GEOLOGY AND PETROLEUM RESOURCES OF THE DE BEQUE OIL FIELD, COLORADO.

By E. G. Woodruff.

INTRODUCTION.

The data presented in this paper relate to the geology and petroleum resources of a small area in the vicinity of De Beque, Mesa County, Colo. The field work was done in the autumn of 1910. The purpose of the investigation was to obtain information concerning all the economic resources of the area, but most especially petroleum.

HISTORY OF GEOLOGIC INVESTIGATION.

A. C. Peale,[1] of the Hayden Survey, made a reconnaissance of the region in 1876 and described it in a report published in 1878. His examination of a country which was then uninhabited was necessarily general, and consequently very little of the information recorded by him bears on the economic possibilities of the field. Subsequent to Peale's work no geologic report has been published, though a part of the field is covered by a geologic map prepared by G. B. Richardson,[2] who made a reconnaissance examination of the Book Cliffs coal field, which is contiguous on the west to the De Beque field.

ACKNOWLEDGMENTS.

The writer is indebted to Mr. A. P. Meade, topographer of the Geological Survey, for most cordial cooperation while Mr. Meade was engaged in the preparation of the topographic base map; to Mr. Robert Eaton, of De Beque, who kindly furnished most of the information upon which the record of development is based; and to a number of other people in the field who gave cordial assistance whenever possible.

[1] Peale, A. C., Geological report on the Grand River district: Tenth Ann. Rept. U. S. Geol. and Geog. Survey Terr., 1878, pp. 170–185.

[2] Richardson, G. B., Reconnaissance of the Book Cliffs coal field: Bull. U. S. Geol. Survey No. 371, 1909.

LOCATION AND COMMERCIAL RELATIONS.

Plate VI shows the location and extent of the quadrangle. The area described embraces four townships in Mesa and Garfield counties, Colo., namely, Tps. 7 and 8 S., Rs. 97 and 98 W. of the sixth principal meridian.

The southern part of the field is crossed by the main line of the Denver & Rio Grande Railroad. De Beque, a station on the railroad and the only town in the field, is a small but important supply point for the contiguous territory to the north and south. A daily stage line is operated from this town southward to Colbran and a triweekly line northward along Roan Creek. The field is traversed by Grand River, which is one of the largest streams flowing westward from the Rocky Mountains. In the vicinity of De Beque this river has a moderately broad flood plain, favorably situated for irrigation.

The oil field embraces an area only a few square miles in extent in the southeastern part of the region. As shown on the accompanying map (Pl. VI), wells have been drilled along Grand River, up Roan Creek for a distance of 2 miles, and one on the terrace about 3½ miles north of De Beque.

TOPOGRAPHY.

The surface features of the field are shown on the accompanying map (Pl. VI). In rather recent geologic time the surface of the area was a high plain extending from the plateau on the north to Battlement Mesa on the south. In this plateau Grand River has cut a great valley to a depth of 3,600 feet. The cutting has progressed rapidly only in the vicinity of the river, thus developing two areas characterized by very different types of topography, the plateau and the valley, which are separated by the great Roan Cliffs in the De Beque field and the equally precipitous Book Cliffs farther to the west. The dominant feature of the plateau area is a slightly dissected plain surface, which is imperfectly represented in the northeast corner of the De Beque field but is more clearly displayed in the adjacent area to the north. The valley may be divided into two parts—an area in which steep cliffs, acute spurs, sharp peaks, and narrow steep-sided valleys predominate, and another area characterized by the moderately broad valleys of Grand River and Roan Creek.

Some of the peaks have been named mountains and appear, when viewed from the valley, to rise above the other topographic features in the background, but as they stand in the foreground and are viewed from a lower level their greater elevation is only apparent. In reality they are lower than the general level of the table-land to the north, from which they have been separated by erosion and, con-

currently, slightly reduced in altitude. Mount Logan, the most prominent of these peaks, is 8,444 feet in altitude, whereas Mount Peay, much less prominent when viewed from the river valley, is 8,950 feet, and its summit probably corresponds with the surface of the table-land farther north. Details of the topography in any specific area can be obtained from the map, hence an extended discussion is omitted in this connection.

