sandstone and siltstone, dark salmon fine grained with coarse etched rounded grains, mostly sandstone.
94-	105	Sand, soft, dark salmon.
105-	115	Sandstone, fine silty, dark salmon, with coarse etched grains.
115-	135	Softer sandstone, mostly fine, angular to subangular.
135-	157	Sandstone, firmer.
157-	170	Limestone, fine powdery, light pink grey, with sandstone.
170-	175	A little anhydrite in sandstone.
175-	188	Sandstone, some light salmon.
188-	192	Limestone, light grey fine powdery texture.
192-	214	Sandstone, soft.
214-	220	Sandstone, fine to silty, dark brown to red (salmon), limy cement.
220-	236	Sandstone, soft.
236-	252	Limestone, blue grey, finely crystalline, fossils, perhaps some sandstone.
252-	257	Probably sandstone, grey to pink, fine to silty, limy, white anhydrite, limestone.
257-	262	Siltstone, lavender to mauve, considerable salmon sandstone and grey limestone.
262-	270	Largely white anhydrite with limestone and sandstone as above, limestone vuggy.
270-	272	Dolomite, cherty, dark blue grey, sugary.
272-	274	Sandstone, bright red, angular to subangular.
274-	275	Sandstone and sugary dolomite.
275-	281	Dolomite, dark grey and anhydrite, white.
281-	284	Anhydrite with selenite, white.
284-	291	Dolomite, light brown grey, sugary, a little black shale.
291-	295	Dolomite and white anhydrite.
295-	307	Sandstone, lavender or pink, anhydrite cement below.
307-	313	Sandstone, lavender or pink, with much anhydrite and selenite, white.

313- 324	Sandstone, bright red, with large amount selenite.
324- 331	Siltstone, purple, and anhydrite, white.
331- 352	Sandstone, red, largely white anhydrite.
352- 359	Sandstone, light salmon.
359- 364	Dolomitic grey limestone, sandstone as above, a little dark grey shale.
364- 369	Sandstone, light salmon, and white anhydrite increasing downwards.
369- 372	Anhydrite, white.
372	Large piece dark blue grey mudstone (hard).
372- 375	White anhydrite and sand.
375- 379	Anhydrite, white.
379- 393	Cavernous, light brown magnesian limestone.
393- 406	Limestone, dolomitic, silty, lavender, fine grained.
406- 412	Sandstone, soft, light salmon to pink, medium to coarse, limy some limestone as above.
412- 419	Sandstone, soft, light pink.
419- 426	Dolomite, lavender and grey, powdered sugar texture, fossiliferous, silty, some very fine and dense, dull luster.
426- 441	Same dolomite with some white anhydrite.
441- 453	Anhydrite, white.
453- 465	Dolomite, light grey fine sugary vuggy to dense, fossiliferous, some chert.
465- 474	Siltstone, lavender and pink.
474- 489	Anhydrite and selenite, white.
489- 500	Dolomite, light grey, fine sugary, vuggy, a little anhydrite. Sandy 498-500'. Small gas show at 494'.
500- 504	Sandstone, gas show.
504- 511	Red marker marked by purple mud, sandstone above with anhydrite matrix. Some dark grey shale and dark brown iron cemented sandstone.
511- 515	Bentonite, purple to grey, laminated, but mainly dolomite and sandstone.
515- 520	Red marker, clay, very thinly laminated, dark dull red and light grey.
528- 540	Limestone, almost crimson, well crystallized, some soft white anhydrite with colorless calcite, gypsum and quartz.
540- 547	Limestone, pink, passing down into sandstone, white and pink, limy, with some large etched grains.
547- 549	Sandstone, cream to pink, mostly dark pink, poorly sorted with many large subround etched grains.
549- 553	Sandstone, grey, dolomite and a little very dark grey mudstone.
553- 555	Sandstone as at 547-549'.
555- 561	Sandstone as above but perhaps not so much

- pink, soft, with secondary quartz.
- 561- 575 Sandstone, mostly dark pink, some light grey, much recrystallized.
- 575- 583 Sandstone, soft, buff, etched, medium to fine, considerable calcite.
- 583- 585 Sandstone, soft, buff, etched, medium fine, some pink limestone and a little milky chert.
- 585- 594 Chert, white, powdery textured, porcellaneous, and sandstone as above.
- 594- 599 Sandstone, light pink, limy.
- 599- 610 Sandstone, pinkish light grey, porous, pink calcite.
- 610- 616 Sandstone and clay, light salmon, with much calcite.
- 616- 628 Sandstone, pink with limestone, light grey, fine grained.
- 628- 639 Sandstone, pink, underlain by dolomite, light grey, fine earthy.
- 639- 650 Same with some chert, pink dogtooth spar.
- 650- 654 Dolomite, dark grey and yellowish, cherty.
- 654- 670 Dolomite and sandstone, grey.
- 670- 673 Same with black shale.
- 673- 675 Sandstone, soft with hole full of water.
- 675- 683 Increase in grey dolomite, black shale.
- 683- 705 Sand, fine angular, grey, some dolomite, grey, silty at base, with calcite in sand. Large amount black shale at 700-705'.
- 705- 749 Sand, light orange, much calcite, some light grey and pink limestone, fine grained, dense, and light pink vuggy limestone, some milky chert.
- 757- 767 Some sandstone but a large amount fine crystalline light pinkish grey limestone, sandstone has lime cement.
- 767- 785 Sandstone and siltstone, limy, lavender and cream, a little chert.
- 785- 792 Sandstone, fine grained, faint pink.
- 799- 814 Limestone, sandy, cream to light pink.
- 814- 837 Limestone, sandy, lavender.
- 837- 848 Sandstone, fine grained, light pink, limy cement.
- 848- 855 Siltstone, lavender, some bright light green, bentonitic, sand and calcite.
- 855- 867 Lateritic siltstone, sandy, dark dull purple, some dark brown red and light bluish green.
- 867- 871 Same with light grey, very fine grained limestone.
- 871- 883 Sand, creamy, many recrystallized grains, angular, medium sized.

- 883- 887 Sand, pink, and laterite clay, purple.
887- 893 Clay, reddish purple, some light greenish
grey.
893- 939 Laterite, clay with sand, a little pink
limestone, cream, very dense and fine
grained, orange, grey, maroon and yellow
mottled.
- 939 Madison limestone, white, dense, finely
crystalline, with grey chert.

FALL RIVER COUNTY

CHRISTIANA GOVERNMENT No. 1
Pacific Western Oil Corporation
Signal Drilling Company
330' S. and 330' E. of W. $\frac{1}{4}$ corner
of S. 10, T. 11 S., R. 1 E.
Altitude 4115' derrick floor
Completed July 12, 1949

5- 30	<u>Niobrara</u> chalk spotted marl, grey.
30- 35	Few fine grains of sand and biotite flakes in the marl.
35- 90	Marl with darker grey less chalky interbeds.
90- 105	<u>Carlile</u> clay, dark blue grey, silty, numerous GLOBIGERINA and fish fragments.
105- 190	Clay, denser and finer grained, dark blue grey.
190- 200	Silt with sand grains and a little glauconite, ashy.
200- 235	Clay, dark blue grey.
235- 330	Claystone, dark grey with white mica flakes.
330- 385	Siltstone, a little lighter grey.
385- 420	Sandstone, abundant fine angular sand, fairly large phlogopite flakes, a few INOCERAMUS prisms, coarser partly recrystallized sandstone at base with grey chert fragments.
420- 640	Varved thin interbeds of light grey siltstone and darker grey claystone, small mica flakes, sparse glauconite, some fine sand size grains, limy laminated, a few GLOBIGERINA.
640- 660	<u>Greenhorn</u> limestone, light grey, common INOCERAMUS LABIATUS, finely crystalline.
660- 770	<u>Graneros</u> (<u>Belle Fourche</u>) mudstone, dark blue grey, hard with very small chalky pellets, some shiny blue black ammonite and fish fragments.
790- 820	Softer, perhaps with silt interbeds.
820- 830	Bentonite, light grey.
830- 850	Limestone, like <u>Greenhorn</u> (cavings)
850-1100	Claystone, blue black, with clay ironstone concretions below 950'.
1100-1110	Mudstone, dark red brown.
1110-1180	Claystone, some silty and concretionary.
1180-1227	Siltstone, grey.
1227-1260	<u>Dakota</u> sandstone, fine grained, limy cement,

- light grey, carbonaceous, grains partly recrystallized.
- 1260-1270 Largely carbonaceous clay, yielding oil when heated in closed tube.
- 1270-1300 Sandstone, light grey fine grained, carbonaceous.
- 1300-1320 Sandstone brown, fluorescent.
- 1320-1430 Fuson clay, dark blue grey, fissile, yields oil upon heating in closed tube, rare manganese bearing pellets, becoming numerous in some lower cavings.
- 1430-1432 Core of dark blue grey mudstone, with some sand laminae below.
- 1432-1464 Shale, dark blue grey, carbonaceous.
- 1464-1490 Lakota sandstone, dark brown iron oxide cement.
- 1490-1500 Lakota sandstone, light grey, fine grained as usual.
- 1500-1600 No cuttings, but light grey coarse sandstone reported 1520-1588', electric resistivity log indicates base Lakota at 1588' depth with strong water sand 1520-1588'.
- 1588-1610 Morrison sandstone, light grey, fine grained, some coarse grains and bentonite, light grey drab.
- 1610-1640 Clay, bentonitic, light sea green, darker below.
- 1640-1660 Bentonite, cream, drab and lavender, with sand grains.
- 1660-1670 Bentonite, sandy, darker lavender.
- 1670-1680 Bentonite, light sea green, very sandy.
- 1680-1690 Bentonite, largely light drab grey.
- 1690-1710 Siltstone, bentonitic, light lavender and sea green, somewhat limy, some finely crystalline cream sandy and bentonitic dolomite, some large etched subround sand grains, a little dark brown clay.
- 1710-1740 Unkpapa, largely sandstone, cream white, fine grained, poorly sorted, partly recrystallized, partly bentonite matrix, some brown, tan and green.
- 1740-1750 Sandstone, some fairly coarse, grey brown and purple.
- 1750-1780 Sandstone, light grey, fine grained, poorly sorted.
- 1780-1790 Perhaps mostly bentonite (badly caved).
- 1790-1820 Sandstone, light grey, fine grained, considerable with bentonite matrix, some bright green bentonite.

