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REPORT ON THE OIL AND GAS POSSIBILITIES OF THE UNIVERSITY BLOCK 46 IN CULBERSON COUNTY

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The benefits of education and of useful knowledge, generally diffused through a community, are essential to the preservation of a free government.

Sam Houston

Cultivated mind is the guardian genius of democracy. . . . It is the only dictator that freemen acknowledge and the only security that freemen desire.

Mirabeau B. Lamar

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REPORT ON THE OIL AND GAS POSSIBILITIES OF THE UNIVERSITY BLOCK 46 IN CULBERSON COUNTY[1]

BY J. W. BEEDE

Block 46 of the University of Texas land is located in the northeastern part of Culberson county, 16 miles south of the New Mexico state line and 22 miles west of the east line of the county. The most convenient railway point from which to reach the land is Van Horn on the Southern Pacific Railroad, 39 miles south and 18 miles west of the property. The public road from Van Horn to Carlsbad, New Mexico, avoiding the gypsum country on the east, passes through the center of this block. The tract of land included in this block is eight miles long and six miles wide. It contains 48 sections, amounting to approximately 30720 acres.

GEOLOGY

All of the rocks in the region of University Block 46 are of Permian age. The formations represented are the Delaware Mountain, which lies at the surface in the west half of the block, and the Castile gypsum, which occupies a trifle less than the east half of the block. For the most part these formations dip to the east or a little north of east.

This block of land lies about 15 miles east of the Delaware Mountains or escarpment and all the rocks of this escarpment pass under the University block, as do those that outcrop between the block and the escarpment. Consequently no intelligent idea of the rocks to be encountered in drilling can be obtained without a careful study of the escarpment and the rocks outcropping between it and the University land. For that reason two sections were measured on the escarpment, one nearly opposite the north end and the other nearly opposite the south end of the block.

The one farther north was measured over the highest point on the Delaware escarpment north of Hogue Canyon.

[1]Published February, 1924.

It lies nearly due east from the concrete tank on the east side of Salt Flat on the Six Bar, or Delaware Ranch. From there it swings northward to a high mountain with a sandstone top and then east down the ridge running just north of the D South wells to the point about north of the wells. Here it was offset to the point at the K.C. Last Chance wells. From this point it extends east along the ridge south of Chico Draw, to the flat west of the 7 L (Seven L) wells.

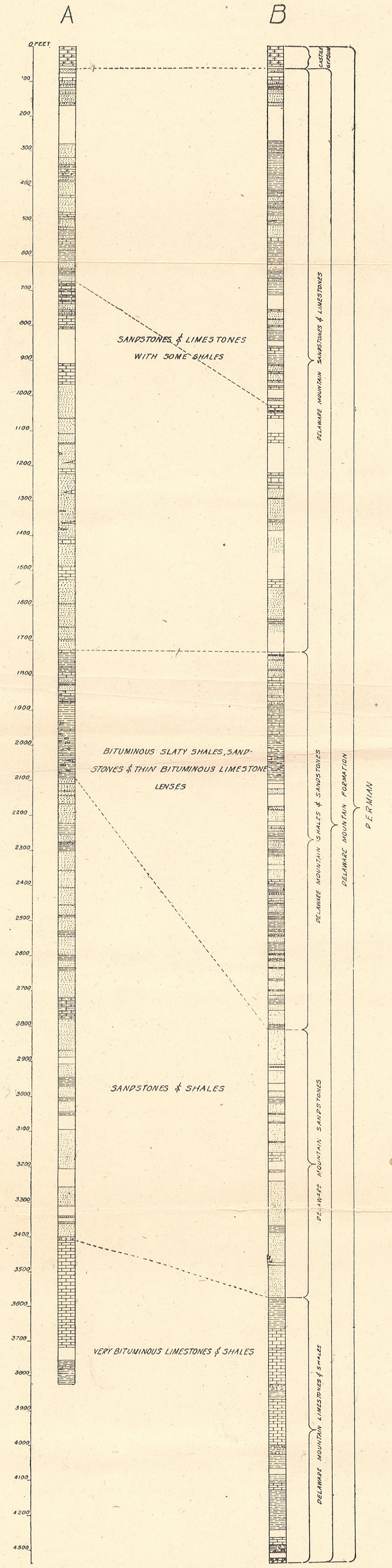
The south section was taken over the main scarp just north of Hogue Canyon and carried down Chico Draw and the divide south of it to the Last Chance Wells. Here it offset to the south of the old Terry Church and thence nearly east to Wildhorse Draw, thence southeast to the south line of the block and east to the gypsum beds on the scarp east of the Van Horn Road.

As nearly as possible the details of the succeeding beds were studied for the full distance. A comparison of the two sections shows some rather remarkable variations. The two sections are of sufficient importance to warrant including in this report. These sections follow:

North Delaware Mountain Section

Between base of Escarpment east of Murchant concrete tank and Whitehorse Draw on the northern part of the University Block No. 46.

96. Sandstone, yellow, some shaly and brown with large concretions	40
95. Sandstone, light, some shale, two beds	20±
94. Shale, sandy, and limestone concretions and beds	35
93. Shale, 5 feet with massive sandstone on top	10
92. Sandstone, shaly	10
91. Sandstone, yellow	30
90. Limestone, 1 foot, followed by sandstone	50
89. Limestone, sandy, grading into sandy shale	10
88. Shales, sandy, dark buff	10
87. Sandstone, massive, light yellow, 20 feet to	25
86. Sandstone, rather massive, buff	10±
85. Shales, yellowish, sandy, probably weathering as sandstone under different exposure	15
84. Sandstone, shaly, "Base ball" concretions	7
83. Shale, dark brown, carrying nodular limestone with minute ammonoid fauna, 1 foot at the top	15



Geologic section; A, North Delaware Mountain section; B, South Delaware Mountain Section.