DESCRIPTIVE GEOLOGY.

STRATIGRAPHY.

SEQUENCE OF FORMATIONS.

Except the surficial deposits all the rocks exposed in the De Beque quadrangle and immediately underlying the surface are of Tertiary and Cretaceous age. The following table shows the stratigraphic sequence:

Stratigraphic relations of formations in the De Beque region, Colorado.

System.	Series.	Formation.	Description of strata.
Quaternary.			Alluvium in valleys and gravel on terraces, variable thickness.
Tertiary.	Eocene.	Green River formation.	Shale and sandstone. Locally calcareous. The shale is sandy, fine grained, and evenly bedded: faded oilve green in color. The sandstone is thin bedded and fine grained.
		Wasatch formation.	Shale and sandstone. Irregularly bedded. The shale is variegated, various shades of gray and pink predominating. The sandstone is coarse grained and variegated.
Cretaceous.	Upper Cretaceous.	Mesaverde formation.	Sandstone, thick bedded and sandy shale. Not exposed in this quadrangle.

The rocks exposed at the surface in the De Beque field consist of sandy shale and sandstone which is generally shaly, though locally it is massive. The beds in the lower part of the section are remarkably lenticular, whereas those in the upper part are generally regularly bedded. The following section of the strata is exposed between the summit of Mount Logan and the bridge across Grand River near De Beque:

Section of rocks exposed in the De Beque region.

Green River formation:	Feet.
1. Sandstone, tan colored, shaly	400
2. Sandstone, olive-green, thin bedded	830
3. Sandstone, thick bedded	20
4. Shale, olive-green	230

Wasatch formation:	Feet.
5. Shale, pink, sandy	225
6. Sandstone, gray	12
7. Shale, varicolored, sandy	333
8. Shale, pink, sandy	25
9. Shale, olive-green, sandy	30
10. Shale, pink, sandy	595
11. Sandstone, gray, shaly, coarse	4
12. Shale, pink, sandy	26
13. Sandstone, gray, shaly, coarse	2
14. Shale, pink, sandy	78
15. Sandstone, tan colored	122
16. Shale, olive-green, sandy	83
17. Sandstone, tan colored	25
18. Shale, tan colored, sandy	51
19. Sandstone, tan colored	13
20. Shale, tan colored, sandy	92
21. Sandstone, tan colored	16
22. Shale, tan colored, sandy	40
23. Shale, pink, sandy	40
24. Sandstone, tan colored	14
25. Shale, pink, sandy	46
26. Sandstone, tan colored	10
27. Shale, tan colored, sandy	10
28. Sandstone, tan colored, shaly	12
29. Shale, tan colored, sandy	120
30. Sandstone, shaly	2
31. Shale, tan colored, sandy	16
32. Sandstone	1½
33. Shale, tan colored, sandy	44½
34. Sandstone	2
35. Shale, tan colored, sandy	92
36. Shale, black, carbonaceous. Locally this shale contains thin lenses of coal varying from half an inch to 6 inches in thickness. Attempts to mine this bed have failed	6
37. Shale, tan colored, sandy	64
38. Sandstone, tan colored, shaly	3
39. Shale, tan colored, sandy	8
40. Sandstone, tan colored	6
41. Shale, variegated, sandy	133
42. Sandstone, gray, shaly	4
43. Shale, pink, gray, and lavender, sandy	86
44. Sandstone, gray, shaly	3
45. Shale, variegated, sandy	58
46. Shale, pink, sandy	20
47. Sandstone, gray, shaly	3
48. Shale, pink, sandy	36
	4,092

