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

Charles Laurence Baker

University of South Dakota
Vermillion, South Dakota
April, 1951
Reprint, 1953
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WELL BORINGS IN SOUTH DAKOTA, 1948-1950

by

Charles Laurence Baker

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.
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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 Niobrara chalk.
195-215 Carlile shale.
215-280 Codell sandstone, Carlile formation.
280-335 Shale, Carlile formation.
335-350 Sandstone, Carlile formation.
350-515 Shale, Carlile formation.
515-570 Shelly lime, Greenhorn formation.
570-600 Graneros shale.
600-640 Dakota sandstone.
640-710 Fuson, shale and manganese pellets.
710-733 Lakota sand.

Rainbow in the mud at 620' (oil show).
BROWN COUNTY
CITY OF ABERDEEN
Completed, August, 1949

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<tr>
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<td>830-940</td>
<td>Dakota sand</td>
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BRULE COUNTY

KUCERA-BISKEPORN No. 1
Winkler Drilling Company
N. W. 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, bentoniti-
crystal 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 ce-
ment. 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- 280f 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; lime- stone mainly composed of INOCERAMUS and GLOBIGERINA.

665-690  Graneros shale, bentonitic, grey, with some find 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

830-840  Siltstone, muscovitic, light grey, and sand-

840-860  Stone.

860-865  Shale with a little fine sand.

865-870  Mainly brown concretionary limestone.

870-875  A little sandstone, abundant sulphide, a little of which is detrital.

875-885  Sandstone, carbonaceous, cemented with sulphides and CaCO3.

885-890  Considerable sand, much iron sulphide and some copper sulphide.

890-895  Much less sandstone.

Sandstone, carbonaceous, cemented with FeS2
and CaCO₃, a little muscovite.

Much muscovite, considerable sand, carbonaceous.

Much sand and cemented sandstone, considerable lignite, marcasite, bornite and muscovite.

Considerable detrital copper sulphide and some cementing sand.

Less sand and that fine grained.

Some dark blue covellite cementing sand.

Much yellow copper sulphide.

Sandstone, angular, medium to fine grained, light grey cemented with marcasite and CaCO₃, carbonaceous and lignitic.

Sandstone with small pyrite cubes, a little muscovite, some grains from Sioux quartzite.

Some concretionary light brown siderite cementing sand.

Mostly sand, some muscovite.

Sandstone, calcite cemented, carbonaceous, yellow copper sulphide.

Detrital copper sulphide and also as cement for sand.

Sandstone, grey, calcite cemented, poorly sorted, etched grains, carbonaceous, some coarse grains, some covellite and perhaps chalcopyrite. Some Sioux quartzite pink grains.

Yellow copper sulphide.

Sandstone, largely coarse rounded to subround grains.

Much loose coarse sand. Much pyrite and some marcasite cement. A little yellow copper sulphide.

Same with chalcopyrite and bornite.

Loose sand, coarse, buff, subangular to subround, some etched, some citrine and Sioux quartzite grains.

Considerable sulphide cemented sandstone, rest loose sand, large quantity chalcopyrite and bornite.

Much grit, angular to subround, etched.

Grit up to 1/16 inch in size.

Sand, finer but coarse grained.

Sandstone, medium grained, mostly calcite cement, carbonaceous, mostly angular to subround grains, some round and etched.

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.

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 chalcopyrite, calcite and other sulphide cement, carbonaceous.

1200-1210 Large amount marcasite cement, much loose sand.

1215-1260 Much sulphide cemented sandstone, some chalcopyrite 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 chalcopyrite.

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 chalcopyrite. Oil show at base.

1351-1353 Fuson manganese bearing pellets in blue white bentonite.

1353-1365 Fine Sioux quartzite pebbles, etched.

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, Pierre dark blue grey bentonitic clay.
220-393 Pierre dark blue grey bentonitic clay, sticky, shell fragments.
393-403 Same, many shell fragments.
403-503 Niobrara 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 Carlile 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 Greenhorn limestone, light grey, abundant GLOBIGERINA, INOCERAMUS prisms and some fish remains.
1140-1210 Belle Fourche (Graneros) 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 Newcastle sandstone, fine angular grained, grey.
1900-2190 Thermopolis (Skull Creek) shale, light blue grey, clay ironstone, fish scales, bentonitic, silty layers below 2100'.

2190-2240 Dakota sandstone, light grey, very fine grained, white mica flakes, some pyritic cement.

2240-2260 Fuson bentonite with small manganese bearing pellets.

2260-2280 Bentonite, light grey.

2280-2300 Clay, salmon, bentonitic.

2300-2390 Considerable drab bentonite.

2390-2420 Lakota sand, coarse, subrounded to subangular partly etched grains.

2420-2440 Sand, coarse, with very light grey bentonite, all sizes of grains.