82. Limestone, dark concretionary	1
81. Shale, carbonaceous, dark brown, to yellow on weathering	10
80. Sandstone, yellow, shows tendency to spherical weathering	10
79. Shale, yellow, sandy, varying to brown	25
78. Shale, sandy with concretions a foot in diameter, which split up into horizontal slices on weathering	5
77. Limestone, thin plates and sandy shales to top of thin dark limestone which weathers into pieces resembling rounded loaves of bread	23
76. Sandstone, limestone, etc., mostly concealed	30
75. Limestone, drab, Fusulina, ammonoids, large sandy limestone concretions	15
74. Concealed, partially. Largely thin limestones with ammonoids at the top. Probably contains "iron fossil" horizon and has the *Waagenoceras* horizon at its base 30	30
73. Limestone, dark several layers, 4 to	5
72. Shales, sandy, and sandstone grading into limestone	4
71. Limestones, thin dark, marly partings, sandy limestone at base	5
70. Sandstone, some of it shaly and some of it soft	18
69. Limestone, hard, darkly mottled, weathers shaly locally, makes line along outcrop. Two beds, thin shale parting	3
68. Sandstone	7
67. Limestone, or sandy limestone, weathers shaly, top of main ledge	2
66. Limestone, even-bedded, hard, mottled,, marly partings, weathers shaly in slope exposures. Ammonoids	25
65. Sandstone, massive	5
64. Limestone, ammonoids, bright green shale in talus	5
63. Sandstone, thick and massive in part. Rest concealed. Precise thickness not determined on account of fault	100±
62. Limestone, nodular	3
61. Limestone, mostly. Some soft sandstones and marls	13
60. Limestones, thin and marls	12
59. Limestone, massive, highly jointed, weathers to rusty color	3—
58. Marls with thin sheet or two of limestone	5
57. Limestone, rather firm, nodular, thin-bedded	5
56. Sandstone, with sparse limestone nodules	6
55. Limestone, somewhat conglomeratic, thin beds	5
54. Limestone, thin, lenticular, nodular, and marls	5
53. Sandstone, massive so far as exposed, some shale sheets	157

52.	Sandstone, some limestones	100
51.	Limestones, shaly to massive shale parting	15
50.	Sandstone and concealed. Slope has a hard 8-inch limestone in it	100
49.	Limestone, thin, slaty, slightly fossiliferous brown sandstone, some nearly white sands	125
48.	Sandstone	70
47.	Limestone, marly partings, ammonoids, grades into sandstone farther west	38
46.	Sandstone and shales, southward and eastward is 15 to 20 feet limestone lens which is not seen a little farther north. Total thickness	215
45.	Shale 15 feet. Limestone, mottled, 8 inches; 50 feet of shales, 1 foot limestone at top	67
44.	Limestones, fossiliferous, somewhat cherty, sponges, brachiopods, bryozoa, etc. 15 to	17
43.	Sandstones, etc. limestone lens	50
42.	Limestone, like those below, 18 inches, interval mostly shale. Some fossiliferous limestone in upper part	90
41.	Shale, prevailing sandy, part of it calcareous, fissile, black, with small lenses of limestone	75
40.	Limestone, first layer above the great sandstone succession, 18 inches. Shales rusty to drab, brittle, black, bituminous, limestone lenses and shales	75
39.	Sandstone, massive, uppermost bed of succession. Few fossils, shale partings, top composed largely of Fusulina	15
38.	Sandstones, shale partings and some thin shale beds	55
37.	Sandstone, yellow, locally contains fusulinas, occasional coral or shell	55
36.	Shale	25
35.	Sandstone, locally containing Fusulina	25
34.	Shale, black to sandy	25
33.	Sandstone, massive, occasional Fusulina	50
32.	Shale, sandy, blackish, and yellow sandstone, semiquartzitic layer 75 feet below the top, mostly sandstone	260
31.	Sandstone, massive, yellow, occasional Fusulina	20
30.	Shales, drab	10
29.	Sandstone, massive, some fusulinas	25
28.	Sandstone, massive, barren, yellow	55
27.	Shales, sandy	60
26.	Sandstone, yellow, shale partings	80
25.	Sandstone alternating with blue shale, some black calcareous matter	20
24.	Shale and sandy shale for the most part, partially concealed	20

23.	Sandstone, massive, yellow	40
22.	Shales, olive, sandy, followed by fine hard olive sandstone, weathering into semi-quartzite bed	25
21.	Sandstone, massive, yellow	30
20.	Shales, olive, sandy, or sandy marls weathering drab, three sandstone beds in the upper part	50
19.	Concealed	40
18.	Sandstone, soft yellow	55
17.	Sandstone, soft, buff, thickest part of a lens. This sandstone weathers nearly to a quartzite at top, flesh-colored, brownish within, 125 to	60
16.	Concealed	50
15.	Sandstone, soft, buff, Fusulina in lower part	55
14.	Concealed	30
13.	Sandstone, soft, buff-gray	5
12.	Concealed	12
11.	Shales, sandy dark	6
10.	Concealed, largely sandstone as seen farther north	40±
9.	Limestone conglomerate and breccia, cephalopods, brachiopods, fish teeth, etc.	7±
8.	Limestone, black or brownish, thicker bedded than below, thin shale partings. Fossils.	25
7.	Limestone, laminated, black, bituminous, bedding crumpled locally, somewhat siliceous. Upper part weathers drab, lower part more buff, on some exposures	110
6.	Concealed (bituminous shale?)	65
5.	Limestone, black slaty, quite bituminous, concretions	100
4.	Talus to base of cliff	35
3.	Shale, black, slaty bituminous, some fossils	15
2.	Limestone, drab, composed of fragments of fossils including Fusulina	2—
1.	Shales, black, slaty, bituminous, very hard and limestones sheets, fossiliferous, lens-shaped concretions	45

South Delaware Mountain Section

130.	Gypsum, apparently formed by the replacement of limestone. Thickness varies with distance from the escarpment.	
129.	Concealed, probably gypsum	10
128.	Limestone, laminated, hard, blue to gray, very bituminous	5±
127.	Concealed, 6 feet to	10
126.	Sandstone, calcareous, lower part harder than the upper, weathers to buff-brown	11
125.	Shales, soft sandy, dark buff, partially covered	15
124.	Limestone, slabby, banded, rusty and dark blue, excellent horizon marker. 4 inches to	1