The character of the rocks for 1,000 feet below the surface in the valley of Grand River is presented in detail in the log of De Beque well No. 1 on pages 63–64. The surface rocks, except alluvium, were referred by Peale[1] to the Wasatch and Green River formations (Eocene) of the Tertiary. That classification has been generally adopted and will be accepted here, as the field work on which this report is based afforded only imperfect evidence regarding the age of the strata. Fossils were collected at a number of places from several horizons, but the specimens obtained are very poorly preserved and with few exceptions identification was impossible. One lot from the SE. ¼ sec. 21, T. 8 S., R. 98 W., at an altitude of 6,600 feet, was submitted to William H. Dall, who determined one specimen to be *Planorbis* cf. *utahensis* Meek, another *Physa* cf. *pleuromatis* White, and another Goniobasis sp. A lot from the SW. ¼ sec. 11, T. 7 S., R. 98 W., at an altitude of about 5,500 feet, was examined by the same paleontologist, who recognized specimens of *Physa* cf. *pleuromatis* White, *Goniobasis* cf. *carteri* Conrad, and *Planorbis* cf. *utahensis* Meek. Mr. Dall states that these species are Eocene and probably Wasatch, which confirms the determinations of previous investigators in the field. Some vertebrate remains were examined by J. W. Gidley, of the United States National Museum. A collection from the SW. ¼ sec. 31, T. 8 S., R. 97 W., at an altitude of 5,100 feet, contained bone fragments of either Telmatotherium or Manteoceras, but a closer determination was impossible. The types of these species are from the upper Bridger. Mr. Gidley states that these specimens indicate that the formation is Eocene, probably Bridger.

It will be seen from the above statement that the paleontologic evidence is far from conclusive. As yet the fossils are too few and imperfect for the paleontologist to determine definitely the age of the strata. Although the paleontologic evidence is inconclusive the beds are divided on lithologic grounds into two formations which correspond with those previously recognized by Peale. Accordingly, the lower formation is called Wasatch and the upper formation Green River.

WASATCH FORMATION.

The lowest rocks exposed in the De Beque area are assigned to the Wasatch formation on the evidence presented above. That formation includes the beds shown by Nos. 5 to 48, inclusive, in the preceding geologic section, which is believed to extend nearly to the base of the

[1] Peale, A. C., Geological report on the Grand River district: Tenth Ann. Rept. U. S. Geol. and Geog. Survey Terr., 1878, p. 176.

formation. In the southwest part of the area beds of rock are exposed which are believed to be lower than those shown in the section on pages 56–57. An accurate determination of the total thickness of the Wasatch formation is uncertain, because the correlation of beds between the eastern and southwestern parts of the field is prevented by alluvium in the valley of Grand River and Roan Creek. From the evidence at hand, however, it is believed that the surface rocks in the southwestern part of the field include only a small thickness of strata not exposed elsewhere in the area.

Because of the apparent parallelism of the Cretaceous and Tertiary beds in this region, the plane of separation between the Wasatch and the Mesaverde below is indistinct. Consequently it is believed that the contact is not far below the surface in the southern part of the field, that nearly all of the Wasatch is represented in the columnar section given above, and that nearly all the strata shown in the log of well No. 1 on pages 63–64 are Mesaverde. The records of the other wells were not available to the writer, but Mr. Robert Eaton, who made comparisons during the drilling of the wells, states that all the logs are very similar and that there is less variation than might be expected in lenticular beds. Consequently it seems fair to assume that the log of this well is typical of the strata in the vicinity of Roan Creek.

Economically the Wasatch is unimportant. It contains a few thin irregular lenses of impure coal, but neither the quantity, quality, nor extent are sufficient to justify the hope of future development. It is possible that some natural gas obtained in the wells in this field had accumulated in lenses of porous sandstone in the Wasatch, but the reservoirs of oil are in a lower formation. There may be small reservoirs of gas or oil at almost any point in the Wasatch, but it is not thought that oil or gas in commercial quantity will be found in this formation.

GREEN RIVER FORMATION.