2450-2470 Morrison bentonite, light sea green.

2470-2480 Morrison 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 Sundance 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 Spearfish 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 Opechee, 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 kaolinite 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.
4010-4100 Sandstone, cream, fine grained, white powdery 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 crystalline, 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 GUKEISEN FARM
Wave Drilling Company
NW¼ 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.
76-185f 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.
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^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, AMMOSDISCUS.
520-530 Cavings of Greenhorn limestone.
530-540 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 cement 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 ¼ SE ¼ 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, interlaminated 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 bearing pellets just appearing.

470-480 Fuson manganese bearing pellets abundant, many large.

480-500 Sand, medium sized grains, angular, manganese 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  Unkn [illegible] 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 Spearfish 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 Morrison and Sundance 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 Minnekahta limestone, buff to lavender, some brown with bitumen, fine powdery to fine crystalline 2160', quite fluorescent.

2165-2205 Opeche 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 Minnelusa sandstone, dark salmon, all sized unassorted grains, large grains etched, sub-angular to subangular 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.
2505-2515 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, \(\text{NaCl}\) | 16.5 | Iron and Aluminum Oxides | 1.0 |
| Sodium sulphate, \(\text{Na}_2\text{SO}_4\) | 117.8 | Silica \((\text{Si})\) | 21.0 |
| Calcium sulphate, \(\text{CaSO}_4\) | 1673.9 | Volatile and Organic | 65.8 |
| Magnesium sulphate, \(\text{MgSO}_4\) | 97.2 | Total solids | 2174.0 |
| Magnesium carbonate, \(\text{MgCO}_3\) | 180.8 | | |

-20-
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 Opeche siltstone, dark salmon, fine.
45- 94 Minnelusa sandstone and siltstone, dark salmon fine grained with coarse etched rounded grains, mostly sandstone.
94-105 Sandstone, 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.

-21-
Sandstone, bright red, with large amount selenite.

Siltstone, purple, and anhydrite, white.
Sandstone, red, largely white anhydrite.
Sandstone, light salmon.
Dolomitic grey limestone, sandstone as above, a little dark grey shale.
Sandstone, light salmon, and white anhydrite increasing downwards.
Anhydrite, white.
Large piece dark blue grey mudstone (hard).
White anhydrite and sand.
Anhydrite, white.
Cavernous, light brown magnesian limestone.
Limestone, dolomitic, silty, lavender, fine grained.
Sandstone, soft, light salmon to pink, medium to coarse, limy some limestone as above.
Sandstone, soft, light pink.
Dolomite, lavender and grey, powdered sugar texture, fossiliferous, silty, some very fine and dense, dull luster.
Same dolomite with some white anhydrite.
Anhydrite, white.
Dolomite, light grey fine sugary vuggy to dense, fossiliferous, some chert.
Siltstone, lavender and pink.
Anhydrite and selenite, white.
Dolomite, light grey, fine sugary, vuggy, a little anhydrite. Sandy 498-500'. Small gas show at 494'.
Sandstone, gas show.
Red marker marked by purple mud, sandstone above with anhydrite matrix. Some dark grey shale and dark brown iron cemented sandstone.
Bentonite, purple to grey, laminated, but mainly dolomite and sandstone.
Red marker, clay, very thinly laminated, dark dull red and light grey.
Limestone, almost crimson, well crystallized, some soft white anhydrite with colorless calcite, gypsum and quartz.
Limestone, pink, passing down into sandstone, white and pink, limy, with some large etched grains.
Sandstone, cream to pink, mostly dark pink, poorly sorted with many large subrounded etched grains.
Sandstone, grey, dolomite and a little very dark grey mudstone.
Sandstone as at 547-549'.
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.
Sand, pink, and laterite clay, purple.
Clay, reddish purple, some light greenish grey.
Laterite, clay with sand, a little pink limestone, cream, very dense and fine grained, orange, grey, maroon and yellow mottled.

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. 1/4 corner
of S. 10, T. 11 S., R. 1 E.
Altitude 415' derrick floor
Completed July 12, 1949

5- 30 Niobrara 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 Carlile clay, dark blue grey, silty, numer-
ous GLOBGERINA and fish fragments.
105-190 Clay, denser and finer grained, dark blue
grey.
190-200 Silt with sand grains and a little glau-
conite, 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 INO-
CERAMUS prisms, coarser partly recrystal-
lized sandstone at base with grey chert
fragments.
420-640 Varved thin interbeds of light grey silt-
stone and darker grey claystone, small mica
flakes, sparse glauconite, some fine sand
size grains, limy laminated, a few GLOBI-
GERINA.

640-660 Greenhorn limestone, light grey, common
INOCERAMUS LABIATUS, finely crystalline.