123.	Sandstone, dark, shaly, and broken	15
122.	Sandstone, rather massive, gray to yellow	7
121.	Shale, brownish	10
120.	Sandstone, gray	15
119.	Sandstone, shaly, darker near its base, and sandstone, soft gray	43
118.	Concealed	100
117.	Sands and shales	240
116.	Concealed, sandy material	40
115.	Concealed, largely. Contains some sandstone, and some thin limestone and sandstone plates.	130
114.	Shale	40±
113.	Concealed	40±
112.	Limestone, gray to buffish, siliceous, Fusulina and other ground up fossils	4
111.	Sandstone, with 18-inch calcareous sandstone at base	25±
110.	Sandstone, with two beds of limestone	35
109.	Shale, sandy, at base. Rest concealed	35
108.	Concealed. Contains limestone bed with pelecypods	20
107.	Shale, brownish, sandy, brown sandstone at top	10
106.	Concealed, lower part. Upper 20 feet limestone, some sandstone, small *Waagenoceras* and minute ammonoid fauna	75
105.	Limestone and sandstones with thin blue-gray limestone at the top	60
104.	Limestone, thin, with thin sandstones and marls, nearly all talus covered much of the way. Minute ammonoid fauna with some larger ones	60
103.	Limestone, followed by thin marl bed (*Waagenoceras* bed) and long slope with "iron fossils" and limestone concretions resembling base balls	40
102.	Concealed, largely, with some sandstone and limestone at the base	55
101.	Limestone	25
100.	Concealed, 90 to	100
99.	Limestone, ammonoid, forms row of points	50±
98.	Massive sandstone and concealed slope	145
97.	Sandstone and concealed slope	155
96.	Limestone, cephalopod, with other material interbedded	20
95.	Sandstone, soft, with heavy indurated rusty bed at 65 feet	100
94.	Sandstone, massive, very soft, with brown siliceous sandstone on top, much of section talus covered	90
93.	Sandstone slabs and limestone	25
92.	Sandstones, platy, with shale and limestone beds in the lower part. Upper part largely sandstone slabs weathering to yellowish shade, more or less cherty casts of fossils	120

91. Limestone breccia, few fossils, blue-black in color, bituminous, a set of irregular concretionary masses 0 to	10
90. Shales. Some limestone beds and lenses to the base of the limestone ledge	165
89. Shaly and limy beds, some limestone locally, very bituminous	55
88. Slope containing slabby sandstone plates, shales, etc. Shales sandy, nearly black, carbonaceous, slaty, some limestone concretions	33
87. Concealed	35
86. Concealed, with hard thin black sandstone on top	7
85. Sandstone, massive, to top of heavy ledge. Fusulina at the top	35
84. Concealed	12
83. Sandstone, full of Fusulina	5
82. Sandstone, massive	10
81. Shale. hard, bituminous, sandy	15±
80. Sandstone, hard, blocky, Fusulina	2
79. Sandstone, soft	18
78. Shale, bituminous and thin sandstone	15
77. Sandstone, coarse, massive, somewhat calcareous, weathers reddish	20±
76. Concealed. Contains a light green sandstone	10
75. Sandstone, shaly, fine-grained, Fusulina	20±
74. Limestone, quite sandy, full of fusulinas	7
73. Shale, bituminous	2
72. Sandstone, somewhat bituminous	7
71. Shale, black, bituminous, fissile	3
70. Sandstone	12
69. Limestone, two beds, blue-gray, weathers buffish	2
68. Sandstone, thinner bedded at base	12
67. Shales, black, sandy near top, very carbonaceous	15
66. Sandstone, few long fusulinas, 20 to	25
65. Shale, sandy, dark, carbonaceous, 2 foot of sandstone, lens near the middle	13
64. Sandstone, soft	4
63. Shales, hard, dark	3—
62. Sandstone, soft, some fusulinas locally	7
61. Shale, dark	2±
60. Shale, dark, sandy and soft sandstone	15
59. Sandstone, massive	10
58. Shale and sandstone	5
57. Sandstone, massive	13
56. Shale, dark, two thin sandstone lenses in middle	10
55. Sandstone, massive, Fusulina	18
54. Shale, fissile, sandy, black to blue-black when wet	22
53. Sandstone, massive, two shale partings	18

52. Sandstones interstratified with thin shale beds	7
51. Sandstone, massive, 3 feet to	4
50. Shale, bituminous, and thin sandstone lenses	10
49. Sandstone, massive	22
48. Shales, drab to olive, sandy, somewhat carbonaceous	8
47. Sandstone, massive irregularly bedded, local sheets of shale	35
46. Shale, like shale beds above it, local thin sandstone lenses, 4 feet to	6
45. Sandstone, massive, two distinct beds	30
44. Shale parting	2
43. Sandstone, calcareous, locally filled with fusulinas.	15±
42. Shale, black, sandstone sheet in the middle	8
41. Sandstone, local shale partings, 6 to	15
40. Shale, bituminous, 3 to	15
39. Sandstone, with small and large concretions, the larger with light calcareous rims and sandy inside. Ripple marks and some shaly partings	20±
38. Sandstone, shaly, most of interval concealed	40
37. Shale, partly bituminous	15
36. Sandstone, rather massive	115
35. Concealed, thin quartzitic sandstone near top	20
34. Sandstone, 10 feet at base, rest concealed to top which is dark platy sandstone	40
33. Concealed, apparently shale	25
32. Sandstone	25
31. Shale, slaty, bituminous	15
30. Sandstone, with black slaty shale at 25 feet.	65
29. Sandstone, massive, 1 foot reddish siliceous sandstone at the top	65
28. Sandstone	35
27. Sandstone, heavy, alternating with shales, 4-foot limestone with Fusulina 5 feet below top	30
26. Concealed, largely. Contains two sandstone beds 3 feet thick, some hard bituminous shale and much soft thin sandstone. Forms grassy slope	60
25. Sandstone, many soft streaks, probably some shale, in lower part. Fusulina in the upper part	140
24. Shales, locally brown, weathering yellow, followed by sandy shales and soft shaly sandstones	22
23. Sandstones, massive, yellow, rather thick beds, fairly coarse-grained	100
22. Concealed, apparently black shale	10
21. Sandstone, massive, base yellow	100
20. Shaly material, very bituminous, contains sandy beds, top of limestone-shale section	95
19. Limestone, slightly more resistant than beds above and below it	8

18.	Limestone, more shaly than the one below it	60
17.	Limestone, rather slaty, black, bituminous, weathers to lighter shale. Flattened fossils	110
16.	Limestone, thin-bedded, beds contorted, bituminous, weathers with rusty edges	12
15.	Limestone, black, bituminous, thin gnarly beds which appear to be folded but may be concretionary	25
14.	Limestone, like the rest but more shaly and even-bedded	20
13.	Limestone, thin-bedded, gnarled, folded and concretionary beds, blue-black, bituminous, weathers bluish-gray, usually forms talus slope	55
12.	Limestone, hard, platy, dark blue, very bituminous, forms base of first lower black cliff	85
11.	Sandstone, fine-grained, dirty brown, shaly, or very sandy shales, weathers dark yellow	25
10.	Shales and concealed slope. Shales brownish, very bituminous, some concretions	45
9.	Concealed	20
8.	Shale, papery, black, very bituminous, flattened ammonoids, resembles base of north section	25
7.	Limestone, massive, black, fine-grained, very bituminous, weathers light blue and slaty	20
6.	Shale, papery, black, very bituminous, almost "oil soaked" concretions, large ammonoid, and small concretions	115
5.	Concealed, probably shale	25
4.	Limestone, composed of ground fossils and large Fusulina, and siliceous or cherty material, locally very bituminous, upper 5 feet more platy than the rest	13
3.	Shales, papery, black, very bituminous, fossiliferous, large concretions and smaller concretions	27
2.	Concealed	10
1.	Limestone, fault breccia, nearly vertical. Talus slope from there to the flat below. Thickness	15±