As a result of a reconnaissance survey along Roan Creek and across the region to the north Peale[1] assigned the olive-green and drab sandstones and sandy shale exposed along the cliffs to the Green River formation. The character of this formation is shown by the description of Nos. 1 to 4, inclusive, in the columnar section on page 56. This section probably does not represent the entire thickness of the formation when deposition terminated, because it is believed that a considerable part of it has been removed by erosion. It does

[1] Op. cit.

not even represent the maximum thickness of the formation in the area, for the section extends only to the summit of Mount Logan, whereas Mount Peay, a short distance north, was later found to be 500 feet higher. As the beds are about horizontal between the two peaks, it is fair to consider the total thickness of the Green River formation in the De Beque field as about 2,000 feet. The formation is exposed along the summit of the high ridges to the south of Dry Fork, in T. 8 S., R. 97 W., and in the greater part of the two northern townships. Generally the beds are horizontal, or nearly so, except in the southern part of the quadrangle, where they lie on the flank of a low, broad anticline and dip slightly to the north.

The formation is interesting but not important economically. Neither gas nor oil was found in it, but it contains considerable black carbonaceous shale which resembles asphalt. A somewhat extended description of this substance is given on pages 67–68.

SURFICIAL DEPOSITS.

The surficial deposits in this area consist of loose débris on the hillsides and alluvium in the stream valleys. The former is composed chiefly of residual rock fragments from the older formations and probably is nowhere as much as 100 feet thick. This débris consists of irregular masses which lie along the steep cliffs. The blocks have not moved far and the original bedding generally still remains. Large-sized blocks usually tilt toward the face of the cliff because the back side moves faster down the slope than the front side. These slumps are common throughout the region, but the largest ones are in the vicinity of De Beque and in the two western townships.

STRUCTURE.

The De Beque field lies in the great structural basin that extends from the Uncompahgre Plateau on the southwest to the Grand Hogback on the northeast. As the position of the field is toward the southwest limb of the basin the general dip of the rocks in the area immediately west is northeast, or toward the central axis of the trough.

The local structure is very simple. In the northern part the beds are horizontal, but in the southern part they are raised into a slight anticline which trends east-west across the field. One end of the fold flattens out in the southeastern part of the area and the other extends beyond the western limit and is lost in the gently upturned edge of the basin. The beds are faulted only in the NW. ¼ sec. 25, T. 8 S., R. 97 W. The extent of the fault could not be determined because it

is concealed beneath alluvium at one end and débris on a terrace at the other. This fault passes under the terrace, but no trace of it could be discovered in the strata exposed along a small canyon in the NE. ¼ sec. 25. In the other direction it passes under the alluvium, filling the river valley, and does not appear in the bluffs north of the river, therefore it is certainly not more than a mile long and probably much less. It is of the normal type and has a maximum throw of 35 feet. The effect of this fault on the accumulation of petroleum is not known, but it is believed to have had little or no influence in determining the location of a pool. Greater details of the structure in any particular area can be obtained from a consideration of the dip symbols on Plate VI, page 66.

ARTESIAN WATER.

The geologic structure is favorable for artesian water in wells which reach below the valley level at any place in the field. The area is at the base of the upturned limb of the syncline. The higher part of the strata in the rim is eroded and readily receives any moisture falling upon it and conducts it beneath the surface. Some of the beds are porous sandstones through which the water can move laterally, whereas others are either wholly or partly impervious and prevent easy passage of the water vertically. These are essential conditions for artesian water. It seems probable that the supply of water from this source will never be large, but a sufficient quantity may be expected in any well to require casing to prevent it from interfering with drilling or with the flow of gas or oil if any is found. The depth at which artesian water may be expected varies according to the location in the field, but in general flowing water may be anticipated at any point below the level of the water in Grand River. Several abandoned oil wells in the valley of Roan Creek are now discharging water. The relative altitudes of these wells may be determined from the map. The water is generally saline because the strata through which it has passed contain soluble salts. This salt water should not be taken as an indication of petroleum because in its course from the dip slope on the west it passes through only non-petroliferous beds. Therefore the salt-water conditions in this field are not comparable to those found in some of the well-known oil fields of this country.

PETROLEUM.

SOURCE.