1820-1850 Sundance dolomite, cream crystalline, some chert, considerable drab bentonite.

1850-1900 Bentonite, drab, with a little limestone and some calcite concretions.

1900-1920 Limestone, lithographic, light grey drab, some tan below.

1920-1935 Bentonite, sandy, dark grey.

1935-1940 Sandstone, calcite, fine-grained bentonite matrix, subround to angular grains, poorly sorted, probably interbedded with drab sandy bentonite.

1940-1960 Sandstone, as above, with grey glauconitic siltstone, calcite fills vugs.

1960-2050 Siltstone and limestone, glauconitic, various shades of grey, light mica flakes, a little milky chert, probably some sandy bentonite.

2050-2070 Siltstone, light ashy grey to fine grained sandstone, a little glauconite.

2070-2150 Siltstone, terra cotta (red brown), very small white mica flakes, possibly some cream colored.

2150-2170 Siltstone, light grey, a little glauconite.

2170-2200 Siltstone, medium grey, with interlaminated micaceous bentonite.

2200-2230 Mainly blue grey bentonite and siltstone.

2230-2240 Siltstone, light grey to fine sandstone.

2240-2250 Some tan, dark brown red and brown bentonite.

2250-2270 Mostly bentonite with siltstone interbeds, medium dark grey.

2270-2300 Resistivity log indicates sandstone which does not show in cuttings until 2290-2300', where it is fine grained light brown grey, mostly silt size with limy cement, some being fluorescent.

2300-2325 Clay, bentonitic, dark grey.

2325-2350 Same, clay with a little light grey fine grained sandstone with glauconite pellets.

2350-2475 Spearfish siltstone, dark salmon, very small white mica flakes.

2475-2480 Anhydrite.

2480-2500 Siltstone, dark salmon.

2500-2560 Anhydrite interbedded with siltstone.

2560-2600 Mainly siltstone.

2600-2610 Anhydrite, pink stained.

2610-2689 Siltstone, dark salmon.

2689-2736 Minnekahta limestone, grey, pink stained, fine grained. Core 2690-2700' is of stylonitic light grey and pink laminated limestone with a 15° dip, top 2' is dolomitic.

2736-2880 Opeche mudstone, dark dull purple or maroon, some siltstone and sandstone, some spotted with anhydrite, silty below 2780'.

2880-2930 Minnelusa sandstone, cream, some orange stained, fine grained.

2930-2980 Anhydrite, purple stained, likely some other interbeds.

2980-2985 Siltstone (?), red.

2985-2990 Anhydrite (?).

2990-3005 Probably siltstone, salmon, caving badly.

3005-3015 Sandstone, fine grained orange.

3015-3020 Anhydrite.

3020-3045 Limestone, medium grey, fine grained, anhydrite spotted.

3045-3065 Anhydrite, mottled grey.

3065-3070 Sandstone, cream, fine grained.

3070-3075 Siltstone, purple.

3075-3100 Limestone, light grey, with bluish chert.

3100-3105 Sandstone, mostly reddish stained, fine grained.

3105-3115 Dolomite, fine grained, light pink.

3115-3125 Siltstone, pink.

3125-3185 Anhydrite

3185-3205 Dolomite, light grey, very fine grained and siltstone (?), red.

3205-3225 Dolomite, lavender, very fine grained.

3225-3235 Dolomite, grey, very fine grained.

3235-3245 Dolomite, pink stained, very fine grained.

3245-3250 Anhydrite.

3250-3255 Dolomite, grey, mixed with anhydrite.

3255-3285 Sandstone, fine grained, pink stained grey, poorly sorted, some etched.

3285-3305 Dolomite, maroon, fine porcellaneous, grey at base.

3305-3310 Siltstone, dark salmon.

3310-3365 Anhydrite, spotted grey, somewhat silty.

3365-3380 Sandstone, light grey, fine grained.

3380-3385 Limestone, dolomite, dark grey brown, fine texture, and anhydrite.

3385-3390 Sandstone, medium grey, dolomitic cement and sandy limestone.

3390-3400 Anhydrite, grey speckled.

3400-3405 Anhydrite and dark grey dolomite.

3405-3425 Sandstone, dark grey, fine grained, anhydrite cement, poorly sorted, some etched.

3425-3430 Dolomite, dark grey.

3430-3440 Sandstone, fine grained, perhaps mainly dolomite.

3440-3465 Dolomite, dark grey, very fine grained.

3465-3470 Sandstone, light grey, fine grained, and dark grey dolomite with spots of anhydrite.

3470-3535 Limestone, magnesian, fine powdery, dark

grey, some brown and fluorescent, also dolomitic limestone. Sandy at 3515' downwards with some chert mixed with anhydrite 3325-3545'.

3535-3540 Small gas show (drill stem test). Siltstone, grey, dolomitic cement. Slight fluorescence.

3540-3545 Limestone, dolomitic, fluorescent.

3545-3555 Dolomite, light brown, very fluorescent, light oil stain, very fine powdery texture, some anhydrite and chert.

3555-3570 Limestone, magnesian, cream grey, very fine texture, some anhydrite spots.

3570-3575 Limestone, fluorescent.

3575-3585 Limestone, fluorescent, grey, with anhydrite.

3585-3600 Limestone, with considerable milky chert.

3600-3605 Limestone, brown grey, finely crystalline.

3605-3615 Limestone, very silty, well stained with oil, cherty, brown to cream increase in red siltstone (?), 3610-15'.

3615-3630 Limestone, with less oil stain.

3630-3635 Mudstone, dark brown.

3635-3640 Limestone, as above.

3640-3645 Sandstone, cream, very fine grained.

3645-3650 Limestone, cream, very fine grained.

3650-3660 Gas in drill stem test, probably brown siltstone.

3660-3675 Limestone and limy siltstone, cream, cherty, lithographic to fine crystalline.

3675-3680 Anhydrite and limestone (?).

3680-3685 Some oil saturation and fluorescence in dark brown limestone.

3685-3695 Purple siltstone, clay, varicolored siltstone, some bright green, some grey dolomite and milky white chert.

3695-3740 Siltstone or fine sandstone, cream, limy cement, some chert, also varicolored silt and claystone.

3740-3745 Limestone, light cream, fine grained.

3745-3755 Siltstone, salmon and pink claystone.

3755-3760 Limestone, cream.

3760-3775 Amsden chert, brown, red brown, milky and grey, translucent in pink stained lithographic limestone.

3775-3780 Amsden scarlet to crimson chert with dull lavender papery lateritic shale.

3780-3795 Limestone, lithographic light grey, cherty.

3795-3800 Limestone same, partly fluorescent.

3800-3810 Lateritic silt and clay, dark salmon, lavender and purple, some fissile splinter shale, speckled green, interbeds of cherty limestone.

3810-3830 Mainly limestone, cherty, grey and pink.

3830-3865 Shale, dark purple, interbeds of dark grey

- 3865-3880 cherty limestone in upper part.
Shale, as above, with some unsorted coarse to fine etched sandstone, some shale, yellow brown to light green.
- 3880-3890 Sandstone, crimson to light grey, poorly sorted.
- 3890-3925 Laterite with some sandstone and sand, mainly clay, a little cherty limestone.
- 3925-3947 Grey limestone and pink sandstone relatively abundant in shaly laterite, considerable chert.
- 3947-4050 Madison limestone, cream, fine porcellaneous texture.
- 4050-4080 Limestone, light pink cream, some fairly coarsely prismatic, carries water, temperature 120° F., closed pressure 1700 pounds per square inch, flowing pressure 1600 pounds per square inch.

HARDING COUNTY.

STATE ROYALTY #1
State Royalty Petroleum Company
Martin and Manning, Drillers
100' NW of center, SW $\frac{1}{4}$ NE $\frac{1}{4}$
Sec. 35, T. 18 N., R. 1 E.
Altitude 3267.5'
Completed 1940

Some cuttings were not available when this record was published on pages 54 to 63 of Report of Investigations No. 57, Deep Borings of Western South Dakota, August, 1947. They have been found and are described below:

- 1270-1365 Eagle (?) sandstone.
2020 Top Niobrara marl.
2725-2755 Greenhorn limestone.
3080-3140 Graneros shale, flaky, nearly black.
3140-3200 Shale, nearly black with considerable light grey bentonite.
3200-3280 Shale, dark blue grey, fissile.
3280-3290 Bentonite, light greyish white.
3290-3320 Mowry shale, dark grey, bituminous, with small light grey bentonite spots.
3355-3450 Core: Mowry mudstone, hard, dense, dark blue grey, abundant fish scales, silty 3385-95'; volcanic ash, very fine grained, partly bentonized, light grey at 3405-15'; laminated greywacke 3415-25'; shale inter-laminae, some sandstone, medium grained, with volcanic ash matrix, interbedded with mudstone 3425-35'; angular grained, etched sand, gas bearing at 3432'; grey siltstone 3435-45'; grey bentonite and black bituminous mudstone with light grey siltstone at 3445-55'.
3425-3550 Newcastle (Muddy) sandstone and siltstone, light grey, with asphalt streaks 3510-20'; some fluorescent 3525-35'; gas bearing.
3550-3724 Skull Creek (Thermopolis) shale, dark blue grey, with much bentonite.
3724-3790 Cores: mudstone, dense, dark blue grey, partly laminated; at 3734-44' some light

yellow green bentonite with rounded biotite "books"; clay ironstone at 3764-74¹; yellow green bentonite with fine angular sand grains at 3774-84¹.