660-770 Graneros (Belle Fourche) 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 Greenhorn (cavings)
850-1100 Claystone, blue black, with clay iron-
stone concretions below 950'.
1100-1110 Mudstone, dark red brown.
1110-1180 Claystone, some silty and concretionary.
1180-1227 Siltstone, grey.
1227-1260 Dakota 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 subrounded 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, subrounded 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 stylolitic light grey and pink laminated limestone with a 15° dip, top 2' is dolomitic.
<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2736-2880</td>
<td>Opeche mudstone, dark dull purple or maroon, some siltstone and sandstone, some spotted with anhydrite, silty below 2780'</td>
</tr>
<tr>
<td>2880-2930</td>
<td>Minnelusa sandstone, cream, some orange stained, fine grained.</td>
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<tr>
<td>2930-2980</td>
<td>Anhydrite, purple stained, likely some other interbeds.</td>
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<tr>
<td>2980-2985</td>
<td>Siltstone (?), red.</td>
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<tr>
<td>2985-2990</td>
<td>Anhydrite (?).</td>
</tr>
<tr>
<td>2990-3005</td>
<td>Probably siltstone, salmon, caving badly.</td>
</tr>
<tr>
<td>3005-3015</td>
<td>Sandstone, fine grained orange.</td>
</tr>
<tr>
<td>3015-3020</td>
<td>Anhydrite.</td>
</tr>
<tr>
<td>3020-3045</td>
<td>Limestone, medium grey, fine grained, anhydrite splotched.</td>
</tr>
<tr>
<td>3045-3065</td>
<td>Anhydrite, mottled grey.</td>
</tr>
<tr>
<td>3065-3070</td>
<td>Sandstone, cream, fine grained.</td>
</tr>
<tr>
<td>3070-3075</td>
<td>Siltstone, purple.</td>
</tr>
<tr>
<td>3075-3100</td>
<td>Limestone, light grey, with bluish chert.</td>
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<tr>
<td>3100-3105</td>
<td>Sandstone, mostly reddish stained, fine grained.</td>
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<tr>
<td>3105-3115</td>
<td>Dolomite, fine grained, light pink.</td>
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<tr>
<td>3115-3125</td>
<td>Siltstone, pink.</td>
</tr>
<tr>
<td>3125-3185</td>
<td>Anhydrite.</td>
</tr>
<tr>
<td>3185-3205</td>
<td>Dolomite, light grey, very fine grained and siltstone (?), red.</td>
</tr>
<tr>
<td>3205-3225</td>
<td>Dolomite, lavender, very fine grained.</td>
</tr>
<tr>
<td>3225-3235</td>
<td>Dolomite, grey, very fine grained.</td>
</tr>
<tr>
<td>3235-3245</td>
<td>Dolomite, pink stained, very fine grained.</td>
</tr>
<tr>
<td>3245-3250</td>
<td>Anhydrite.</td>
</tr>
<tr>
<td>3250-3255</td>
<td>Dolomite, grey, mixed with anhydrite.</td>
</tr>
<tr>
<td>3255-3285</td>
<td>Sandstone, fine grained, pink stained grey, poorly sorted, some etched.</td>
</tr>
<tr>
<td>3285-3305</td>
<td>Dolomite, maroon, fine porcellaneous, grey at base.</td>
</tr>
<tr>
<td>3305-3310</td>
<td>Siltstone, dark salmon.</td>
</tr>
<tr>
<td>3310-3365</td>
<td>Anhydrite, spotted grey, somewhat silty.</td>
</tr>
<tr>
<td>3365-3380</td>
<td>Sandstone, light grey, fine grained.</td>
</tr>
<tr>
<td>3380-3385</td>
<td>Limestone, dolomite, dark grey brown, fine texture, and anhydrite.</td>
</tr>
<tr>
<td>3385-3390</td>
<td>Sandstone, medium grey, dolomitic cement and sandy limestone.</td>
</tr>
<tr>
<td>3390-3400</td>
<td>Anhydrite, grey speckled.</td>
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<tr>
<td>3400-3405</td>
<td>Anhydrite and dark grey dolomite.</td>
</tr>
<tr>
<td>3405-3425</td>
<td>Sandstone, dark grey, fine grained, anhydrite cement, poorly sorted, some etched.</td>
</tr>
<tr>
<td>3425-3430</td>
<td>Dolomite, dark grey.</td>
</tr>
<tr>
<td>3430-3440</td>
<td>Sandstone, fine grained, perhaps mainly dolomite.</td>
</tr>
<tr>
<td>3440-3465</td>
<td>Dolomite, dark grey, very fine grained.</td>
</tr>
<tr>
<td>3465-3470</td>
<td>Sandstone, light grey, fine grained, and dark grey dolomite with spots of anhydrite.</td>
</tr>
<tr>
<td>3470-3535</td>
<td>Limestone, magnesian, fine powdery, dark</td>
</tr>
</tbody>
</table>
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 t.
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
cherty limestone in upper part.