Petroleum was first discovered in this field in 1902 in De Beque well No. 1 at a depth of 614 feet. This discovery led to considerable excitement and ten wells were drilled within two years. Most of

these wells found a small quantity of gas and oil, but the latter did not seem to come from any definite oil sand. In fact, it seems probable that there is no definite oil-bearing stratum in the field but that oil and gas have accumulated in lenticular masses of sandstone. The reservoirs which were penetrated by the drill are either in the lower part of the Wasatch or in the upper part of the Mesaverde, probably the latter. The lenticular character of the strata and the high percentage of paraffin in the oil leads to the belief that the source of the oil is not in the rocks in which it is now found but in higher or lower strata. It is doubtful if the oil came from above, though it may have come from the carbonaceous beds in the Green River formation, but in that event it left no apparent trace in the intermediate beds. The lower part of the Mancos shale, which underlies this region at a considerable depth, seems to the writer to be the most probable source. This shale is petroliferous elsewhere in the West, where it possesses lithologic properties which are similar in a general way to those which characterize it in and about Grand Junction, a short distance west of this field. If the petroleum has been derived from the Mancos shale it has filtered through several thousand feet of strata and probably has been freed from considerable of its asphalt during this process. The absence of asphalt in the oil, as shown by the analyses on page 63, is evidence favoring such a conclusion. But here also no trace of oil has been found in beds intermediate between the oil-bearing strata and the supposed source.

The quantity of oil is wholly problematical. It is believed, however, that no large pools will be encountered in the field, because there is only a relatively small area in which the structure is favorable for its accumulation. There is porous sandstone in abundance to furnish reservoirs for the oil, but in general the enveloping strata are too open to prevent the oil from escaping and to cause it to accumulate in large quantities. The productive area is probably limited to the anticline in the southern part of the field.

CHARACTER OF THE GAS AND OIL.

The character of the gas escaping from the wells is determined only from its physical properties, because no sample was analyzed. It gives a strong odor of petroleum and burns freely with an almost colorless flame and a high degree of heat. From these properties it is assumed that the gas is derived from petroleum.

In physical appearance the oil is greenish brown and moderately viscous. Samples collected from De Beque well No. 1 were analyzed by David T. Day with the results shown in the following table:

Analyses of petroleum from De Beque well No. 1, three-fourths mile northwest of De Beque, Mesa County, Colo.

[Analyst, David T. Day.]

Collector.	Depth of well (feet).	Physical properties.			
		Specific gravity.	Baumé gravity (°).	Color.	Odor.
D. T. Day	150	0.8645	37.75	Yellow	Aromatic.
E. G. Woodruff	.....	.8997	25.6	Greenish-brown	Do.

Collector.	Distillation by Engler's method.							Paraffin (per cent).	Asphalt (per cent).	Water (per cent).	Unsaturated hydrocarbons (per cent).	
	Begins to boil.	To 150° C.	150°-300° C.		Residuum.		Total.				Crude.	150°-300° C.
	°C.	c. c.	c. c.	Sp. gr.	c. c.	Sp. gr.	c. c.					
D. T. Day	145	1.0	42.0	0.7188	56.5	0.8427	93.5	19.65	....	....	12.4	4.0
E. G. Woodruff	225	.....	27.0	.771	70.9	.8511	97.9	27.23	....	....	....	.....

NOTE.—Both of the samples analyzed were collected from the same well, but at different times. Mr. Day's sample was collected direct from the well and therefore probably represents the character of the oil in the ground more nearly than the samples collected by the writer. Because the well was inaccessible at the time the writer visited the field his sample was procured from a small pool near the well where the oil had accumulated on the surface of the water.

DEVELOPMENT.

Practically all the development in the De Beque field occurred in 1902 to 1904. During that time ten wells were drilled and machinery put in place for one additional well, which was never commenced. The log of one of the wells and such other data as could be obtained are as follows:

1. The De Beque No. 1 was drilled in 1902. The log of this well, furnished by Mr. Robert Eaton, is as follows:

Log of De Beque well No. 1, De Beque.