- 3790-3804 Cores: Dakota sandstone, light grey, fine grained, angular, partly recrystallized, with clay interbeds.
- 3804-3850 Sandstone.
- 3850-3860 Core: sandstone with plant remains.
- 3860-3875 Fuson clay with brown and nearly black iron manganese pellets.
- 3875-3880 Core: clay, nearly black, and sandstone, grey, fine grained, carbonized remains of plants.
- 3885 Sandstone, grey, muscovitic, some large angular, partly recrystallized grains.
- 3895-3900 Typical Fuson bentonitic clay, drab, streaked dark brown red, carbonaceous, iron manganese pellets in bentonite with thin fine sandstone layers.
- 3910-3920 Lakota sandstone, grey.
- 3920-3930 Sandstone, some coarse, angular, partly recrystallized, some fine, darker grey, with mudstone, dark grey.
- 3945-3970 Cores: sandstone, medium to coarse, brownish, shale, grey and grey-black interbeds; upper sandstone carbonaceous, lower with asphalt streaks in top; 3945-50¹, coarse angular unsorted sandstone, partly asphaltic. 3965-70¹, sandstone, coarse, angular, recrystallized, carbonaceous, light grey, porous, with some asphalt.
- 3990 Morrison bentonite, grey drab, purple spotted.
- 4112 Sandstone, coarse, greywacke, with some glauconite, base Morrison?
- 4130-4147 Sundance bentonite, light grey and tan, containing sand grains.
- 4147-4157 Core of sandstone, soft, fine angular, with cream bentonite matrix.
- 4160 Siltstone, light grey.
- 4180 Sandstone, glauconitic.
- 4190-4195 Core of sandstone, fine angular, light grey, bentonite matrix.
- 4200-4210 Siltstone and fine sandstone, glauconitic, with sandy bentonite.
- 4210 Sandstone, fine grained, light green, glauconitic.
- 4250 Clay, bentonitic, light green, with silty

bands, with some purplish clays.
4320-4330 Clay, bentonitic, light green, with silty
bands, with some purplish clays.
4350-4360 Same as above.
4360-4480 Sandstone, fine, light grey, with some coarse
grains, 4400-4450'.
4480-4510 Claystone, dark, with some siltstone and fine
sandstone below 4490'.
4510 Core: sandstone, fine grained, grey, with
small bits of glauconite.
4620-4630 Limestone, cream, very fine sugary, with
milky chert.
4630-4650 Shale, grey and green.

(Remainder of well described on pages 54 to
63 of Report of Investigations, Deep Bor-
ings of Western South Dakota, August, 1947.)

JACKSON COUNTY

CITY OF KADOKA

Sec. 32, T. 2 S., R. 22 E.

Altitude 2451'

Completed 1950

- 0-1280 Pierre bentonitic clay. INOCERAMUS prisms below 1100'.
- 1280-1550 Sharon Springs member, dark blue grey bituminous shale, laminated fish fragments.
- 1550-1680 Niobrara chalky marl, flattened, nearly white pellets in grey marl. More chalky 1620-1680'.
- 1680-2060 Carlile shale, at 1700' shows green drab swelling laminated bentonite, with chalk spots near top, dark blue grey. At 1800' becomes sufficiently compact to be flaky. Very fine mica particles in very fine clay, light grey bentonite, 1960-70', dark greenish drab greatly swelling bentonite at 2020'. Basal Carlile very dark blue grey (2040-2060'), compact, bituminous, with fish scales.
- 2060-2070 Greenhorn limestone interbedded with shale, INOCERAMUS prisms.
- 2070-2090 Greenhorn limestone.
- 2090-2347 Graneros shale, dark blue grey, dense. Bentonite 2120-2130'. Dark grey with many minute chalk spots (really chalky marl), partly laminated, bituminous. INOCERAMUS prisms. Much swelling dark green drab bentonite at 2220', some light grey bentonite at 2250', mostly drab bentonite 2260-2290', shale, blue grey firm, flaky, very finely laminated, 2290-2347'.
- 2347-2440 Dakota sandstone, light grey, angular grained, fine grained, carbonaceous, micaceous, partly recrystallized.
- 2440-2470 Fuson bentonite, various shades grey, carbonaceous, especially in light drab bentonitic clay.
- 2470-2500 Sandstone, light grey, medium and angular grained, recrystallized, carbonaceous.
- 2500-2520 Shale, dark grey.

2520 Manganese-iron pellets in bentonite, pellets abundant at 2555'. Sandstone, as at 2470-2500'.

2560-2640 Lakota sandstone, coarser and more permeable than Dakota. Recrystallized, fairly coarse, angular grained, poorly sorted, etched.

2660-2680 Back in fine grained light grey sandstone, with dark grey fissile thinly foliated shale, splintery, with dark drab bentonite.

2670-2855 Mostly shale, dark slate grey, splintery, finely laminated, apparently has INOCERAMUS prisms, with green grey bentonite, 2680-2705', green drab bentonite 2825-30' is finer textured. Of course these may be cavings.

2855-2875 Sandstone, fine grained recrystallized. Largely or mostly siltstone, light grey carbonaceous, some has light blue green micaceous bentonite matrix.

2875-2880 Bentonite, light grey, flakes of biotite.

2880-2900 Siltstone and sandstone, as at 2855-2875'.

2900-2910 Mostly shale, dark blue slate grey.

2910-2965 Siltstone and fine sandstone, perhaps with some interbedded shale (mud pit full of cuttings).

2965 T. D.

Water Analysis
by Charles Bentley
State School of Mines and Technology
Depth, 2555-2640 feet.

Values in parts per million:

Sodium chloride, (NaCl)	112.0	Silicon dioxide, (SiO ₂)	26.0
Sodium sulphate, (Na ₂ SO ₄)	1467.0	Volatile and Organic	2.6
Sodium carbonate, (Na ₂ CO ₃)	98.1	Total solids	1788.0
Iron and Aluminum Oxides	6.0	Total hardness	150.2
Magnesium carbonate, (MgCO ₃)	43.9	pH	8.1

LAWRENCE COUNTY

WEISMAN No. 1

F. J. Weller

Morton Drilling Company

990' N. and 330' E. from SW. corner

SE. $\frac{1}{4}$ Sec. 30, T. 7 N., R. 4 E.

Altitude 3680'

Completed October 25, 1950

- 0- 70 Debris of Dakota sandstone, some white alabaster, some Fuson grey bentonitic clay and silt, carbonaceous. The Dakota is siltstone to fine angular grained sandstone with both biotite and muscovite.
- 70- 160 Lakota sandstone, coarser, carbonaceous, medium angular grained, with muscovite and some siderite and sulphide cement.
- 160- 180 Morrison bentonite, light grey, silty.
- 180- 200 Bentonite, darker grey.
- 200- 230 Bentonite, light grey.
- 230- 250 Silt, bentonitic, light butternut brown.
- 250- 280 Silt, cream, bentonitic matrix, some fine blue tuff breccia, some with fine sand grains, partly with brown interbeds.
- 280- 290 Bentonite, light dull green.
- 290- 300 Bentonite, largely blue grey.
- 300- 320 Silt, bentonitic, light grey.
- 320- 350 Sandstone, bentonitic, light grey, fine grained.
- 350- 360 Claystone, slate grey.
- 360- 380 Claystone, some purple.
- 380- 400 Sand, buff, coarse, etched, angular to sub-round, some iron oxide cement.
- 400- 405 Bentonite, light grey to dark slaty grey and lavender.
- 405- 410 Silt, bentonitic, light green grey.
- 410- 415 Bentonite, light green grey, in part silty.
- 415- 435 Silt, light grey, quite limy, some purplish, light greenish in lower part.
- 435- 450 Silt, light grey green.
- 450- 455 Sand, light grey, with bentonite matrix, fine grained.
- 455- 465 Sundance sandstone, with sparse glauconite, fine, light grey, some bentonite in matrix, some siltstone, oyster shell.
- 465- 490 Siltstone, light grey, glauconitic, clayey, muscovitic, bentonitic.
- 490- 495 Siltstone, limy, glauconitic, fossiliferous.

495- 500	Sandstone, fine grained, light grey, glauconitic.
500- 505	Limestone, very silty, light green, with glauconitic clay.
505- 510	Siltstone, limy, light green grey micaceous, interbedded with sandstone, fine glauconite.
510- 525	Sandstone, fine glauconitic, light green grey, thin bentonite films.
525- 530	Mainly siltstone, grey.
530- 560	Siltstone, bentonitic, glauconitic, micaceous, light green.
560	Sandstone, fine light grey green, glauconitic.
560- 565	Siltstone, red brown.
565- 570	Bentonite, flaky, dark slate grey, micaceous.
570- 575	Bentonite, light butternut brown, silty, with dark grey interbeds.
575- 585	Bentonite, dark grey, silty.
585- 590	Bentonite, dark grey, brown and purplish.
590- 610	Bentonite, dark grey, flaky, in part silty.
610- 615	Siltstone, light green grey, glauconitic.
615- 620	Siltstone, brown, bentonitic.
620- 630	Sandstone, light green grey, fine grained, glauconitic.
630- 635	Siltstone, light green grey, bentonitic, glauconitic, in part fine sandstone.
635- 645	With considerable bentonite, PACHYTEUTHIS.
645- 660	Siltstone, light grey green to grey, bentonite matrix.
660- 680	Siltstone, light grey green to grey, bentonite matrix, glauconitic fine sandstone and clay interbeds.
680- 730	Terra cotta zone, siltstone, dull reddish brown, some grey interbeds.
730- 800	Siltstone to fine sandstone, light grey green, angular grains, rare glauconite, micaceous, with thin clay interbeds.
800- 820	Clay, bentonitic, flaky, grey green.
820- 840	Siltstone, bentonitic cement, light green, micaceous.
840- 870	A little reddish clay, mainly light green grey with interbedded siltstone.
870- 890	<u>Spearfish</u> siltstone, dark salmon.
890- 900	<u>Spearfish</u> siltstone, dark salmon, with alabaster.
900- 910	Anhydrite, white.
910-1140	Siltstone, bright salmon, micaceous, some small patches alabaster, also light green grey spots, texture varies from clay to fine sand.
1140-1160	Claystone with satin spar.
1160-1180	Siltstone and claystone, bright salmon.

1180-1190 Anhydrite, pink.
 1190-1200 Siltstone and claystone.
 1205-1220 Siltstone and claystone, bright salmon
 1220-1265 Anhydrite.
 1265-1285 Siltstone, light salmon, anhydrite spots,
 some clay.
 1285-1290 Alabaster
 1290-1310 Claystone.
 1310-1400 Siltstone, bright salmon

 1400-1410 Minnekahta anhydrite, cream to light brown.
 1410-1445 Limestone, light brown, fine dense, very
 bituminous, dried black oil in fractures.