It will be seen from the sections (Plate I), that, so far as our present discussion is concerned, the Delaware Mountain formation falls readily into four parts. First (beginning below); at the bottom black, bituminous, shales and limestone. Second; the thick, yellowish sandstones with rather distant shale partings. Third, the brownish, rather bituminous shales with limestones and some sandstones.

Fourth; very thick sandstones alternating with less thick limestones, and rather hard shales.

There is relatively little change in the thickness and appearance of the black shales and limestone, referred to by some geologists as "oil shale." However there is a very marked change in the thickness of the yellow sandstones which follow it, amounting to 550 feet, in a distance of not far from five or six miles. This appears to be due in part to the setting in or thickening up of shaly beds in the upper part of the section as one goes south. It may possibly be accounted for to some extent by faulting in the north section, though this is by no means all of it.

While the heavy sandstones are much thicker in the northern than in the southern section, the added thickness of the overlying shaly and limestone beds in the southern section more than counterbalance the reduction in thickness in the underlying sandstones which amounts to 720 feet. The thickness of the higher beds in the two sections varies but little.

Another point of interest is the fact that in some of the beds there is a tendency for the limestones to set in as one goes east. This is not so marked, perhaps as might be expected, yet there is evidence of it locally. Together with this is found a tendency for the shales to thicken in the same direction. This is particularly true in a south or east of south direction. Moreover these shales are sometimes fifty or more feet thick and bituminous, and frequently they are associated with large sandstone beds or lenses.

There are reasons for supposing that something of the same kind occurs in the yellow sandstone beds below as well. If this is actually the case it would reduce the large thickness of the basal bed of sandstone below the first shale of considerable thickness and increase the thickness of the shales over and in it until the sand might become a fair container for oil from the underlying very bituminous shales and limestones.

It will be seen from the sections that the top of these so-called "oil shales" should be reached on block 46 at a depth of about 3400 feet and the base at an uncertain depth, four hundred or more feet, below that. The 3400 foot depth would be the best chance for oil unless there should be a good sandstone below the limestone and shales. This is not known to be the case in this latitude in the Delaware mountain region. The diamond drill at Guadalupe Point revealed no such sand.

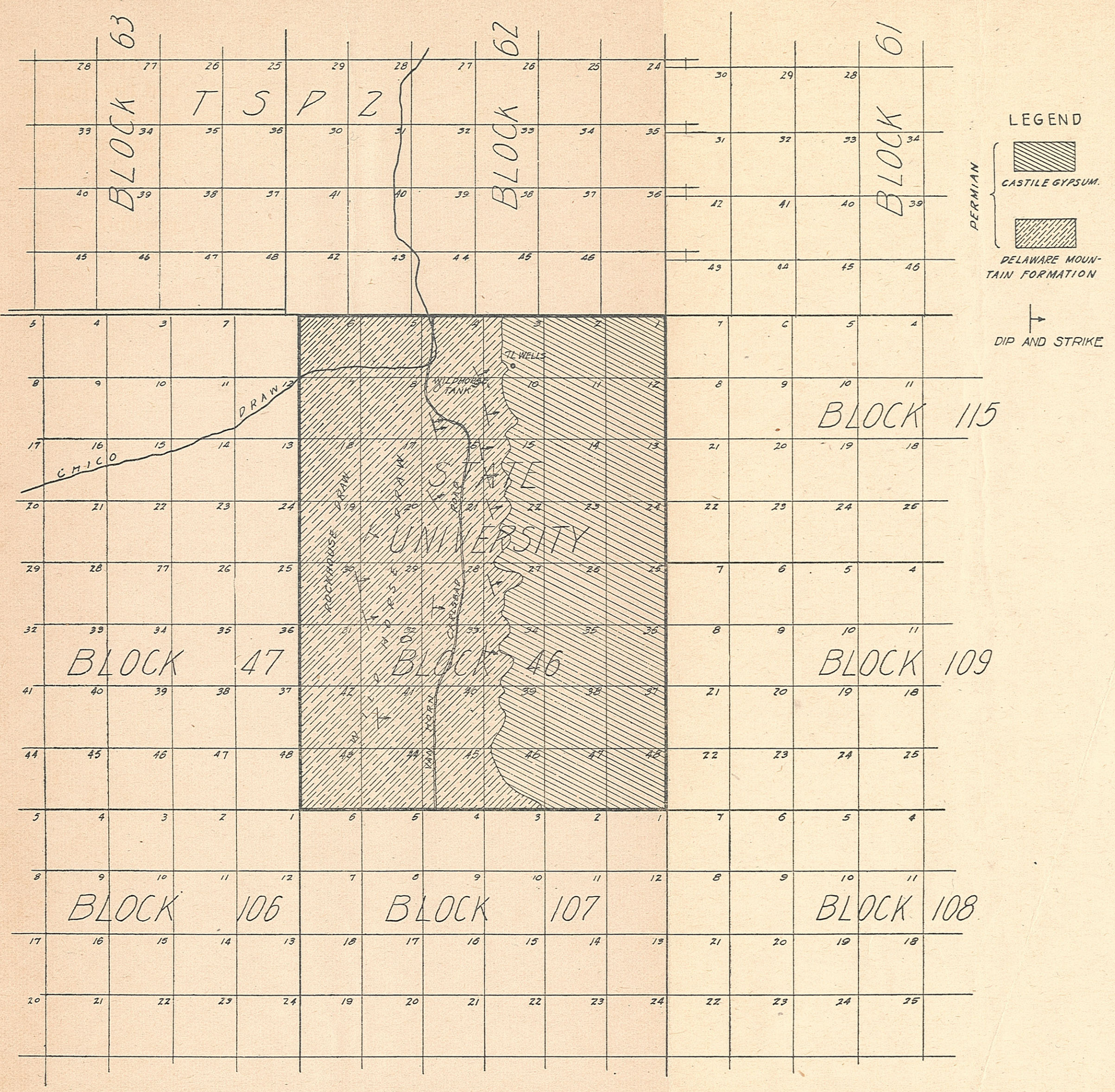
The opportunity of possibly getting oil in the higher shales is not to be overlooked. It may be important.

