

by Alfred I. Schultz.

Work done in the Basin.

Many requests for information about the possibilities of finding oil in Baxter Basin, in the central part of the Rock Springs Coal Field, Wyoming, have been received by the U.S.G.S. Dept of Interior. The Survey has no report in which this possibility is specifically discussed tho it has issued two general reports on the coal deposits of this part of the State. Bull. #341 & 381. The following summary of the available facts bearing on the existence of oil or gas in this basin has therefore been prepared in response to the numerous inquiries received.

The structure of the Rock Springs dome or anticline has long been regarded by oil men as favorable to the accumulation of oil and gas. Several wells have been drilled on this dome prior to 1907 but none of them were favorably located or drilled deep enough to reach the more promising sands of the dome, so that no positive statement can be made regarding the presence of oil beneath the dome in commercial quantities. Nevertheless many geologic features indicate that oil may be found and the work of thoroughly prospecting the anticline should go on until oil is discovered or until it is demonstrated beyond a doubt that the oil bearing sands that are so productive in other fields in Wyoming are not present in Baxter Basin or, if they are present, that they do not contain oil. The final test of the presence or absence of oil in this field as everywhere, is the drill. Drill holes put down to moderate depths, say, 1000 to 2500 feet will not adequately test the field. Nor should one or two failures, even if properly located wells of sufficient depth, condemn the entire field until the Aspen formation which yields oil in the Spring Valley field has been explored by the drill at several of the most favorable points along this great anticline, its productivity or its barrenness cannot be considered as satisfactorily demonstrated. Geologic studies in this part of Wyoming, ~~xxx~~ and in northwestern Colorado, northeastern Utah have been made by the Survey, and the results of these studies have been published in the reports which describe the geology, structure, and mineral resources of the region, which afford grounds for valuable inferences as to the probable thickness and character of the beds that lie stratigraphically below those exposed along the Rock Springs anticline. These reports, which are listed below, are useful in considering conditions in the Rock Springs field.

- Professional Paper # 56
- Bulletin #341, P220 & 282
- " 381, P214-281
- " 415,
- " 543

The Rock Springs anticline was mapped by the Survey in 1907 & 1908. The general structure of the field and the distribution of the coal bearing formations are shown on the map in Bull. 341 & 381.

On these maps all the rocks that lie stratigraphically below the Rock Springs coal group and that are exposed along the crest of the anticline are shown in one pattern, tho they may be readily be divided into two members, the upper a sandy shale series and the lower a drab shale series that forms the central part of Baxter basin. The positions and form of the anticline are outlined in a general way by the outcrop of this sandy shale and of the beds of the overlying Rock Springs coal group. The favorable oil territory is encircled by these two

formations and is in the central part of Baxter basin, the outer boundary of which is distinctly marked topographically and lithologically.

The work done in this field in 1907 & 1908 shows that the shales exposed along the main axis of the anticline are not a part of the Colorado shales but belong well up in the shales that lies at the base of the Montana Group. Fossils collected from a diamond drill core from a point 600 feet below the surface of Baxter basin in Sec. 22, T. 19, R. 108, represented a stratigraphic horizon in the Marine Montana beds much lower than that of any other beds exposed along the crest of the dome along north of Aspen Mt. The logs of the wells drilled in the northern part of Baxter basin prior to 1907 indicate that the drill did not pass through the Hilliard shale or enter the Frontier formation below it. Drilling probably stopped within the Montana-Colorado shale series, mapped in northern Colorado and Utah as the Mancos and in western Wyoming as the Hilliard shale, the upper part of which is represented in the Rock Spring fields by the shale in Baxter basin.

Rock formations beneath Baxter basin.

Hilliard shale. The Montana-Colorado group shale group in northern Colorado and Utah is about 5000 feet thick, in western Wyoming it is 5500 feet to 6800 feet thick and in the Rawlins field, east of the Rock Springs dome and in the Vermillion Creek and Henry's Fork field south of the dome it is about 5000 feet thick. Although we have no way of determining the thickness of the shale group in the Rock Springs field other than by the drill, and it seems reasonable to assume that it is here at least 5000 feet thick. At some places along the crest of the anticline north of Aspen Mts., about 2000 feet of these shales have been removed by erosion so that at the most favorable points in the Baxter basin, the drill would have to penetrate about 3000 feet before passing through the Hilliard shale group to the next formation below.