 1445 Opeche top siltstone reduced to green ferrous
 iron either by H₂S or organic matter.
 1445-1455 $\frac{1}{2}$ Core Opeche siltstone, dark purple, except
 top which is reduced to green, somewhat limy,
 micaceous.
 1455-1495 Siltstone, light salmon.
 1495-1510 Alabaster and anhydrite.
 1510-1520 Siltstone and claystone, salmon.
 1520-1530 Claystone, dull dark red, with gypsum.
 1530-1562 Claystone, salmon.

 1562-1574 Minnelusa siltstone to sandstone, light brown
 grey, limy.
 1574-1580 Sandstone, grey, small irregularly cemented
 aggregates, medium grained, yellow below,
 with pink tinge, angular etched - "cornmeal"
 rock.
 1580-1585 Same, pink.
 1585-1590 Same, dark reddish brown.
 1590-1605 Same, lighter brown to pink.
 1605-1645 Limestone, light pink grey, dense, porcel-
 laneous, milky chert; becomes brittle and
 magnesian near base.
 1645-1700 Sandstone, pink cream, porous, rhombohedral
 and scalenohedral calcite, unsorted, etched,
 angular grains, partly recrystallized, finer
 at base.
 1700 A little anhydrite.
 1700-1740 Sandstone, pink, fine grained, limy cement.
 1740-1750 Sandstone, and siltstone, dark red.
 1750-1760 Sandstone, light pink, very limy.
 1760-1785 Limestone, light pink, very silty.
 1785-1790 Siltstone, bright red.
 1790-1795 Limestone, sandy, light pink.
 1795-1815 Sandstone, limy, light pink, angular, fine
 grained.
 1815-1825 Limestone, cream pink, sugary, vuggy.
 1825-1835 Sandstone, limy, subround, medium grained,
 etched, pink.

1835-1845 Dolomite, pink, powdery texture
 1845-1865 Sandstone, angular, medium grained, pink, limy.
 1865-1870 Dolomite, light pink, fine dense texture.
 1870-1885 Sandstone, fine grained, very dolomitic, light pink.
 1885-1890 Sandstone with some anhydrite.
 1890-1910 Sandstone, light pink, porous, medium angular, limy cement.
 1910-1920 Dolomite, cream buff, very dense, porcellaneous.
 1920-1925 Dolomite, light brown.
 1925-1930 Limestone, magnesian, dense, lavender.
 1930-1940 Dolomite, cream, dense, porcellaneous, with fine scattered sandgrains, pink stained.
 1940-1985 Dolomite as above, but no sand, possibly with sandstone interbeds.
 1985-2015 Dolomite, yellow stained in part, some chert.
 2015-2025 Red marker (?), shale, dark purplish red, finely fissile.
 2025-2035 Limestone, partly magnesian, pink to lavender, but mostly fine powdery textured limestone.
 2035-2060 Limestone, magnesian, pink cream, fine sugary, porcellaneous.
 2060-2090 Limestone, magnesian, with milky chert.
 2090-2095 Limestone, dolomitic and non-dolomitic, pink cream, porcellaneous.
 2095-2115 Limestone, cream.
 2115-2135 Limestone, cream, altered oolitic, milky chert.
 2135-2150 Limestone, light dove grey, dull, dense, silty, magnesian.
 2150-2180 Limestone, pink cream, some laterite, dull, corroded.
 2180-2185 Limestone, pink cream, in fine crystals.
 2185-2210 Laterite zone, silty clay, red, and limestone, vuggy, brown and yellow.
 2210-2225 Madison dolomite, cream brown, rhombic crystals.
 2225-2255 Dolomite, cream, rhombic, vuggy, large rhombs in finer matrix.
 2255-2260 Dolomite, altered oolitic, cream, porous, some larger rhombs.
 2260-2280 Dolomite, well crystallized, vuggy, cream, with pink tinge.
 2280-2295 Marble, fairly coarse rhombic, cream, vuggy.
 2295-2320 Finer and denser crystals of dolomite.
 2320-2380 Coarser and vuggy, brown cream.

- 2380-2390 As above, but pink to lavender stained.
 2390-2410 Dolomite, grey with pink tinge, finely crystalline, clayey.
- 2410-2415 Limestone, fairly coarsely crystalline, light pink grey.
- 2415-2445 Dolomite, yellow brown, very cavernous, rhombic, fairly large crystals.
- 2445-2465 Dolomite, light pink grey, vuggy, well crystallized.
- 2460-2470 Limestone, brown cream, fine powdery matrix of small rhombs, vuggy, becomes magnesian downwards.
- 2470-2545 Dolomite, brown cream, porous fine crystalline, buff cream below.
- 2545-2550 Oxidized zone, red and dark brown iron oxide cementing fine angular sand.
- 2550-2560 Dolomite, with fine pores, cream buff, crystalline, also limestone.
- 2560-2585 Mainly limestone, mixed with dolomite (latter cavernous).
- 2585-2605 Limestone, altered oolitic, cream buff, fine grained, with scattered small rhombs in powdery matrix near base.
- 2605-2650 Dolomite, cream.
- 2650-2680 Englewood siltstone, dolomitic, dull purple, some magnesian limestone.
- 2680-2700 Siltstone, very dark purple brown, dolomite cement.
- 2700-2705 Whitewood limestone, light pink to yellow, vuggy, some rather coarse sandstone.
- 2705-2710 Dolomite, light yellow cream, finely crystalline, cavernous.
- 2710-2715 Dolomite, pink, finely crystalline, cavernous.
- 2715-2780 Dolomite, light yellow cream, finely crystalline, cavernous, some pink.
- 2780-2830 Same, with considerable secondary calcite.
- 2830-2850 Dolomite, pink.
- 2850-2860 Siltstone, to fine sandstone, dolomite cement, grey.
- 2860-2865 Same, with black manganese dioxide and some coarse sand.
- 2865-2895 Sandstone, fine silty, light grey.
- 2895-2900 Same, light green grey.
- 2900-2968 Black River, shale, bentonitic, fissile, green and grey green, some brick red with small sand grains at top, where silty, black GRAPTOLITE fragments in unctuous shale and small black phosphate nodules. Dark blue grey and darker green with sand

grains at base.

- 2968-3015 St. Peter sandstone, subround grains, all sizes, etched. Pyrite and marcasite cemented at top, some oxidized. In part cemented with lime but apparently quite porous. Becomes pink spotted below, interstitial calcite rhombs and red clay.
- 3015-3030 Deadwood sandstone, finer and more angular grained, oxidized purplish red from glauconite, considerable clay (bentonite-like) matrix. Sand grains partly recrystallized.
- 3030-3040 Sandstone, pink, fine, clayey, partly recrystallized, rare glauconite.
- 3040-3055 Sandstone, green grey, glauconitic, finer, angular grains, limy cement, clayey, some dolomite, less permeable than that above.
- 3055-3065 Dolomite, green grey, glauconitic, in parts silty to sandy, well crystallized.
- 3065-3080 Same, in part stained pink.
- 3080-3143 Total depth, same, not oxidized, some thin grey siltstone laminae, some coarse angular grained sandstone, TRILOBITE moults.

LINCOLN COUNTY

CITY OF CANTON
Omaha Drilling Company
Completed August, 1950

- 0- 20 Gravel, bird seed size, quartz, orthoclase, albite, granite, schist, pegmatite, dolomite, chert, largely angular, some quartz rounded. No Sioux quartzite.
- 20- 85 No samples.
- 85- 100 Gravel, averaging pea size, subangular, one fragment Sioux quartzite 95-100'.
- 100- 205 Carlile clay, dark slate grey, bentonite, very fine sericite, small limy spots, fish remains INOCERAMUS prisms.
- 205- 210 Marl, white spotted dark grey, very limy.
- 210- 265 Greenhorn limestone, dark grey, GLOBIGERINA, INOCERAMUS prisms, fish remains, fluorescent, largely a breccia of INOCERAMUS prisms.
- 265- 280 Heavy marcasite zone, oily shale reported at 266'.
- 280- 285 Marl, white spotted limy.
- 285- 305 Sandstone, light brown grey, unsorted, some arkosic, coarse, angular.
- 305- 310 Sandstone, finer grained, some glauconite and wood, light brown limy cement.
- 310- 370 Graneros siltstone, light brown.
- 370- 395 Graneros siltstone, hard, micaceous, some has limy cement.
- 395- 405 (?) sand, medium.
- 405- 408 Shale, dark slate grey.
- 408- 448 Dakota sand, etched, angular, fine grained, buff, well sorted, some rounded grains, a few Sioux quartzite grains, some polished grains a little coarser, becoming medium grained at base.
Total depth, 448' 7".

LINCOLN COUNTY

CITY OF WORTHING
Omaha Drilling Company
Altitude 1360'
Completed August 3, 1950

- 20- 143 Gravel and sand, fine, quartz, chert, dolomite, granite, Sioux quartzite, feldspar, INOCERAMUS prisms.
- 143- 365 Carlile clay, dark grey, practically all fragments from drift.
145-148, considerable microfauna, pyritized and calcitized.
280-285, Niobrara chalk boulder in drift (?), a little brown peat 245-250.
- 365- 415 Greenhorn limestone, dark grey, partly spotted marl, INOCERAMUS prisms and GLOBIGERINA, some hauerite and iron sulphides and bornite, fluorescent, reported oil-bearing, sandy at base.
- 415- 455 Dakota sandstone, brown clay ironstone cement, fine grained, angular (sphaeroiderite), cement in part.
- 455- 465 Sand, coarse, some large grains rounded and etched, large amount angular and subangular, practically all etched.
- 479 Total depth.

At 247-270' reported black oily petroliferous shale, with bright rainbow play of colors when samples were washed in water.