3865-3880 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 1/4 NE 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 interlaminae, 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 37°64'-74"; yellow green bentonite with fine angular sand grains at 37°74'-84".

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; 3945-50', coarse angular unsorted sandstone, partly asphaltic. 3965-70', 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 Borings 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 cavities.

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

<table>
<thead>
<tr>
<th>Substance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium chloride, ((\text{NaCl}))</td>
<td>112.0</td>
</tr>
<tr>
<td>Sodium sulphate, ((\text{Na}_2\text{SO}_4))</td>
<td>1467.0</td>
</tr>
<tr>
<td>Sodium carbonate, ((\text{Na}_2\text{CO}_3))</td>
<td>98.1</td>
</tr>
<tr>
<td>Iron and Aluminum Oxides</td>
<td>6.0</td>
</tr>
<tr>
<td>Magnesium carbonate, ((\text{MgCO}_3))</td>
<td>43.9</td>
</tr>
<tr>
<td>Silicon dioxide, ((\text{SiO}_2))</td>
<td>26.0</td>
</tr>
<tr>
<td>Volatile and Organic</td>
<td>2.6</td>
</tr>
<tr>
<td>Total solids</td>
<td>1788.0</td>
</tr>
<tr>
<td>Total hardness</td>
<td>150.2</td>
</tr>
<tr>
<td>pH</td>
<td>8.1</td>
</tr>
</tbody>
</table>
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.

Lakota sandstone, coarser, carbonaceous, medium angular grained, with muscovite and some siderite and sulphide cement.

Morrison bentonite, light grey, silty.
Bentonite, darker grey.
Bentonite, light grey.
Silt, bentonitic, light butternut brown.
Silt, cream, bentonitic matrix, some fine blue tuff breccia, some with fine sand grains, partly with brown interbeds.
Bentonite, light dull green.
Bentonite, largely blue grey.
Silt, bentonitic, light grey.
Sandstone, bentonitic, light grey, fine grained.
Claystone, slate grey.
Claystone, some purple.
Sand, buff, coarse, etched, angular to sub-rounded, some iron oxide cement.
Bentonite, light grey to dark slaty grey and lavender.
Silt, bentonitic, light green grey.
Bentonite, light green grey, in part silty.
Silt, light grey, quite limy, some purplish, light greenish in lower part.
Silt, light grey green.
Sand, light grey, with bentonite matrix, fine grained.
Sundance sandstone, with sparse glauconite, fine, light grey, some bentonite in matrix, some siltstone, oyster shell.
Siltstone, light grey, glauconitic, clayey, muscovitic, bentonitic.
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  **Spearfish** siltstone, dark salmon.
890- 900  **Spearfish** 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      Opechee top siltstone reduced to green ferrous iron either by H2S or organic matter.
1445-1455½ Core Opechee 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, porcelaneous, 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, subrounded, medium grained, etched, pink.
<table>
<thead>
<tr>
<th>Time Period</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1835-1845</td>
<td>Dolomite, pink, powdery texture</td>
</tr>
<tr>
<td>1845-1865</td>
<td>Sandstone, angular, medium grained, pink, limy.</td>
</tr>
<tr>
<td>1865-1870</td>
<td>Dolomite, light pink, fine dense texture.</td>
</tr>
<tr>
<td>1870-1885</td>
<td>Sandstone, fine grained, very dolomitic, light pink.</td>
</tr>
<tr>
<td>1885-1890</td>
<td>Sandstone with some anhydrite.</td>
</tr>
<tr>
<td>1890-1910</td>
<td>Sandstone, light pink, porous, medium angular, limy cement.</td>
</tr>
<tr>
<td>1910-1920</td>
<td>Dolomite, cream buff, very dense, porcellaneous.</td>
</tr>
<tr>
<td>1920-1925</td>
<td>Dolomite, light brown.</td>
</tr>
<tr>
<td>1925-1930</td>
<td>Limestone, magnesian, dense, lavender.</td>
</tr>
<tr>
<td>1930-1940</td>
<td>Dolomite, cream, dense, porcellaneous, with fine scattered sandgrains, pink stained.</td>
</tr>
<tr>
<td>1940-1985</td>
<td>Dolomite as above, but no sand, possibly with sandstone interbeds.</td>
</tr>
<tr>
<td>1985-2015</td>
<td>Dolomite, yellow stained in part, some chert.</td>
</tr>
<tr>
<td>2015-2025</td>
<td>Red marker (?), shale, dark purplish red, finely fissile.</td>
</tr>
<tr>
<td>2025-2035</td>
<td>Limestone, partly magnesian, pink to lavender, but mostly fine powdery textured limestone.</td>
</tr>
<tr>
<td>2035-2060</td>
<td>Limestone, magnesian, pink cream, fine sugary, porcellaneous.</td>
</tr>
<tr>
<td>2060-2090</td>
<td>Limestone, magnesian, with milky chert.</td>
</tr>
<tr>
<td>2090-2095</td>
<td>Limestone, dolomitic and non-dolomitic, pink cream, porcellaneous.</td>
</tr>
<tr>
<td>2095-2115</td>
<td>Limestone, cream.</td>
</tr>
<tr>
<td>2115-2135</td>
<td>Limestone, cream, altered oolitic, milky chert.</td>
</tr>
<tr>
<td>2135-2150</td>
<td>Limestone, light dove grey, dull, dense, silty, magnesian.</td>
</tr>
<tr>
<td>2150-2180</td>
<td>Limestone, pink cream, some laterite, dull, corroded.</td>
</tr>
<tr>
<td>2180-2185</td>
<td>Limestone, pink cream, in fine crystals.</td>
</tr>
<tr>
<td>2185-2210</td>
<td>Laterite zone, silty clay, red, and limestone, vuggy, brown and yellow.</td>
</tr>
<tr>
<td>2210-2225</td>
<td>Madison dolomite, cream brown, rhomic crystals.</td>
</tr>
<tr>
<td>2225-2255</td>
<td>Dolomite, cream, rhombic, vuggy, large rhombs in finer matrix.</td>
</tr>
<tr>
<td>2255-2260</td>
<td>Dolomite, altered oolitic, cream, porous, some larger rhombs.</td>
</tr>
<tr>
<td>2260-2280</td>
<td>Dolomite, well crystallized, vuggy, cream, with pink tinge.</td>
</tr>
<tr>
<td>2280-2295</td>
<td>Marble, fairly coarse rhombic, cream, vuggy.</td>
</tr>
<tr>
<td>2295-2320</td>
<td>Finer and denser crystals of dolomite.</td>
</tr>
<tr>
<td>2320-2380</td>
<td>Coarser and vuggy, brown cream.</td>
</tr>
</tbody>
</table>
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, subrounded 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 moulds.
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\".