	Thickness (feet).
Alluvium	10
Gravel	22
Shale	98
Sandstone, red	30
Sandstone, blue	20
Gas at 170 feet.	
Sandstone, blue	20
Oil at 200 feet.	
Sandstone, red and blue	20
Sandstone, blue	15
Water at 235 feet.	

	Thickness (feet).
Shale	1
Shale and sandstone	15
Unreported	40
Sandstone, very hard, blue	20
Sandstone, blue	15
Shale, blue	15
Sandstone	17
Coal	3
Sandstone	5
Sandstone, white	15
Shale, brown	5
Sandstone, white	15
Unreported	10
Sandstone, white	15
Unreported	20
Sandstone, white	65
Shale and white sandstone	20
Sandstone, white	30
Sandstone and shale	20
Unreported	10
Sandstone	30
Strong flow of water at 580 feet.	
Shale, sandy; showing of oil	15
Pumped about 12 barrels of oil in 2 days.	
Sandstone	15
Shale and sandstone	40
Sandstone	5
Sandstone and shale	10
Shale	10
Shale and sandstone	20
Sandstone, containing water and gas	20
Sandstone	15
Shale, sandy	10
Sandstone and shale, containing gas	15
Sandstone, showing trace of oil	15
Sandstone and shale	85
Unreported	10
Sandstone and shale, containing a small amount of gas	20
Sandstone	75
Sandstone and shale	13
Sandstone	
Sandstone, very hard	12
Sandstone	10
Shale	30
	1,066

Mr. Patrick McCaffrey states that oil was first found in this well at a depth of 614 feet, and an average of 8 barrels of oil a day was obtained on a run of eight days. After this test the management decided to try for a stronger flow. At 790 feet, according to report, an oil sand 32 feet thick was encountered, but the flow of

water was so strong that the well could not be controlled. Gas still flows from the well and is led into a tank reservoir from which it is piped into a near-by dwelling for domestic use. Artesian water escapes from the well and brings with it a small amount of crude petroleum, which collects in a pool a short distance from the well. Analyses of samples of the oil from the well are shown on page 63. Practically the entire discharge of gas is consumed in a single residence and the oil finds local domestic use.

2. The Buckeye No. 1 well was drilled in 1902 to a depth of 800 feet. Gas was encountered in this well, but there is no authentic account of oil. The well is now discharging salt water and a small quantity of gas.

3. The Blaine well was put down in 1902 to a depth of 900 feet. Salt water and gas were encountered. When completed the well was capped and the gas conducted into a residence for domestic use. The well is still closed and the gas is not now used. When examined the well was found to contain gas under considerable pressure and to be discharging water around the casing.

4. The Blair-McMullen No. 1 well was drilled in 1902 and is reported to be between 300 and 400 feet deep. No trace of the well now remains and no further information concerning it was obtainable.

5. At the Blair-McMullen No. 2 well very few data were obtainable. It is reported that a rig was put up, but no information could be obtained concerning the amount of drilling done.

6. The Curtis-Mann well was drilled to a depth of about a thousand feet in 1902. The hole still remains open and a small amount of water flows from it. Considerable gas and a small amount of petroleum escape from the vent. The gas has the odor of petroleum and burns with little flame but intense heat.

7. The De Beque No. 2 well was drilled in 1903 to a depth of about a thousand feet. The machinery is still in place. The well is cased and gas and water escape from it. There is a trace of petroleum about the well.

8. The Buckeye No. 2 well was drilled in 1903 to a depth of 750 feet. The machinery still remains in place. It is one of the two wells from which the machinery has not been removed. Some water and gas escape from it. There is no evidence about the well that petroleum was encountered when it was drilled.

9. The Wood well was drilled in 1904 to a depth of about a thousand feet. The well was cased and the vent still remains open. Considerable gas escapes from it, but there is no evidence that petroleum was found. This is one of the best gas wells in the field, but no attempt is made to use the product.