Kirby, driller, gives Greenhorn 235-270'

Dakota 463-471'

LYMAN COUNTY

BURKHARDT No. 2
Red Butte Oil Company
Fred C. Summers, Contractor
330' N. and 900' W. of SE. $\frac{1}{4}$ SE. $\frac{1}{4}$
Sec. 6, T. 104 N., R. 74 W.
Altitude 1779'
Completed July 12, 1949

- 0- 280 No cuttings, Pierre.
- 280- 290 Pierre, bentonitic slaking clay, medium blue grey, with silt and limy concretions.
- 300- 310 Same, with selenite and INOCERAMUS prisms. Cavings (?) of dark grey Virgin Creek (?) shale.
- 310- 500 Clay, bentonitic, dark blue grey.
- 500- 590 Niobrara chalk-white spotted light grey marl at top.
- 590- 700 Niobrara chalk.
- 700- 710 Silt, abundant marcasite, very minute light brown concretions.
- 710- 780 Carlile marcasite, hauerite, white milky gypsum, calcite, some coarse quartz sand, subround, light and dark blue grey clay, largely cavings.
- 780- 850 Codell sandstone, fine grained, angular, bentonite matrix, poorly sorted, grey.
- 850- 900 Carlile clay, silty, muscovitic, dark blue grey.
- 900- 920 Sandstone, grey, fine grained, bentonitic, muscovitic, INOCERAMUS prisms, fish remains, a little light green glauconite, white chalky spots.
- 920- 950 Greenhorn limestone, sandy, INOCERAMUS prisms, fish remains, grey.
- 950- 990 Sandstone, as at 900-920', clayey, with selenite, some coarser grains, with Graneros clay, dark blue grey.
- 990-1060 Newcastle (?) sandstone, grey, fine grained angular, with clay interlaminae, dark grey, some fairly coarse angular sandstone, calcite cemented, fairly dark grey, polished grains, much caving.

- 1060-1080 Sandstone, finer grained.
 1080-1100 Much marcasite.
- 1110-1240 Dakota sandstone, medium to coarse, angular, poorly sorted, much marcasite cement, muscovitic, contains some grains from Sioux quartzite, grey bentonite 1150-60', dark grey clay 1170-80', marcasite and hauerite 1180-1230', abundant pyrite 1240', may be partly at least caving.
- 1240-1280 Sandstone, very light grey, averages medium grained, angular, limy cement.
- 1280-1300 Same, more porous, irregularly cemented, somewhat nodular.
- 1300-1305 Much marcasite.
- 1305-1370 Sandstone, very light grey, some grains from Sioux quartzite.
- 1370-1390 Perhaps some shale, dark grey, and sandstone, as above.
- 1390-1400 Some light grey spotted bentonite, considerable coarse sand, some angular.
- 1400-1445 Fuson manganese bearing pellets in bentonite, sandy at 1430-40'.
- 1445-1450 Sandstone, brown, somewhat limy, and limestone, fine grained brown.
- 1450-1520 Shale dark grey, with silt laminae, siltier at base.
- 1520-1550 Lakota sandstone, coarse angular, medium grey, partly recrystallized, permeable, brown matrix below, some grains from Sioux quartzite, brown limy matrix 1540-1550'.
- 1550-1570 No cuttings, drill pipe stuck.
- 1570-1630 Largely cavings with much dark grey fissile shale.
- 1630 Sandstone, fine grained, grey, bentonite matrix.
- 1635-1665 Sandstone, fine grained, light grey, still cavings.
- 1665-1680 Increase in sand.
- 1680-1690 Considerable blue grey bentonite.
- 1715 Circulated, sand, all size grains.
- 1710-1745 Sandstone, brown, bentonite matrix, fine grained, grey near base.
- 1745-1778 Conglomerate, small pebbles of Sioux quartzite and transparent and milky vein quartz, angular to subround.
- 1778-1800 Sioux quartzite with light brown vuggy chert or very finely crystalline quartz (residual duricrust (?)) at top.

From 1550 to 1778' there is possibility of some Jurassic, but cuttings are mostly cavings, appearing to be material from higher up the hole.

2504

Drilled quartzite.
Total depth.

MEADE COUNTY

KUCERA-GINGRAS No. 1

E. B. Kucera et al
B & D Drilling Company
300' N. and 200' W. of SE $\frac{1}{4}$ NW $\frac{1}{4}$
of Sec. 19, T. 3 N., R. 7 W
Altitude about 3600'
Completed July 31, 1949

0-	20	<u>Sundance</u> clay, very bentonitic, green grey, with thin interbeds of light grey limestone.
20-	25	Clay as above, sandstone, light grey, brown and pink, unsorted grains, a little alabaster, some large etched sand grains, fossiliferous.
25-	35	Bentonite, green grey and light brown grey, siltstone, light grey, PACHYTEUTHIS, glauconitic, other fossils.
35-	40	Clay, silty, bentonite light brown and light blue grey, gypsum.
40-	50	Bentonite, light brown and blue grey, fossils, some grey very fine glauconitic sandstone, "golf ball" pyritic fossil. Fine black carbonaceous specks.
50-	55	Sandstone, grey, much glauconite, fine angular grains, satin spar gypsum.
55-	60	Bentonite, grey, silty glauconitic, some of it light yellow brown.
60-	65	Sand, fine grained, light grey, etched grains, glauconitic, largely angular, bentonite matrix.
65-	70	Sand purer a little coarser, angular with glauconite.
70-	80	Sand as above, still fine grained, bentonitic.
80-	90	Sandstone, finer glauconitic, bentonite matrix, with bentonitic silt and clay, grey.
90-	95	Mostly bentonite, as above.
95-	100	Sand, fine, light grey, glauconite and bentonite, selenite.
100-	105	PACHYTEUTHIS, about same as above, carbonaceous light grey bentonite, "golf ball".
105-	110	Bentonite, grey and drab and fine glauconitic sandstone.
110-	125	Sandstone, light grey, fine grained glauconitic, bentonite grey, PACHYTEUTHIS.
125-	135	Sandstone, light brown glauconitic, fine grained, bentonite, light blue grey.
135-	145	Sandstone light grey, fine grained, and bentonite, light grey, a little glauconite, PACHYTEUTHIS.

145- 150	Sandstone, dull salmon, fine grained, a little terra cotta bentonite, top of terra cotta 142'.
150- 170	Bentonite, terra cotta, silty, and sandstone, dull salmon, fine grained PACHYTEUTHIS.
170- 175	Same with a little light grey very fine grained limestone.
175- 195	Sandstone, salmon fine grained and clay, terra cotta or chocolate, PACHYTEUTHIS.
195- 210	Sandstone, salmon, fine grained with secondary quartz, PACHYTEUTHIS, secondary calcite.
210- 215	Sandstone, very fine grained, light green grey, glauconitic, bentonite matrix.
215- 252	Same with light blue grey bentonite, PACHYTEUTHIS, PENTACRINUS ASTERISCUS, both interbedded.
252- 257	Siltstone, dark salmon, anhydrite and satin spar.
257- 271	Sandstone and bentonite as above 252', PACHYTEUTHIS, mostly siltstone, PENTACRINUS ASTERISCUS 268'.
271- 290	Clay bentonitic, light grey, PENTACRINUS and PACHYTEUTHIS, gas at 277'.
290- 295	Same with dark pink (mauve) clay, not much siltstone.
295- 306	Same with a little alabaster, PACHYTEUTHIS.
306- 339	<u>Spearfish</u> siltstone, salmon; at 324' salmon becomes predominate, white splotches.
339- 395	Siltstone, darker and finer grained becomes duller and lighter below, gas at 380'.
395- 410	Clay, salmon, with a little anhydrite.
415- 437	Siltstone, dark salmon.
437- 516	Clay, dark salmon, a little gypsum and anhydrite.
516- 532	Anhydrite, light brown.
532- 537	Anhydrite light brown and clay, dark salmon.
537- 542	Mostly anhydrite.
547- 553	Clay, dark red and anhydrite.

Second Hole

485- 490	Siltstone and clay, dark salmon, anhydrite and satin spar, white.
550- 565	Siltstone, dark salmon, anhydrite and satin spar, some sand grains in siltstone.
565- 575	Mostly anhydrite.
575- 580	Clay and siltstone, dark salmon, anhydrite and gypsum, gas show 578'.
580- 590	Large amount gypsum, weathered looking, opaque white, possible gas horizon.

- 590- 605 Mostly siltstone and clay, some white opaque gypsum, some anhydrite, some fine sandstone.
- 605- 610 Anhydrite in clay and silt.
- 610- 625 Increase in anhydrite, still much gypsum (satin spar).
- 625- 743 Siltstone, some clay, with anhydrite, gypsum, oil showing 676-693.
- 743- 748 A little fine-grained sandstone.
- 760- 765 Mostly siltstone, dark salmon.
- 765- 770 Minnekahta, some limestone.
- 770- 825 Limestone, cream to pink to dense vitreous, some secondary calcite, coarser crystalline 812', oil stain 818-823-825' at base.
- 825- 838 Opeche siltstone, clayey, dull dark brown red, some mauve to purple.
- 838- 843 A little milky chert.
- 848- 859 Some gypsum and anhydrite, mostly dark red siltstone, no purple.
- 859 Increase in anhydrite and gypsum, clayey siltstone, dark red.
- 885- 890 Some limestone, like Minnekahta.
- 900
- 900- 910 Clay and siltstone, dark brown red, gypsum rarity.
- 910 Limestone like Minnekahta, top of Minnelusa 912'.
- 915- 930 Minnelusa, considerable round and subround large etched quartz grains, probably at base of Opeche, usual clay and siltstone, anhydrite and gypsum 925-930'.
- 930- 940 Siltstone and clay, dark salmon, anhydrite and gypsum, mostly claystone.
- 940- 945 Increase in sand, large grains, rounded and etched.
- 945- 950 Much mauve sand, all sized grains, rounded, etched sandstone, 20'.
- 950- 977 Dolomite, cream, very fine grained, better called magnesian limestone, drills flaky, a few small vugs in lower part, where it is pink silty (967' down), some red clay below 972'.
- 977- 987 Some milky chert, limestone becomes lavender and is limestone.
- 987- 992 Much calcite in lavender crystalline limestone.
- 992- 997 Sandstone, quite fine grained, dark dull orange, limy cement pink, peculiar color.
- 997-1022 Some sandstone, clay and sandstone, dark brown red, gypsum, grains angular, may be fresh water, 100% saturation but low