Structure

The structure of this region is quite as remarkable as its stratigraphy. The Delaware escarpment is to a considerable extent a fault scarp, and is highly elevated. Nevertheless there is but very slight amount of folding to be noted. There are changes of dip which are easily noticeable locally, but on the whole the main structural features of the western part of the area are faults of relatively little displacement. They are usually nearly vertical and, near the escarpment, are parallel to it and open at the surface, the interior being filled apparently by crystallization of calcareous material infiltrated from the sides at shallow depths. They are probably closed a short distance below. One of these was seen in a ravine which formed a vertical wall that was from three to six feet thick and stood nearly fifteen feet high. Farther east the faults are closed and usually show drag. They become very inconspicuous as the University block is approached and are noticeable only on the scarp east of the Carlsbad road. Here they are very small and form lines along which replacement of limestone with gypsum has taken place. These faults, though quite small may be of importance in locating wells.

There are very few folds of any great consequence in this whole region. It is doubtful if there is an actual closure between the D. Ranch road and the Carlsbad road on the University block. However, terraces do occur as is the case shown on the map of the University block, in section 28. The significance of these terraces will be apparent when it is stated that the dips vary from a hundred to four hundred feet to the mile. So far as determined the dips on that part of the University block which is not covered by gypsum deposits are shown on the map. No attempt was made to determine the structure in the gypsum area, since that is impossible.

From a structural standpoint there are possibilities of the accumulation of oil beneath University block 46. It deserves a thorough test.



GEOLOGIC MAP OF UNIVERSITY BLOCK 46 CULBERSON COUNTY, TEXAS.

BY J.W.BEEDE. SCALE: 0 1 2 3 4 MILES

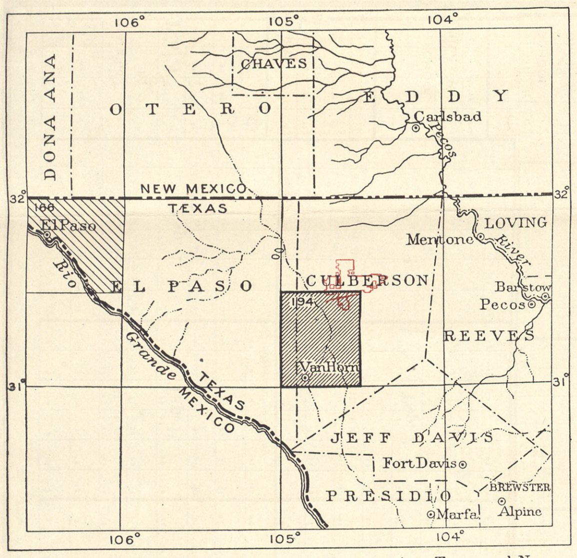


FIGURE 1.—Index map of part of trans-Pecos region, Texas and New Mexico.

The location of the Van Horn quadrangle is shown by the darker ruling. The El Paso folio (No. 166), previously published, is indicated by lighter ruling.

STRUCTURE

TRANS-PECOS REGION

The dominant structure of the trans-Pecos region is expressed in the northwestward to northward trend of the highlands and intervening lowlands. The highlands are areas of relative uplift and the lowlands are troughs of corresponding depression. The chief movements of the rocks have been vertical, and the main structural features are normal faults. Most of the highland areas are bounded by faults that strike in general with the main trend of the region, though some cut this transversely. In general, the strata either lie nearly flat in the plateaus or are inclined at greater or less angles that form, according to the degree of dip, narrow mountain ridges or broad monoclinal slopes. In places masses of igneous rock have domed and tilted the strata through which they have been intruded.

The major faults apparently were initiated with the Tertiary continental emergence and developed between then and the late Tertiary or early Quaternary uplift. During Mesozoic and Paleozoic time there was in general comparatively little disturbance of the strata in trans-Pecos Texas north of the Texas & Pacific Railway, although there is evidence of a number of regional uplifts and subsidences and of slight local pre-Pennsylvanian tilting (p. 5). It should be noted, however, that the general absence of structural disturbance in this area during the Paleozoic and Mesozoic eras is in contrast with the sharp folding of the Paleozoic strata in the vicinity of Marathon, Brewster County, Tex., about 100 miles southeast of Van Horn, which R. T. Hill and J. A. Udden consider to have taken place in pre-Cretaceous time. In pre-Cambrian time profound structural disturbances occurred, in the development of which lateral pressure was the effective agent in contrast with the vertical movements which produced the dominant later structures.

STRUCTURE OF THE VAN HORN QUADRANGLE

Types.—In the Van Horn quadrangle both the earlier lateral and the later vertical types of structure are developed, although here, as throughout the region, the vertical type is the more prominent.

The earlier structure is recorded by the steeply tilted and obscurely folded Algonkian (?) rocks, in which two main structural trends are present—one northeast and southwest and the other east and west.

The later movements, produced by vertical forces, resulted in normal faults with steep dip, which range in displacement from a few feet to more than 1000 feet. The faults strike in various directions, the most prominent trending northwest, though some strike northeast and east and others have still different trends.

Salt Flat.—Salt Flat is the central structural feature of the quadrangle. It is a depressed trough, above which the highland masses on both sides have been relatively raised. The differential movements along the border of the basin apparently began during the post-Cretaceous uplift and were continued, at intervals through Tertiary time. Different dates of uplift are indicated by the relatively young fault scarp of the eastern Sierra Diablo and the maturely dissected zone along the base of the Delaware and Apache mountains. The attitude of the bedrock underlying Salt Flat is concealed by the thick cover of Quaternary deposits.

EXPLANATION

No geological report is available for this entire block of acreage, therefore, U. S. Government and Texas Geological Reports covering parts of this acreage and adjoining areas are made use of in arriving at the general geological conditions existing within it.

The shaded areas within the red boundries on the sectionized map of this territory are not included in this property. Those in the western part happen to be located in the roughest and most elevated part of this property.

At the left of this page are certain plates and extracts taken from U. S. Geological Folio No. 194, Van Horn, Texas, by Dr. G. B. Richardson, which are descriptive of the geology of the south part of this acreage.