10. The Canfield well was drilled in 1904 to a depth of about a thousand feet. Salt water, gas, and oil were encountered. At the present time water flows in a small stream from the vent and gas escapes by bubbling up through the water. A small amount of petroleum has collected in a pool about the vent. The residue from this petroleum is dark brown and has a moderate degree of fluidity. The well was abandoned soon after the completion and no attempt has been made to use the gas.

11. The Wheeler well was drilled in 1902 to a depth of about 800 feet. It is now abandoned.

12. The Home Oil Co. erected a derrick at a point in sec. 31, T. 8 S., R. 97 W., but abandoned the project before drilling was commenced.

From the above records it will be seen that from the 12 wells in the field the flow of oil is only a few barrels a year. In fact, nothing more than a mere trace of oil is shown in eight of the wells, whereas

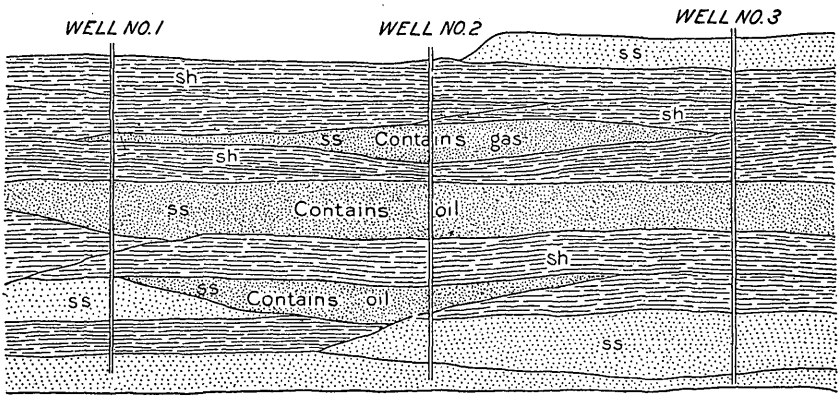

FIGURE 1.—Diagram showing why wells in lenticular strata obtain unequal amounts of oil or gas, though the wells are not far apart.

the ninth contains only a moderate quantity. Gas flows from most of them, however, and from one the product is now used for illuminating and as a domestic fuel. Mr. Robert Eaton, of De Beque, who has closely followed the development, states that some oil and gas were found in each of the wells. Mr. Eaton further states that the depths at which oil and gas were found are variable. The greatest amount of gas found in a single well was in the Blaine well. Gas was discharged violently but periodically from this well and in doing so threw water from the well like a geyser. In this field it is to be expected that the quantity of oil and gas will vary in the different wells because the beds containing the petroleum are lenticular and their degree of porosity is different in different places. These conditions render it possible that a bed containing considerable gas or oil may be encountered in one well and be absent at the same

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LEGEND

Qal	Alluvium	QUATERNARY
Tgr	Green River formation	TERTIARY — Eocene
Tw	Wasatch formation	TERTIARY — Eocene
⊕	Horizontal beds	
13°	Strike and dip	

R. B. Marshall, Chief Geographer.
Sledge Tatum, Geographer in charge.
Topography by A. P. Meade, Jr., and F. H. Nelson.
Control by C. F. Urquhart and C. H. Semper.
Surveyed in 1910.

Scale 1/62500

1 ½ 0 1 2 3 4 Miles

1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 50 feet

Datum is mean sea level

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION 1910

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

MAP OF THE DE BEQUE OIL FIELD, COLORADO

Showing geologic formations and structure

By E. G. Woodruff

1913

horizon in another well a short distance away (fig. 1). Another result of these conditions is that the quantity and flow of the gas are variable, because, as shown by the figure, a large lens probably contains more gas than a small one, but on the other hand it may be penetrated in a thin portion where there is less opportunity for gas to escape than if the thick portion is entered. Therefore, because the beds are variable in thickness, extent, and porosity, it is to be expected that the quantity of gas and oil found in different parts of the field will be highly variable rather than uniform.

CARBONACEOUS SHALE IN THE GREEN RIVER FORMATION.