	resistivity, sand per cent increases downward, some pink milky chert below 1012'.
1022-1064	Increase in dark brown red clay and siltstone (caving?), chert continues, secondary quartz crystals below 1029', some anhydrite.
1064-1089	Soft to very soft, good oil and gas, sandstone largely brown yellow, rest buff, larger grains marked and etched below 1080', calcite.
1089-1101	Increase in silt and clay, pink sandstone.
1101-1106	Mainly clay, dark brown red, silty.
1106-1111	Considerable anhydrite and gypsum in red clastics.
1111-1116	Sandstone, fine grained, brown yellow to pink and buff, pink limestone, limy cement.
1116-1142	Sandstone, fine grained, brown yellow to pink and buff, pink limestone, limy cement.
1142-1157 $\frac{1}{2}$	Sandstone, fine grained, pink, limy cement, much calcite.
1157 $\frac{1}{2}$ -1168	Clay, siltstone, sandstone, anhydrite, soft 1162-1168'.
1168-1183	Limestone, magnesian, porous, fine grained, pink, some sandstone?.
1183-1188 $\frac{1}{2}$	Limestone, magnesian, sandy.
1188 $\frac{1}{2}$ -1198 $\frac{1}{2}$	Silty claystone, dark dull brown red and pink sandstone.
1198 $\frac{1}{2}$ -1209	Limestone, magnesian, porous fine grained pink.
1209-1219	Sandstone, fine grained, pink limy cement (limestone and clay as above).
1219-1224	Miscellaneous.
1224-1229 $\frac{1}{2}$	Claystone or shale, somewhat fissile, mauve to purple.
1229 $\frac{1}{2}$ -1234 $\frac{1}{2}$	Sandstone, pink.
1234 $\frac{1}{2}$ -1274 $\frac{1}{2}$	Limestone, pink to cream, porous.
1274 $\frac{1}{2}$ -1291	Mostly silt and claystone.
1291-1321	Sandstone, light pink, fine grained, limy cement.
1321-1347 $\frac{1}{2}$	Limestone, dolomitic, dense, light pink, sandy and sandstone, porous, stylolites.
1347 $\frac{1}{2}$ -1368	Sandstone, very limy, pink, fine grained.

MEADE COUNTY

KUCERA-GINGRAS No. 2

E. B. Kucera et al

B & D Drilling company

660' S & 230' E of N corner SW $\frac{1}{4}$ NE $\frac{1}{4}$
of Sec. 19, T. 3 N., R. 7 E.

Altitude 3665'

Completed May 25, 1950

- 0- 35 Sundance clay, bentonitic, weathered to brown green (olive drab), with considerable fine angular grained thin bedded glauconitic sandstone, some gypsum rosettes and siltstone, PACHYTEUTHIS, PENTACRINUS, ASTERISCUS and fragments of OSTREA, all of which continue to base of Sundance, practically all of the Sundance caves badly.
- 35- 140 Silt, glauconitic and bentonitic, light grey, small specks of glauconite.
- 140- 140 Gas in sand, fine, silty, light brown.
- 140- 160 Siltstone and clay, bentonitic, grey.
- 160- 232 Siltstone, terra cotta brown (reddish brown), with calcite in vugs.
- 232- 242 Siltstone, interbedded with bentonitic light grey clay.
- 242- 263 Sandstone, fine grained, light grey angular, with white bentonite matrix, shell fragments.
- 263- 268 Sandstone with interlaminae of bentonitic clay.
- 268- 278 Clay, bentonitic, green grey, silty in part.
- 278- 309 Siltstone, grey.
- 309- 314 Spearfish, weathered top brown silty sandstone with grains of all sizes.
- 314- 319 Siltstone, clayey, terra cotta brown, with anhydrite changed partly to selenite and satinspar.
- 319- 329 Anhydrite, cream to light grey.
- 329- 397 Siltstone, dark salmon (brown red) and anhydrite. Gas at 340'.
- 397- 402 Anhydrite, gas at 402'.
- 402- 525 Siltstone and mudstone, dark salmon, gypsum 418-428'.
- 525- 539 More gypsum in dark salmon mudstone (salt clay?).
- 539- 547 Alabaster gypsum.
- 547- 640 Siltstone, dark salmon, with some gypsum below 565' and anhydrite interbeds below 600'.
- 640- 798 Siltstone and mudstone,

dark salmon, containing anhydrite crystals.
Gas at 755'.

- 798- 862 $\frac{1}{2}$ Minnekahta limestone, pink to grey, very fine dense powdery texture, calcite veined, good gas show at base. Very likely carries water.
- 862 $\frac{1}{2}$ - 870 Opeche siltstone, dark salmon.
870- 896 Anhydrite with secondary satin spar and some siltstone.
896- 901 Limestone, like Minnekahta, light brown grey.
901- 911 Limestone with anhydrite and satin spar.
911- 926 Mainly anhydrite, red and grey, brecciated.
926- 946 Anhydrite and red siltstone.
946- 963 $\frac{1}{2}$ Some sandstone, all sized grains, dark salmon, limy cement, angular to subround, large grains etched. May be top of Minnelusa.
- 963 $\frac{1}{2}$ - 973 Anhydrite, sandstone and siltstone, dark salmon, casing cemented at 963'.
- 973- 978 Minnelusa sand, medium, subround and sub-angular, orange etched. Yielded upon bailing test 20 gal. water per hour.
978- 983 Tar (?) sand.
983- 986 Limestone, cream, fine, powdery.
986- 988 $\frac{1}{2}$ Limestone, brown grey, fine, powdery, silty.
988 $\frac{1}{2}$ (Bailings from bottom) largely brecciated anhydrite and vein selenite.
988 $\frac{1}{2}$ - 998 $\frac{1}{2}$ (After water test) limestone as above, silty, pink stained, finely granular.
998 $\frac{1}{2}$ -1003 $\frac{1}{2}$ Limestone, rose pink and cream. Practically all Minnelusa below this has a rose pink tint.
- 1003 $\frac{1}{2}$ -1014 Some limestone with milky chert.
1014-1045 Sandstone, fine grained, pink and siltstone, likely interbeds of limestone, limy cement, milky white chert.
- 1045-1065 Core, 6' recovery, in descending order comprises:
(1) Limestone, light grey, porcellaneous, quadrangular cracked.
(2) Fault breccia, 8" angular fragments of light grey pink limestone, some angular salmon sandstone, purplish calcite, some purple clayey sandstone.
(3) Sandstone, pink salmon, fine grained, 8".
(4) Limestone fault breccia, light grey, cemented, 8".

- (5) Limestone, light grey and breccia, in part vuggy cement, in part finely crystalline dark red calcite, 6".
- (6) Some dark red brown siltstone.
- (7) Sandstone, pink, somewhat fractured, fine grained, thin calcite veins, inclined contorted bedding at top 2'.
- 1065-1070 Same as above.
- 1070-1076 Sandstone, rose, finer grained, limey cement, larger amount of vein calcite, some milky chert. Gas at 1072'.
- 1076-1101½ Sandstone, light yellow, fluorescent, medium and fine grained, larger grains subround and etched, much vein calcite, becomes cream buff below.
- 1101½-1106 Sandstone, yellowish and lavender, sub-angular grains, a little purplish siltstone.
- 1106½-1117 Sandstone, rose pink to purplish etched, limy cement.
- 1117-1127 Limestone and sandstone, rose pink, mainly sandstone with limy cement.
- 1127-1132 Sandstone, as above except some yellow, milky chert.
- 1132-1168½ Sandstone, rose pink, medium subround grains with chert. Gas at 1135'.
- 1168½-1178½ More limestone, rose pink, cherty with sandstone interbeds.
- 1178½-1193½ Mainly sandstone, rose pink, fine grained, limy cement.
- 1193½-1208½ Limestone, dark rose pink or lavender and light grey, fine to granular, much sand.
- 1208½-1225 Shale, fissile, dull purple, and limestone, old rose, also sand, very fine muscovitic, a little yellow and pink shale.
- 1225-1240½ Sandstone, rose pink, fine to medium, angular, limy, poor sorting, some porosity.
- 1240½-1256 Red marker, shale, limy, lavender to dull purple or maroon, a little drab and green, fissile.
- 1256-1290 Limestone, magnesian, silty, fine granular, pink grey, some milky chert and sandstone.
- 1290-1296 Sandstone, fine grained.
- 1296-1302 Limestone, light pink grey, dull maroon and purple.
- 1302-1317 Shale, like red marker above with some light grey sandstone
- 1317-1348 Mostly sand, pink grey, limy cement, milky chert.
- 1348-1369 Limestone, light pink grey, fine powdery, vuggy, sandy in part.
- 1369-1374 Sandstone, limy cement, pink grey.
- 1374-1379 Limestone, dolomitic, light pink grey, fine powdery.

1379-1394	Sandstone, pink grey, fine angular, magnesian limestone cement. Light <u>oil</u> 1391'.
1394-1399	Shale purplish, chert blue and limestone, pink grey, fine granular.
1399-1404	Dolomite, very fine grained, very light greenish grey.
1404-1409	Sandstone, light pink grey, fine angular, dolomitic cement.
1409-1420	Dolomite, light pink grey, and sandstone, as above.
1420-1450 $\frac{1}{2}$	Dolomite, pink cream, porous, finely angular, becomes coarse and sandier below.
1450 $\frac{1}{2}$ -1476	Dolomite, light pink grey, fine porcellaneous.
1476-1505	Dolomite with milky chert and dull purplish clay, some green grey, very small crystals steel grey marcasite and pyrite. 10th and strongest <u>gas</u> at 1497'.
1505-1532	Dolomite, pink cream, fairly coarsely crystalline, fairly porous.
1532-1584	Dolomite, porcellaneous texture, largely yellow brown, some chert fluoresces at 1560-1568 $\frac{1}{2}$ ', <u>oil</u> show 1571'.
1584-1595	Clay, light green grey with minute marcasite crystals, some purple clay. A little medium grained sandstone (laterite zone) more sandstone at base. Fluorescent 1585-1590'.
1595-1657	<u>Madison</u> , dolomite, cream, well crystallized, porous, good show <u>gas</u> 1626-1631', core 1641-1647' fractured and somewhat corroded but not veined. Carries water in lower part, rising to within 6 $\frac{1}{2}$ ' of surface. Gas has distillate or condensate.
1657-1667	Dolomite, finer crystalline, cream and light brown grey. Powdery textured and greyer below.
1667-1682	Limestone, magnesian, light grey, porcellaneous dull.
1682-1708	Limestone, magnesian, cream, porous, coarser below. May carry water.
1708-1729	Dolomite, light grey, finer powdery, dull.
1729-1734	Dolomite, buff.
1734-1759	Limestone, pinkish, partly porous, silty.
1759-1780	Limestone, yellow buff, some fluorescent, somewhat vesicular, finely crystalline.
1780-1795	Limestone, light brown, well crystallized, partly porous.
1795-1805	Limestone, magnesian, light pink grey, porcellaneous, porous.
1805-1816	Limestone, magnesian, light grey.