-42-
LINCOLN COUNTY
CITY OF WORTHING
Omaha Drilling Company
Altitude 1360 ft.
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 GLOBI-GERINA, 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 (sphaerosiderite), 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 ft reported black oily petrolierous shale, with bright rainbow play of colors when samples were washed in water.

Kirby, driller, gives Greenhorn 235-270 ft

Dakota 463-471 ft
LYMAN COUNTY

BURKHARDT No. 2
Red Butte Oil Company
Fred C. Summers, Contractor
330° N. and 900° W. of SE. ¼ SE. ¼
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 markasite, very minute light brown concretions.

710-780 Carlile markasite, hauerite, white milky gypsum, calcite, some coarse quartz sand, subrounded, 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.  Much marcasite.

1080-1100

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 hauserite 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 savings, appearing to be material from higher up the hole.

Drilled quartzite.

2504 Total depth.
MEADE COUNTY

KUCERA-GINGRAS No. 1
E. B. Kucera et al
B & D Drilling Company
300' N. and 200' W. of SE ¼ NW ¼
of Sec. 19, T. 3 N., R. 7 W
Altitude about 3600'
Completed July 31, 1949

0-20 Sundance 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, glau-
conitic, 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,
glaucnitic, largely angular, bentonite
matrix.

65-70 Sand purer a little coarser, angular with
glaucnite.

70-80 Sand as above, still fine grained, benton-
itic.

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 ben-
tonite, selenite.

100-105 PACHYTEUTHIS, about same as above, carbon-
aceous light grey bentonite, "golf ball".

105-110 Bentonite, grey and drab and fine glaucon-
itic sandstone.

110-125 Sandstone, light grey, fine grained glau-
conitic, 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, glauconite, 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 Spearfish 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.

770-825 Minnekahta, some limestone.
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.

843-859 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

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.

1142-1157½ Sandstone, fine grained, pink, limy cement, much calcite.

1157½-1168 Clay, siltstone, sandstone, anhydrite, soft 1162-1168'.

1168-1183 Limestone, magnesian, porous, fine grained, pink, some sandstone?.

1183-1188½ Limestone, magnesian, sandy.

1188½-1198½ Silty claystone, dark dull brown red and pink sandstone.

1198½-1209 Limestone, magnesian, porous fine grained pink.

1209-1219 Sandstone, fine grained, pink limy cement (limestone and clay as above).

1219-1224 Miscellaneous.

1224-1229½ Claystone or shale, somewhat fissile, mauve to purple.

1229½-1234¼ Sandstone, pink.