By referring to the sectionized map of this territory it will be observed that this block of acreage, indicated by the red boundries, adjoins the west and south lines of University block 46 on which Dr. J. W. Beede made a report on the oil and gas possibilities. (Bulletin No. 2346, Bureau of Economic Geology, State of Texas.) At the right of this page is a copy of this report less the measurements which due to lack of space cannot be included. Section A (Plate 1) of this report was measured across the north end of this property. Section B. (Plate 1) of this report was measured across the north central part of this property.

Dr. G. B. Richardson's cross section of the Delaware escarpment (left) shows a major fault along the western boundry of the escarpment. This major fault enters this property from the south at approximately Section 4, School Block 66 and leaves it at approximately Section 6 School Block 67 at the north side.

Considering the structure section across Delaware escarpment and the fault zone by Dr. G. B. Richardson and the report by Dr. J. W. Beede on the formations in the locality it appears that the Permian sand bodies immediately west of the major fault should produce oil and gas in considerable quantities, provided, the major fault is sealed and there are structural closures effected primarily by this normal fault. It also appears that many other structural closures effected primarily by normal faults, similar in principal to those that are productive in the Mexia, Texas, district, should be found on this acreage some of which should be productive.

The Missippian, which was first reported by Dr. J. W. Beede (Bulletin No. 1852, Bureau of Economic Geology, State of Texas 1921) outcropping in the Hueco Mountains sixty miles to the west, no doubt, underlies this property and it appears that it can be reached by the drill in the area immediately east of the major fault and between it and the erroded Delaware escarpment. (See structure section by Dr. G. B. Richardson, left.)

This acreage is located sixty miles south of the Artesia, New Mexico, oil field which is the nearest commercial oil production, however, about twenty miles east of the east end of this block is the Toyah shallow pool which was operated during the world war and due to its quality the product commanded a very high price, the quantity, however, was small. This oil, no doubt, is a migratory accumulation which has escaped, through faulting, from the underlying Delaware Mountain Formation the top of which is found in that locality at approximately three thousand feet. The volatile properties of this oil having escaped leaving only the heavy oil which with very little refining makes a high grade lubricating oil.

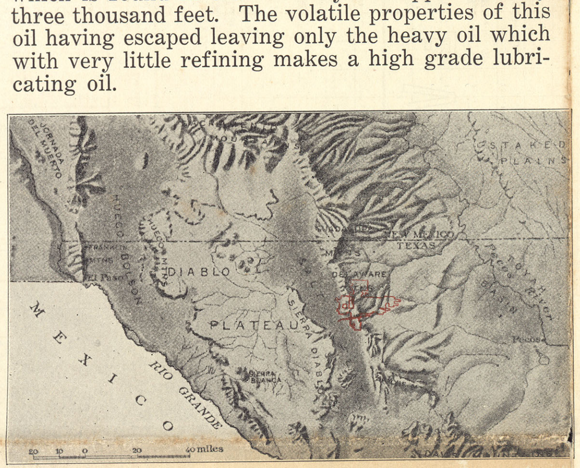
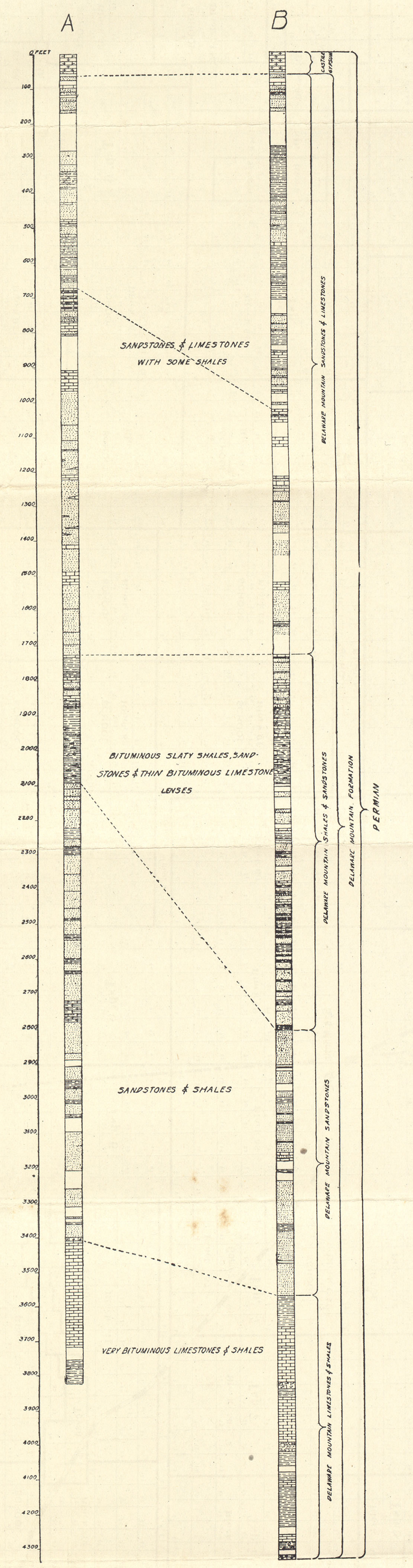


Figure 2.—Relief map of part of trans-Pecos region, Texas and New Mexico.

The Van Horn quadrangle lies in the south-central part of the area, including the southeast end of the Sierra Diablo and the west end of the Apache Mountains.



Geologic section; A, North Delaware Mountain section; B, South Delaware Mountain Section.

REPORT ON THE OIL AND GAS POSSIBILITIES OF THE UNIVERSITY BLOCK 46 IN CULBERTSON COUNTY

By J. W. Beede

Block 46 of the University of Texas land is located in the northeastern part of Culberson county, 16 miles south of the New Mexico state line and 22 miles west of the east line of the county.

GEOLOGY

All of the rocks in the region of University Block 46 are of Permian age. The formations represented are the Delaware Mountain, which lies at the surface in the west half of the block, and the Castile gypsum, which occupies a trifle less than the east half of the block. For the most part these formations dip to the east, or a little north of east.

This block of land lies about 15 miles east of the Delaware Mountains or escarpment, and all the rocks of this escarpment pass under the University block, as do those that outcrop between the block and the escarpment. Consequently no intelligent idea of the rocks to be encountered in drilling can be obtained without a careful study of the escarpment and the rocks outcropping between it and the University land. For that reason two sections were measured on the escarpment, one nearly opposite the north end and the other nearly opposite the south end of the block.