1816-1867	Dolomite, light brown, finer crystals, coarser below, porous.
1867-1892	Dolomite, light brown, with some fine white powdery limestone filling vugs. Good <u>gas</u> at 1874'.
1892-1932 $\frac{1}{2}$	Dolomite, yellow cream, some tinged with pink, well crystallized, vuggy.
1932 $\frac{1}{2}$ -1975	<u>Englewood</u> dolomite, dark dull lavender streaks alternating with dull grey, silty. Core from 1940 to 1948 $\frac{1}{2}$ ' mottled grey and dark lavender showing considerable dip, some calcite geodes and dull earthy surface. Black shale in lower 20' may belong to some formation not heretofore seen in the State.
1975-1977	<u>Whitewood (Trenton)</u> dolomite, well crystallized, brown grey, vuggy.
1977-2008 $\frac{1}{2}$	Dolomite, light brown.
2008 $\frac{1}{2}$ -2015 $\frac{1}{2}$	Sandstone with dolomite cement, grey brown, some larger etched grains but mostly fine angular to silt size.
2015 $\frac{1}{2}$ -2035	Dolomite, light brown, some fine sandstone.
2035-2062	<u>Black River, Trenton</u> transition, siltstone, light grey with some interlaminae of metabentonite and some dolomite, <u>strong gas</u> show 2051-2062'.
2062-2067	Larger amount of olive drab metabentonite, flaky, but mainly prismatic brown bituminous dolomite.
2067-2072	Same with small black phosphatic grains in flaky metabentonite.
2072-2109	<u>Black River</u> metabentonite, olive drab, flaky.
2150	Top of <u>St. Peter</u> sandstone.
2153	Total depth.

Formation Waters of the
Piedmont Anticline

Analyses by Charles Bentley
State School of Mines and Technology
Experiment Station

Values given in parts per million:

*	1	2	3	4
Sodium (Na)	47.3	41.1	108.0	38.9
Calcium (Ca)	108.4	170.5	63.8	72.9
Magnesium (Mg)	35.9	75.4	34.8	51.3
Iron and Aluminum Oxides (Fe ₂ O ₃ & Al ₂ O ₃)	2.0	2.0	8.0	0.5
Chloride (Cl)	4.1	39.0	225.8	122.0
Sulphate (SO ₄)	223.1	628.0	92.4	48.0
Carbonate (CO ₃)	169.9	73.3	75.4	150.3
Silica (SiO ₂)	20.0	16.0	2.0	2.0
Total Solids	644.0	1044.6	624.0	485.9
Volatile and Organic	30.8	121.4	13.7	41.4
Hardness	420.0	739.1	279.5	322.5
pH	7.4	7.7	8.0	---

1. Unkpapa formation, sample from old Snively-Gingras well, now used as water well.
2. Top Minnelusa formation, sample from Kucera-Gingras #2, depth 985 feet.
3. Top Madison formation, sample from Kucera-Gingras #2, depth 1642 feet. Water rose to 6.5 feet below ground surface.
4. Madison formation, sample from Kucera-Gingras #2, depth 1626-1897 feet. Water rose to 6.5 feet below ground surface.

MEADE COUNTY

I. H. BERTELSEN No. 1
Morton Oil Company
330' S and 330' E of NW. Corner of
NW. Quarter, Sec. 9, T. 2 N., R. 9 E.
Altitude 3180'
Completed August 30, 1950

- 0- 160 No cuttings, starts in high terrace gravel.
- 160- 310 Pierre clay, with some grey siltstone to fine sandstone, mainly light blue grey bentonitic clay, considerable gravel terrace material, INOCERAMUS prisms, some has brownish or dull greenish tint.
- 310- 490 Somewhat silty, greenish drab, fine mica flakes, ironstone concretions.
- 490- 520 Hauerite.
- 580 Sharon Springs, dark blue grey with considerable fish remains, cone-in-cone concretions, laminated.
- 790 Niobrara, spotted chalky marl, GLOBIGERINA.
- 850- 910 Chalk more abundant, dirty mud pit.
- 910- 970 Chalky material more compact, some dark green blue chalky bentonite.
- 970-1005 More solid and more chalky, electric log gives Niobrara base 1005', flattened and laminated.
- 1005-1050 Carlile shale, blue grey.
- 1050-1075 Codell siltstone, sandy, dark grey, violetitic, scarce glauconite, clayey.
- 1075-1120 Shale, like Carlile above.
- 1120-1150 Large amount marcasite, sandy at 1130' and 1180', biotite and scarce glauconite.
- 1360 Greywacke, sand streaks to 1250'.
- 1360-1400 Shale, black, very bituminous, fish remains with minute light grey spots.
- 1400-1500 Greenhorn limestone, INOCERAMUS prisms, GLOBIGERINA, slightly fluorescent.
- 1500-1540 Graneros, shale, dark blue grey.
- 1540-1800 Shale, dark ashy grey, white-spotted, really a GLOBIGERINA marl, laminated, chalky, bituminous, fish at 1760', Mowry equivalent.
- 1800-1835 Same, blue grey bentonite with biotite in shale, dark blue grey, very bituminous.

1835-1955	Shale, somewhat lighter.
1950-1985	Siltstone, light grey, with fine sand grains, micaceous and carbonaceous.
1985-2020	Shale, bentonitic, lighter grey.
2020-2086	<u>Mowry</u> bentonite, dull green drab shale with fish scales. Shale laminated and bentonitic, medium or "silvery" grey.
2086-2122	<u>Newcastle (Muddy)</u> sandstone with shale 2100-2110', light grey, fine angular grained carbonaceous (small plant fragments), clay seams and interbeds. Some grains medium sized also some coarse angular in lower part, light blue grey bentonite 2110-2115', fine at top to coarse at base.
2122-2160	<u>Skull Creek</u> , shale, dark blue grey, fissile.
2160-2230	Grey, drab bentonite in shale, micaceous.
2230-2355	Some siltstone below is bentonitic shale with marcasite.
2355-2390	<u>Dakota</u> sandstone, light grey, fine angular grained recrystallized in part, muscovite carbonaceous, red brown at 2375', bentonite at 2380'.
2390	Total depth.

MEADE COUNTY

JOHN BREHM No. 1
Morton Oil Company
2310' N. and 2310' E. of
SW. Corner, Sec. 4, T. 2 N., R. 10 E.
Elevation 2913'
Completed November 5, 1950

130- 190	<u>Pierre</u> clay, olive drab.
190- 640	Clay, medium grey and olive drab, some selenite and satin spar, clay ironstone concretions.
640- 850	<u>Sharon Springs</u> clay, dark blue grey, bituminous, fish remains.
850-1190	<u>Niobrara</u> chalky marl, more chalky 1060-1190'.
1195-1270	<u>Carlile</u> shale, dark blue grey, upper parts with chalky dots.
1270-1370	Some grey silt with biotite, interbedded with shale.
1500-1610	<u>Greenhorn</u> limestone, GLOBIGERINA, INOCERAMUS.
1610-1690	<u>Graneros</u> shale, dark blue grey, bituminous.
1690-1740	Shale, slate grey.
1740-1820	Shale, with small chalk spots.
1820-1845	Shale, black, bituminous.
1845-1850	Limestone, composed entirely of INOCERAMUS prisms, with biotite, honey yellow.
1850-1860	Shale, black, bituminous.
1860-2050	Shale, dark blue grey, drab bentonite, more abundant near base, some black shale.
2050-2070	<u>Newcastle (Muddy)</u> sandstone, grey, fine grained.
2070-2105	<u>Skull Creek</u> shale, dark blue grey.
2105	Zone of dwarfed globigerinids.
2150	Tan to purplish silty horizon.
2195-2200	Bentonite, drab, light brown to dark purple red silt.
2200-2335	Much olive drab bentonite, may be cavings.
2335-2340	Shale, bentonitic, medium grey.
2370-2375	Bentonite, olive drab, carbonaceous.
2425-2475	<u>Dakota</u> sandstone, fine grained, muscovitic, light grey, partly recrystallized, at 2445' coarse and more permeable, shale interbeds.
2475	Total depth.

MEADE COUNTY

LOUIS CARLSON No. 1
Morton Oil Company
2310' S. and 2310' E. of NW $\frac{1}{4}$ NW $\frac{1}{4}$ of
Sec. 20, T. 5 N., R. 8 E.
Completed September 14, 1950

160- 280	<u>Pierre</u> clay, blue grey, fish remains.
280- 310	Some brown silt.
310- 340	Clay ironstone concretions, light brown grey.
400- 430	Some sand grains.
400- 490	<u>Niobrara</u> chalky marl, blue grey.
490- 550	Denser and with thicker chalk spots.
550- 640	Lighter and chalkier, INOCERAMUS prisms.
640- 730	<u>Carlile</u> shale, at least below 700'.
730- 790	Sand, fine greywacke, micaceous, grey, biotitic, limy cement.
790- 850	Shale, grey.
850- 880	Large amount marcasite.
880- 970	Shale dark blue grey, bituminous, with minute white spots.
970-1050	<u>Greenhorn</u> limestone, INOCERAMUS and GLOBIGERINA.
1050-1330	<u>Graneros</u> shale, dark blue grey, bituminous, laminated and chalky just above 1200'.
1330	Bentonite, light blue grey, dwarf GLOBIGERINA.
1385-1390	Shale, black, very bituminous.
1390-1410	Shale, dark grey to black, bituminous.
1410-1420	Shale, dark grey.
1420-1425	Shale, black, bituminous.
1425-1445	Shale, dark grey, some light blue grey bentonite.
1445-1515	Shale, black, Mowry type, fish scales.
1515-1580	Shale, dark blue grey.
1580	Shale, black, some siderite.
1600-1660	Shale, dark slate grey, fish remains, bentonitic.
1660-1700	Shale, some drab, bentonitic.
1700-1740	<u>Newcastle (Muddy)</u> sandstone fine grained, light grey, carbonaceous, muscovitic, more sandy at 1720', some siltstone.
1740-1780	<u>Skull Creek</u> shale, dark blue grey, fissile, some drab bentonite.
1780-1790	A little grey siltstone.
1790-1800	Bentonite, grey drab.
1800-2005	Shale, dark blue grey, finely fissile.