1234¼-1274¾ Limestone, pink to cream, porous.

1274¾-1291 Mostly silt and claystone.

1291-1312 Sandstone, light pink, fine grained, limy cement.

1312-1347½ Limestone, dolomitic, dense, light pink, sandy and sandstone, porous, stylolites.

1347½-1368 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^1/4 NE^3/4
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, PACHYTELITHIS, PENTACRINUS,
ASTERISCUS and fragments of OSTREA, all of
which continue to base of Sundance, practi-
cally all of the Sundance caves badly.

35- 140 Silt, glauconitic and bentonitic, light
grey, small specks of glauconite.

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 angu-
lar, 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 sand-
stone with grains of all sizes.

314- 319 Siltstone, clayey, terra cotta brown, with
anhydrite changed partly to selenite and
satin spar.

319- 329 Anhydrite, cream to light grey.

329- 397 Siltstone, dark salmon (brown red) and anhy-
drite. Gas at 340'.

397- 402 Anhydrite, gas at 402'.

402- 525 Siltstone and mudstone, dark salmon, gyp-
sum 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- 862½
Minnekahta limestone, pink to grey, very fine dense powdery texture, calcite veined, good gas show at base. Very likely carries water.

862½- 870
Oneche 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- 963½
Some sandstone, all sized grains, dark salmon, limy cement, angular to subrounded, large grains etched. May be top of Minnelusa.

963½- 973
Anhydrite, sandstone and siltstone, dark salmon, casing cemented at 963½.

973- 978
Minnelusa sand, medium, subrounded and subangular, orange etched. Yielded upon bailing test 20 gal. water per hour.

978- 983
Tar (?) sand.

983- 986
Limestone, cream, fine, powdery.

986- 988½
Limestone, brown grey, fine, powdery, silty.

988½- (Bailings from bottom) largely brecciated anhydrite and vein selenite.

988½- 998½
(After water test) limestone as above, silty, pink stained, finely granular.

998½-1003½
Limestone, rose pink and cream. Practically all Minnelusa below this has a rose pink tint.

1003½-1014
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, 6½ 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, limy cement, larger amount of vein calcite, some milky chert. Gas at 1072'.

1076-1101 1/2
Sandstone, light yellow, fluorescent, medium and fine grained, larger grains subrounded and etched, much vein calcite, becomes cream buff below.

1101 1/2-1106
Sandstone, yellowish and lavender, subangular grains, a little purplish siltstone.

1106 1/2-1117
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.

1132-1168 1/2
Sandstone, rose pink, medium subrounded grains with chert. Gas at 1135'.

1168 1/2-1178 1/2
More limestone, rose pink, cherty with sandstone interbeds.

1178 1/2-1193 1/2
Mainly sandstone, rose pink, fine grained, limy cement.

1193 1/2-1208 1/2
Limestone, dark rose pink or lavender and light grey, fine to granular, much sand.

1208 1/2-1225
Shale, fissile, dull purple, and limestone, old rose, also sand, very fine muscovitic, a little yellow and pink shale.

1225-1240 1/2
Sandstone, rose pink, fine to medium, angular, limy, poor sorting, some porosity.

1240 1/2-1256
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 oil 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.
1420-1450½ Dolomite, pink cream, porous, finely angular, becomes coarse and sandier below.
1450½-1476 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 gas at 1497'.
1505-1532 Dolomite, pink cream, fairly coarsely crystalline, fairly porous.
1532-1584 Dolomite, porcellaneous texture, largely yellow brown, some chert fluoresces at 1560-1568½', oil 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 Madison, dolomite, cream, well crystallized, porous, good show gas 1626-1631', core 1641-1647' fractured and somewhat corroded but not veined. Carries water in lower part, rising to within 6½' of surface. Gas has distillate or condensate.
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.
<table>
<thead>
<tr>
<th>Depth Range</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1816-1867</td>
<td>Dolomite, light brown, finer crystals, coarser below, porous.</td>
</tr>
<tr>
<td>1867-1992</td>
<td>Dolomite, light brown, with some fine white powdery limestone filling vugs. Good gas at 1874'.</td>
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<tr>
<td>1892-1932</td>
<td>Dolomite, yellow cream, some tinged with pink, well crystallized, vuggy.</td>
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<tr>
<td>1932-1975</td>
<td>Englewood dolomite, dark dull lavender streaks alternating with dull grey, silty. Core from 1940 to 1948½' 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.</td>
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<tr>
<td>1975-1977</td>
<td>Whitewood (Trenton) dolomite, well crystallized, brown grey, vuggy.</td>
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<tr>
<td>1977-2008</td>
<td>Dolomite, light brown.</td>
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<tr>
<td>2008½-2015</td>
<td>Sandstone with dolomite cement, grey brown, some larger etched grains but mostly fine angular to silt size.</td>
</tr>
<tr>
<td>2015½-2035</td>
<td>Dolomite, light brown, some fine sandstone,</td>
</tr>
<tr>
<td>2035-2062</td>
<td>Black River, Trenton transition, siltstone, light grey with some interlaminae of metabentonite and some dolomite, strong gas show 2051-2062'.</td>
</tr>
<tr>
<td>2062-2067</td>
<td>Larger amount of olive drab metabentonite, flaky, but mainly prismatic brown bituminous dolomite.</td>
</tr>
<tr>
<td>2067-2072</td>
<td>Same with small black phosphatic grains in flaky metabentonite.</td>
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<tr>
<td>2072-2109</td>
<td>Black River metabentonite, olive drab, flaky.</td>
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<tr>
<td>2150</td>
<td>Top of St. Peter sandstone.</td>
</tr>
<tr>
<td>2153</td>
<td>Total depth.</td>
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Formation Waters of the
Piedmont Anticline