The one farther north was measured over the highest point on the Delaware escarpment north of Hogue Canyon. It lies nearly due east from the concrete tank on the east side of Salt Flat on the Six Bar, or Delaware Ranch. From there it swings northward to a high mountain with a sandstone top and then east down the ridge running just north of the D South wells to the point about north of the wells. Here it was offset to the point at the K. C. Last Chance wells. From this point it extends east along the ridge south of Chico Draw, to the flat west of the 7 L (Seven L) wells.

The south section was taken over the main scarp just north of Hogue Canyon and carried down Chico Draw and the divide south of it to the Last Chance Wells. Here it offset to the south of the old Terry Church and thence nearly east to Wildhorse Draw, thence southeast to the south line of the block and east to the gypsum beds on the scarp east of the Van Horn Road.

As nearly as possible the details of the succeeding beds were studied for the full distance. A comparison of the two sections shows some rather remarkable variations. The two sections are of sufficient importance to warrant including in this report. These sections follow:

* * * * * * * *

It will be seen from the sections (Plate 1), that, so far as our present discussion is concerned, the Delaware Mountain formation falls readily into four parts. First (beginning below); at the bottom black, bituminous, shales and limestone. Second; the thick, yellowish sandstones with rather distant shale partings. Third; the brownish, rather bituminous shales with limestones and some sandstones. Fourth; very thick sandstones, alternating with less thick limestones, and rather hard shales.

There is relatively little change in the thickness and appearance of the black shales and limestones, referred to by some geologists as "oil shale." However there is a very marked change in the thickness of the yellow sandstones which follow it, amounting to 550 feet, in a distance of not far from five to six miles. This appears to be due in part to the setting in or thickening up of shaly beds in the upper part of the section as one goes south. It may possibly be accounted for to some extent by faulting in the north section, though this is by no means all of it.

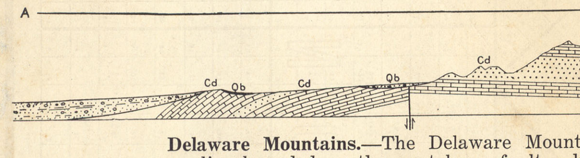
While the heavy sandstones are much thicker in the northern than in the southern section, the added thickness of the overlying shaly and limestone beds in the southern section more than counterbalance the reduction in thickness in the underlying sandstones, which amounts to 720 feet. The thickness of the higher beds in the two sections varies but little.

Another point of interest is the fact that in some of the beds there is a tendency for the limestones to set in as one goes east. This is not so marked, perhaps, as might be expected, yet there is evidence of it locally. Together with this is found a tendency for the shales to thicken in the same direction. This is particularly true in a south or east of south direction. Moreover these shales are sometimes fifty or more feet thick and bituminous, and frequently they are associated with large sandstone beds or lenses.

There are reasons for supposing that something of the same kind occurs in the yellow sandstone beds below as well. If this is actually the case it would reduce the large thickness of the basal bed of sandstone below the first shale of considerable thickness and increase the thickness of the shales over and in it until the sand might become a fair container for oil from the underlying very bituminous shales and limestones.

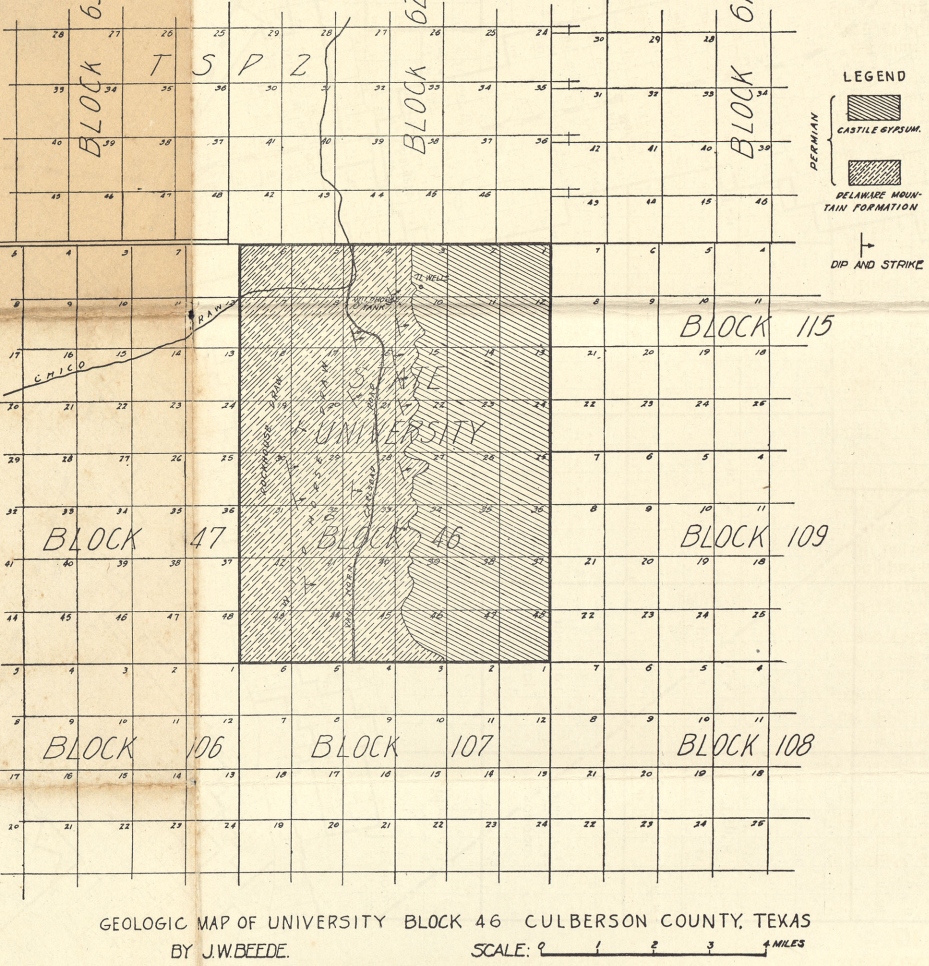
It will be seen from the sections that the top of these so-called "oil shales" should be reached on block 46 at a depth of about 3400 feet and the base at an uncertain depth, four hundred or more feet, below that. The 3400 foot depth would be the best chance for oil unless there should be a good sandstone below the limestone and shales. This is not known to be the case in this latitude in the Delaware mountain region. The diamond drill at Guadalupe Point revealed no such sand.