2000-2105 Dakota sandstone, light grey, fine grained,
with clay interbeds.

2105-2134 Fuson manganese pellets, light brown, in
dark grey bentonitic clay.

2134 Total depth.

MEADE COUNTY

VICTOR OLSON No. 1
Morton Oil Company
330' S. and 330' W. of NE $\frac{1}{4}$ NE $\frac{1}{4}$ of
Sec. 35, T. 2 N., R. 9 E.
Altitude 2934'
Completed July 22, 1950

0-1470 No cuttings.

1470-1510 Mixture of Greenhorn limestone and clay,
with GLOBIGERINA and INOCERAMUS.

1510-1540 Greneros clay, blue grey, with drab bentonite.
1540-1570 Largely white potted dark blue grey marly
clay.

1570-1600 Bornite.
1600-1780 Clay, blue grey.
1780-1800 Bentonite, green grey.
1800-1980 Clay, dark blue grey with very fine sericite
flakes.

1980-2030 Newcastle (Muddy) siltstone, light grey,
limy, a little coarser in lower 15',
probably largely cavings.

2030-2235 Skull Creek (Thermopolis) clay, blue grey.
2235 Angular quartz grains in ashy matrix,
light grey.

2295-2305 Dakota sandstone, fine grained, light grey,
angular, sericitic, some pyrite cemented.
2305-2335 Sand grains coarser and recrystallized,
clayey interbeds.
2335-2375 Sandstone, coarse, angular, poorly sorted,
light pink.
2375-2405 Sandstone, fine, carbonaceous, light grey.

2405-2440 Fuson terra cotta and grey drab bentonite.
2440-2460 Sandstone, light green, bentonite matrix.
2460-2480 Bentonite, yellow brown and red brown.

2480-2490 Lakota sandstone, fine grained, light grey.
2490-2525 Sandstone, partly quartzitic.
2525-2605 Clay, bentonitic.
2605-2615 Sandstone, light grey, fine grained.

2615-2640 Morrison bentonite, dull olive drab.
2640-2650 Bentonite, varicolored, with ostracods.
2650-2710 Sandstone, grey, fine, clay, lavender,
purplish at base.

2710-2725 Siltstone and bentonite, light grey.
2725-2780 Siltstone, lavender and grey.

2780-2805 Sundance sandstone, fine grained, light grey and green, faintly glauconitic, sericitic.

2805-2825 Bentonite, varicolored, mostly purple, sandy.
2825-2830 Anhydrite, light grey.
2830-2860 Sandstone and siltstone, fine grained, light grey-green, glauconitic, fluorescent at top.
2860-2885 Bentonite, light green grey, with much sand and sericite.
2885-2925 Bentonite, grey, with small biotite flakes, sandy and silty, detrital glauconite, PACHYTEUTHIS at 2915'.
2925-2970 Siltstone, mottled salmon and green grey, bleached mostly to brownish. Either terra cotta zone of Sundance or top of Spearfish.
2970-2985 Siltstone, buff, sandy.
2985-3045 Siltstone, orange to light salmon, sandy.
3045-3070 Siltstone, light green.
3070-3085 Siltstone, grey.

3085-3095 Spearfish siltstone and clay, salmon, green mottled.
3095-3110 Anhydrite, grey to white.
3110-3130 Siltstone, salmon and anhydrite.
3130-3140 Siltstone, salmon.
3140-3145 Anhydrite, partly pink.
3145-3425 Siltstone, salmon.

3425-3470 Minnekahta limestone, with anhydrite at top.

3470-3555 Opeche siltstone, dark salmon.
3555-3630 No cuttings.

3630-3640 Minnelusa limestone, buff, fine grained, pinkish, anhydrite splotches.
3640-3660 Cavings.
3660-3665 Anhydrite, light pink, limy.
3665-3675 Limestone, pink.
3675-3680 Anhydrite, cream.
3680-3695 Sandstone, pink, angular fine grains, dolomitic cement.
3695-3700 Anhydrite.
3700-3710 Dolomite, buff, some bluish chert.
3710-3770 Dolomite, light pink, fluorescent.
3770-3795 Anhydrite.
3795-3805 Sandstone, pink, medium grained, some rounded grains, dolomitic cement, etched, recrystallized, cream colored at base.
3805-3840 Anhydrite, partly pseudomorphous after rock salt.

3840-3845	Siltstone, salmon.
3845-3850	Sandstone, cream, fine grained.
3850-3865	Limestone, cream, lithographic.
3865-3870	Dolomite, light pink grey.
3870-3880	Shale, lavender, finely fissile, upper red marker.
3880-3885	Dolomite, light rose pink, fine sugary.
3885-3890	Shale, dull purple, and anhydrite.
3890-3900	Anhydrite and dolomite.
3900-3930	Dolomite, light grey brown, porcellanous, some fluorescent.
3930-3935	Sandstone, buff, fine.
3935-3950	Shale, fissile, salmon, dull dark red below, some siltstone.
3950-3955	Limestone, magnesian, light brown grey, finely crystalline.
3955-3965	Anhydrite.
3965-3970	Sandstone, light grey, fine grained, angular.
3970-3975	Shale, fissile, dull purplish red.
3975-4000	Cavings, anhydrite (?).
4000-4010	Anhydrite, mottled, grey and white.
4010-4035	Sandstone, light grey, medium grained, limestone, grey, dull, fine grained, poorly sorted, angular grains.
4035-4060	Sandstone, angular, medium grained, etched, darker grey, porous, dolomite cement.
4060-4065	Laterite, dark brick red, clay and siltstone.
4065-4080	Dolomite, drab, vuggy, dull, finely crystalline.
4080-4090	Laterite.
4090-4095	Cavings.
4095-4110	Sandstone, fine grained, light grey.
4110-4130	Dolomite, drab, cream below.
4130-4140	Sandstone, cream, fine grained, dolomite cement.
4140-4175	Dolomite, dove, fine grained, vuggy.
4175-4180	Laterite, brick red, silt and claystone.
4180-4195	Sandstone, fine grained, light grey, recrystallized.
4195-4200	Dolomite, marbleized, fine grained.
4205	Lost drill stem.

MEADE COUNTY

H. T. SNYDER No. 1
Morton Oil Company
330' N. and 330' W. of the SE $\frac{1}{4}$ SE $\frac{1}{4}$
Sec. 20, T. 5 N., R. 9 E.
Altitude 2770'
Completed August 18, 1950

- 150- 885 Pierre clay, olive drab, with concretions
changing to blue grey downwards.
280 Marcasite.
300 DENTALINA
380 ROBULUS
580 Sharon Springs shale, dark blue grey,
bituminous, fish remains.
- 885-1065 Niobrara chalky marl, especially below 970'
where more chalky.
- 1065-1155 Chalk, sandy, and with much biotite. Sandy
zone with limy cement.
- 1155-1215 Carlile clay, blue grey.
1215-1285 Chalky marl, with small white spots.
1285-1345 Shale.
1345-1405 Shale, black bituminous, small grey spots.
- 1405-1510 Greenhorn limestone, grey, usual INOCERAMUS
and GLOBIGERINA.
1510-1520 Shale, black, bituminous.
1520-1620 Shale, lighter color, bituminous.
1620-1650 Chalk-spotted marly shale, dark blue grey.
1650-1660 Bentonite, light grey.
1660-1670 Shale some chalk spots, dark blue grey.
1670-1885 Shale, fissile, dark blue grey, dwarf
globigerinids 1690-1700', bituminous light
grey bentonite 1700-1705', fish remains
throughout.
- 1885-1965 Shale, very dark blue grey, bituminous,
minute forams, olive drab bentonite.
1965-2000 Shale, lighter grey.
2000-2085 Bentonite, light ash grey, some olive drab
bentonite in increasing amounts below,
especially below 2060'.
- 2085-2110 Newcastle (Muddy) sandstone, light grey,
fine grained, muscovitic.
- 2110-2290 Skull Creek shale, dark slate grey with drab
bentonite, some sandstone 2185-2195', silty
at 2200' and 2270'.
2290-2350 Shale, dark grey.

2350-2400 Dakota sandstone, light grey fine grained,
angular, poorly sorted, carbonaceous,
partly recrystallized, with clay interbeds.

2400 Fuson iron manganese pellets abundant, light
brown.

2400 Total depth.

PENNINGTON COUNTY

WANENMACHER-JOHN M. BOETKER No. 1
NE Corner Sec. 14, T. 2N., R. 8 E.

Altitude 3205'

Completed December 14, 1950

40- 90	Terrace gravel of Black Hills crystalline rocks.
90- 470	<u>Pierre</u> clay, bentonite, olive drab at weathered top, muscovitic.
470- 520	Clay with light grey spots.
520- 560	Clay somewhat darker grey, <u>Sharon Springs</u> (?).
560- 720	<u>Niobrara</u> chalky spotted marl, light grey.
720- 800	<u>Carlile</u> shale, dark grey.
800- 845	Siltstone, greywacke grey, limy matrix with biotite, sharp angular explosion fine fragments of quartz and perhaps kaolinized feldspar.
845-1040	Shale, blue grey.
1040-1100/	<u>Greenhorn</u> limestone, more typical around 1100' which may be the real <u>Greenhorn</u> horizon with the usual INOCERAMUS AND GLOBIGERINA.
1100/-1210	<u>Graneros</u> shale, blue grey.
1210-1370	Shale, black, bituminous, fissile, considerable fish scales, <u>Mowry</u> .
1460	<u>Greenhorn</u> -like.
1700- and below	Some drab bentonite. Cuttings are very poor. Resistivity log shows <u>Newcastle</u> sand 1800-1815' and <u>Dakota</u> sand at 2070'.
2100	Total depth.