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

Values given in parts per million:

<table>
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<th>1</th>
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<td>Sodium (Na)</td>
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<td>41.1</td>
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<td>Calcium (Ca)</td>
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<td>170.5</td>
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<td>72.9</td>
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<tr>
<td>Magnesium (Mg)</td>
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<td>75.4</td>
<td>34.8</td>
<td>51.3</td>
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<td>Iron and Aluminum Oxides (Fe2O3 &amp; Al2O3)</td>
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<td>2.0</td>
<td>8.0</td>
<td>0.5</td>
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<td>Chloride (Cl)</td>
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<td>Sulphate (SO4)</td>
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<td>628.0</td>
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<td>48.0</td>
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<td>Carbonate (CO3)</td>
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<td>73.3</td>
<td>75.4</td>
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<td>Silica (SiO2)</td>
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<td>16.0</td>
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<td>Total Solids</td>
<td>644.0</td>
<td>1044.6</td>
<td>624.0</td>
<td>485.9</td>
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<tr>
<td>Volatile and Organic</td>
<td>30.8</td>
<td>121.4</td>
<td>13.7</td>
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<td>Hardness</td>
<td>420.0</td>
<td>739.1</td>
<td>279.5</td>
<td>322.5</td>
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<tr>
<td>pH</td>
<td>7.4</td>
<td>7.7</td>
<td>8.0</td>
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</table>

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 ben-
tonitic 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 consid-
erable fish remains, cone-in-cone concre-
tions, laminated.

790  Niobrara, spotted chalky marl, GLOBIGERINA.
850- 910  Chalky material 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, vio-
titic, 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, micaeous and carbonaceous.
1985-2020  Shale, bentonitic, lighter grey.
2020-2086  *Mowry* bentonite, dull green drab shale with fish scales. Shale laminated and bentonitic, medium or "silvery" grey.
2086-2122  *Newcastle (Muddy)* sandstone with shale 2100-2110\textsuperscript{f}, 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\textsuperscript{f}, fine at top to coarse at base.
2122-2160  *Skull Creek*, shale, dark blue grey, fissile.
2160-2230  Grey, drab bentonite in shale, micaeous.
2230-2355  Some siltstone below is bentonitic shale with marcasite.
2355-2390  *Dakota* sandstone, light grey, fine angular grained recrystallized in part, muscovite carbonaceous, red brown at 2375\textsuperscript{g}, bentonite at 2380\textsuperscript{f}.
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 Pierre clay, olive drab.
190- 640 Clay, medium grey and olive drab, some
selenite and satin spar, clay ironstone
concretions.

640- 850 Sharon Springs clay, dark blue grey,
bituminous, fish remains.

850-1190 Niobrara chalky marl, more chalky 1060-
1190'.

1195-1270 Carlile shale, dark blue grey, upper parts
with chalky dots.
1270-1370 Some grey silt with biotite, interbedded
with shale.

1500-1610 Greenhorn limestone, GLOBIGERINA, INOCERAMUS.

1610-1690 Graneros 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 Newcastle (Muddy) sandstone, grey, fine
grained.

2070-2105 Skull Creek 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 Dakota 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
2310¹ S. and 2310¹ E. of NW² NW² of
Sec. 20, T. 5 N., R. 8 E.
Completed September 14, 1950

160- 280 Pierre 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 Niobrara chalky marl, blue grey.
490- 550 Denser and with thicker chalk spots.
550- 640 Lighter and chalkier, INOCERAMUS prisms.

640- 730 Carlile shale, at least below 700'.
730- 790 Sand, fine greywacke, micaceous, grey, biotitic, limy cement.
790- 850 Shale, grey.
850- 890 Large amount marcasite.
880- 970 Shale dark blue grey, bituminous, with minute white spots.

970-1050 Greenhorn limestone, INOCERAMUS and GLOBIGERINA.