The opportunity of possibly getting oil in the higher shales is not to be overlooked. It may be important.



Delaware Mountains.—The Delaware Mountains are an east-dipping monocline bounded on the west by a fault, which separates them from Salt Flat. The disturbed zone is marked in places by a belt of foothills, forming a downthrown block, in which the maximum dip of the strata is 15° SW. The rocks of the main Delaware Mountains dip 1°-5° NE. At the extreme southern end of the mountains there are diverse dips and a low anticlinal fold of small extent.

FIGURE 3.—Generalized geologic map of northern trans-Pecos Texas.

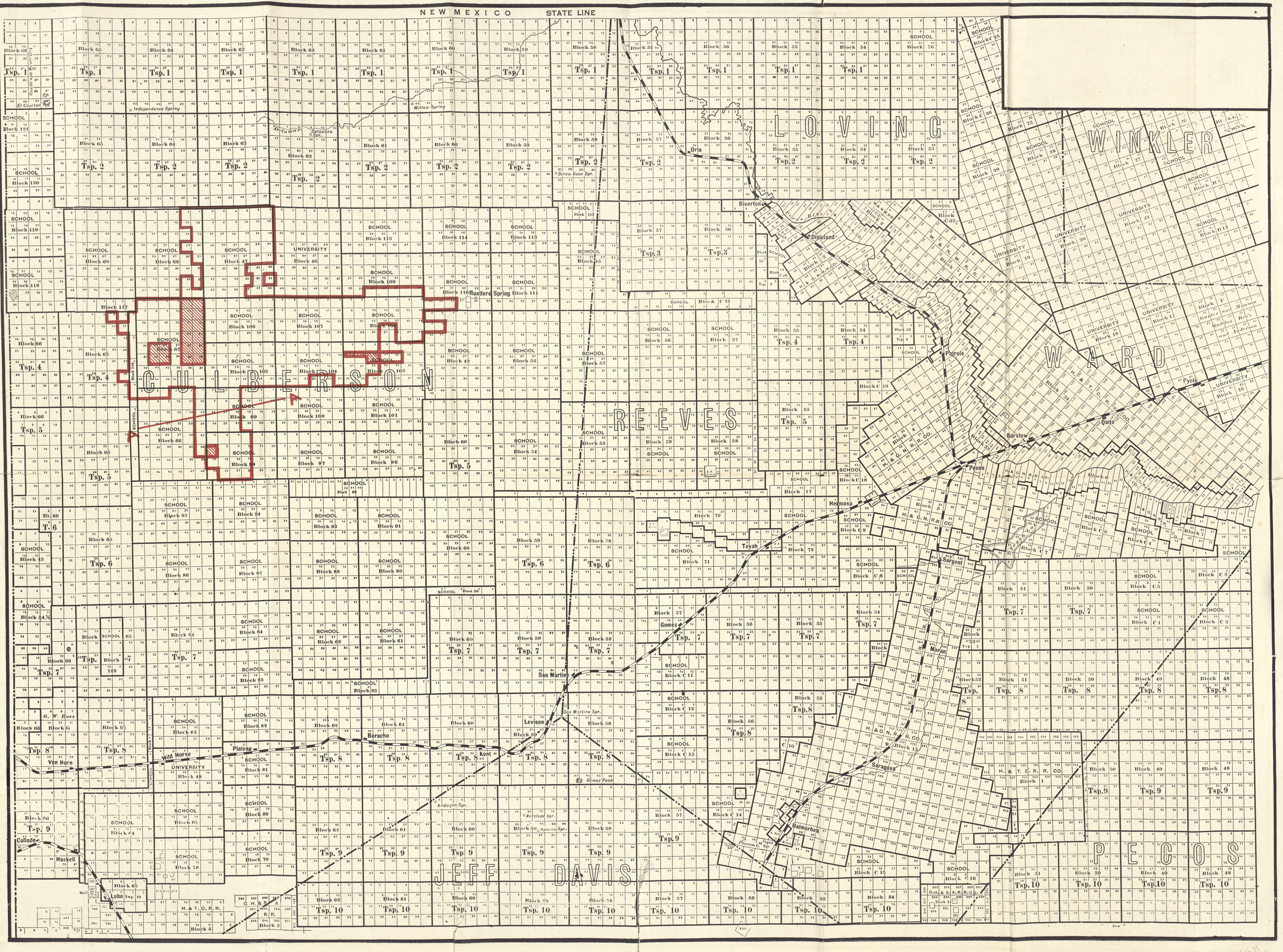


STRUCTURE

The structure of this region is quite as remarkable as its stratigraphy. The Delaware escarpment is to a considerable extent a fault scarp, and is highly elevated. Nevertheless there is but very slight amount of folding to be noted. There are changes of dip which are easily noticeable locally, but on the whole the main structural features of the western part of the area are faults of relatively little displacement. They are usually nearly vertical and, near the escarpment, are parallel to it and open at the surface, the interior being filled apparently by crystallization of calcareous material infiltrated from the sides at shallow depths. They are probably closed a short distance below. One of these was seen in a ravine which formed a vertical wall that was from three to six feet thick and stood nearly fifteen feet high. Farther east the faults are closed and usually show drag. They become very inconspicuous as the University block is approached and are noticeable only on the scarp east of the Carlsbad road. Here they are very small and form lines along which replacement of limestone with gypsum has taken place. These faults, though quite small may be of importance in locating wells.

There are very few folds of any great consequence in this whole region. It is doubtful if there is an actual closure between the D. Ranch road and the Carlsbad road on the University block. However, terraces do occur as is the case shown on the map of the University block, in section 28. The significance of these terraces will be apparent when it is stated that the dips vary from a hundred to four hundred feet to the mile. So far as determined the dips on that part of the University block which is not covered by gypsum deposits are shown on the map. No attempt was made to determine the structure in the gypsum area, since that is impossible.

From a structural standpoint there are possibilities of the accumulation of oil beneath University block 46. It deserves a thorough test.


NEW MEXICO STATE LINE
LOVING
WINKLER
WARD
CULBERSON
REEVES
PECOS
JEFF DAVIS
El Capitan
Independence Spring
Willow Spring
Oria
Riverton
Dixieland
Rustlers Spring
Pecos
Barstow
Quito
Pyote
Hermosa
Toyah
Sargent
Moran
San Martine
Gomez
Levison
Boracho
Kent
Plateau
Wild Horse
Van Horn
Saragosa
Balmorhea
Culladon
Haskell
Lobo