In the region which embraces the De Beque oil field the Green River formation contains a mass of strata about 200 feet thick in which is considerable dark-brown or black carbonaceous shale closely resembling lignite. This shale contains resin, paraffin, and fragments of vegetable tissue. These hydrocarbons are generally distributed through the strata and are intimately mixed with sand and shale. Locally, however, they occur in small beds or in places in thin veins, where they are comparatively free from impurities and resemble asphalt. One such bed east of Roan Creek near the center of sec. 1, T. 17 S., R. 98 W., is lenticular. It extends about 300 feet along the outcrop and ranges in thickness from a few inches to a maximum of 13 inches. The bed is underlain and overlain by shales containing a high percentage of vegetable matter but less carbonaceous material than the lens which they inclose. This shale is remarkable because it contains remains of plants and also paraffin, which is supposed not to be derived directly from vegetable material. One sample analyzed by David T. Day was found to contain 4½ per cent of paraffin. It was examined by David White, who recognized resin and plant-spore cases. It is suggested that these beds are carbonaceous shale impregnated with petroleum subsequent to their deposition. The writer believes that the beds are of vegetable origin and that in some way the paraffin has been produced from the vegetable matter. Persons who may be considering the development of this "asphalt" should know its chemical and physical properties before attempting to place it on the market as asphalt, because it is like that substance only in some of its physical properties. It contains a small percentage of paraffin but no asphalt, though it is dark-brown or black. When refined the paraffin may be used as that material is commonly used, but the product is not a suitable material for paving, roofing, or painting. In 1908 an attempt was made to mine the "asphalt" with a view to placing it on the market. An entry was driven from the outcrop to a depth of 40 feet, but operations were abandoned before any of the material was refined or marketed.

Shale impregnated with paraffin occurs at many places along the cliffs in the same general zone, but no other bed was found with extent, thickness, or purity of material equal to the lens described above. No veins were found in this field, but in an adjacent area to the east on Parachute Creek, 11 miles north of Grand Valley, a distinct vein is exposed in a small prospect opening. The vein extends vertically in rocks which lie approximately horizontal. The "asphalt" in it is generally very pure, though some crystals of calcite were observed. The vein is in carbonaceous shale and appears to have been formed by the movement of plastic material from the strata into a fissure in the rocks. The calcite which is also in the veins was probably derived from the calcareous sandstone in which the vein occurs or from limestones a short distance below.

If large veins of pure paraffin could be found they would be commercially valuable, but none have been discovered in the De Beque field. However, an exhaustive search has never been undertaken, chiefly because the outcrop of the shale lies in an almost inaccessible position near the summits of the cliffs.

Genetically these carbonaceous beds are believed to have no connection whatever with the oil in the deep wells near De Beque. Nearly 3,000 feet of strata intervene between the oil-bearing sands in the wells and the beds containing this material. A close study of the strata where they are freshly exposed revealed no trace of petroleum products below the "asphalt-bearing" strata. It is believed that some trace would remain if the oil had passed through the adjacent strata either above or below. Furthermore, the product of the wells is a petroleum and the bedded deposit is properly classed as a lignite. The carbonaceous beds seem to be stratified as if deposited concurrently with the associated material. The lines of stratification continue from one into the other. The inclosing strata seem to be destitute of traces of oil or asphalt. The veins are secondary accumulations, which filled crevices that formed after the strata were deposited. The lignite ("asphalt") occurs in the Green River formation at about the same horizon throughout a large area. A condition similar to the one noted above was studied by Endlich [1] in the Green River formation near White River, Colo. Arthur Lakes [2] discusses the occurrence of a similar material at about the same stratigraphic horizon near Rifle and Piceance creeks, in Rio Blanco County. The character of the deposit, the absence of similar material in the inclosing strata, and the wide distribution lead the writer to conclude that the material is lignite and that it was included in the sand and clay when they were deposited.

[1] Endlich, F. M., Tenth Ann. Rept. U. S. Geol. and Geog. Survey Terr., for 1876, 1878.
[2] Lakes, Arthur, Mines and Minerals, August, 1902, p. 6.