1050-1330 Graneros 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 Newcastle (Muddy) sandstone fine grained, light grey, carbonaceous, muscovitic, more sandy at 1720', some siltstone.

1740-1780 Skull Creek 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 NE1/4 NE1/4 of
Sec. 35, T. 2 N., R. 9 E.
Altitude 2934.4'
Completed July 22, 1950

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1470</td>
<td>No cuttings.</td>
</tr>
<tr>
<td>1470-1510</td>
<td>Mixture of Greenhorn limestone and clay,</td>
</tr>
<tr>
<td></td>
<td>with GLOBIGERINA and INOCERAMUS.</td>
</tr>
<tr>
<td>1510-1540</td>
<td>Greenros clay, blue grey, with drab bentonite.</td>
</tr>
<tr>
<td>1540-1570</td>
<td>Largely white potted dark blue grey marly clay.</td>
</tr>
<tr>
<td>1570-1600</td>
<td>Bornite.</td>
</tr>
<tr>
<td>1600-1780</td>
<td>Clay, blue grey.</td>
</tr>
<tr>
<td>1780-1800</td>
<td>Bentonite, green grey.</td>
</tr>
<tr>
<td>1800-1980</td>
<td>Clay, dark blue grey with very fine sericite flakes.</td>
</tr>
<tr>
<td>1980-2030</td>
<td>Newcastle (Muddy) siltstone, light grey,</td>
</tr>
<tr>
<td></td>
<td>limy, a little coarser in lower 15',</td>
</tr>
<tr>
<td></td>
<td>probably largely cavings.</td>
</tr>
<tr>
<td>2030-2235</td>
<td>Skull Creek (Thermopolis) clay, blue grey.</td>
</tr>
<tr>
<td>2235</td>
<td>Angular quartz grains in ashy matrix, light grey.</td>
</tr>
<tr>
<td>2295-2305</td>
<td>Dakota sandstone, fine grained, light grey,</td>
</tr>
<tr>
<td></td>
<td>angular, sericitic, some pyrite cemented.</td>
</tr>
<tr>
<td>2305-2335</td>
<td>Sand grains coarser and recrystallized,</td>
</tr>
<tr>
<td></td>
<td>clayey interbeds.</td>
</tr>
<tr>
<td>2335-2375</td>
<td>Sandstone, coarse, angular, poorly sorted, light pink.</td>
</tr>
<tr>
<td>2375-2405</td>
<td>Sandstone, fine, carbonaceous, light grey.</td>
</tr>
<tr>
<td>2405-2440</td>
<td>Fusion terra cotta and grey drab bentonite.</td>
</tr>
<tr>
<td>2440-2460</td>
<td>Sandstone, light green, bentonite matrix.</td>
</tr>
<tr>
<td>2460-2480</td>
<td>Bentonite, yellow brown and red brown.</td>
</tr>
<tr>
<td>2480-2490</td>
<td>Lakota sandstone, fine grained, light grey.</td>
</tr>
<tr>
<td>2490-2525</td>
<td>Sandstone, partly quartzitic.</td>
</tr>
<tr>
<td>2525-2605</td>
<td>Clay, bentonitic.</td>
</tr>
<tr>
<td>2605-2615</td>
<td>Sandstone, light grey, fine grained.</td>
</tr>
<tr>
<td>2615-2640</td>
<td>Morrison bentonite, dull olive drab.</td>
</tr>
<tr>
<td>2640-2650</td>
<td>Bentonite, varicolored, with ostracods.</td>
</tr>
<tr>
<td>2650-2710</td>
<td>Sandstone, grey, fine, clay, lavender, purplish at base.</td>
</tr>
</tbody>
</table>
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 ft.
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, porcelainous, 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^4 SE^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
305 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 Fosun 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  Pierre clay, bentonite, olive drab at weathered top, muscovitic.

470- 520  Clay with light grey spots.

520- 560  Clay somewhat darker grey, Sharon Springs (?).

560- 720  Niobrara chalky spotted marl, light grey.

720- 800  Carlile shale, dark grey.

800- 845  Siltstone, greywacke grey, limy matrix with biotite, sharp angular explosion fine fragments of quartz and perhaps kaolinitized feldspar.

845-1040  Shale, blue grey.

1040-1100/ Greenhorn limestone, more typical around 1100' which may be the real Greenhorn horizon with the usual INOCERAMUS AND GLOBIGERINA.

1100/-1210  Graneros shale, blue grey.

1210-1370  Shale, black, bituminous, fissile, considerable fish scales, Mowry.

1460  Greenhorn-like.

1700- and below  Some drab bentonite.
Cuttings are very poor. Resistivity log shows Newcastle sand 1800-1815' and Dakota sand at 2070'.

2100  Total depth.