Frontier formation. The Frontier formation underlies the Hilliard shale group described above, and, with the Aspen shale, to be described below, contains the oil sands of this region. Here, and in other parts of Wyoming, the Frontier consists of a series of shales and interbedded sandstones with possibly some coal beds. Observations made in Uinta and Lincoln Counties indicate that some of the sandstones of the Frontier in the Rock Springs dome are lenticular and that others are continuous over large areas, like those of the Big Horn Basin and other parts of the State.

The persistent sandstones of the frontier formation in southwestern Wyoming resemble Wall Creek sandstones of the same formation of the Salt Creek field. In southwestern Wyoming the Frontier formation is more than 2000 feet thick, but it thins rapidly toward the east. It is less than 400 feet thick at many points along the north and south flanks of the Uinta Mts., is 500 to 700 feet thick in the Rawlins field and is probably not less than 500 feet thick in the Rock Springs dome. (see U.S.G.S. Bull. 381.)

Aspen shale. In southwestern Wyoming the Aspen shale underlies the Frontier formation in a position stratigraphically similar to that occupied by the Mowry shale in other parts of the state. Like the Mowry it is light colored, fissile, it contains numerous fish scales. Toward the bottom of the Aspen the shales are dark in color which suggests their possible equivalence to the Thermopolis shales of the Big Horn basin. Unlike the Thermopolis shales, however, the lower part of the Aspen contains fish scales. Observations made

on these beds in the surrounding areas make it appear probable that the Aspen, from which the oil in the Spring Valley field is obtained, is at least 200 feet thick in the Rock Springs Field and may be much thicker. Until a test well has determined the thickness of these formations in the Rock Springs Field, no more definite statements as to their real thickness in this part of Wyoming are justified.

Structure.

The central part of the Rock Springs dome within the outcrop of the surrounding sandstone ridges of the Rock Springs coal group and the underlying shaly sandstone is about 30 miles long by 10 miles wide. The dips in the central part of this dome are low—about 4 degrees east., and 10 deg. to 15 deg. west, altho locally they may exceed these amounts. Few structural observations were made within the shale outcrop in the center of the dome, as the work upon which this report was based was restricted primarily to the overlying coal bearing formations around the margin of the basin. No secondary structures were observed north of the Aspen Mts., but the occurrence of secondary structures is indicated by the presence of two small anticlines south of Aspen Mts., near the south end of the dome. The larger of these transverse anticlines, which is in T.14, R.100, 101, 102, 103, 104, is associated with an overthrust fault, which is in turn believed to be related to an overthrust fault along the north flank of the Uinta Mts about 20 miles to the south. The structure in this part of the field indicates that the south end of the Rock Springs dome may be affected by the uplift of the Uinta Mts, and that, by careful search, smaller secondary anticlines, somewhat similar to those mentioned above, may be found on the major structure at at least as far north as Aspen Mts and perhaps farther north.

The sandstone ridges that surround Baxter basin are cut by a number of dip faults, particularly along the eastern and western borders of the arch, and at some places as in the vicinity of the Union Pacific RR these faults may be continuous across the dome. Whether or not these displacements cut the Frontier or other sandstones near the base of the Colorado, cannot be stated positively, but they are probably all taken up in the shale above the Frontier sandstone, or if continuous, they make only slight flexures in the sandstones near the base of the Colorado series. Maps in S.B. 341 & 381, show in a general way, the structure of the Rock Springs dome but do not indicate the position of the axis of the anticline, which extends from the north to the south along the west side of Baxter basin. This main axis extends from the southwest corner which is about 15 miles north of the north end of Baxter basin, southward thro the west tier of sections in R.103 west, and in the end of Baxter basin, in T.20, R.104 W.; thence nearly southward to Baxter station on the U.P. RR; thence southward in the tier of sections to Aspen Mt., which it strikes in Sec.14, T.17, R.104; thence southward near Jacobs and Brooks ranches in T.15 & 16., R.104, respectively, to the south end of the dome, T.14, R.103 W., near the headwaters of Salt Wells Creek, west of Rife Mt.

Summary.

The oil sands to sought in Rock Springs dome are in the Frontier and Aspen formations. The Frontier lies at a minimum depth of about 60000 feet below the base of the Rock Springs coal group or 5000 feet below the base of the sandstones and sandy shale series, and about 1000 feet stratigraphically below the Rock Springs coal group.

In parts of the basin, erosion has removed some of the intervening shales and at places in the central part of the dome, particularly near Baxter, some of the oil sands may be reached at a depth of 3000 feet. The data on hand indicate that the dome is mostly eroded along Bitter Creek near Baxter. A point in this vicinity would therefore be one of the most favorable places to drill along the main anticlinal crest, unless there are secondary and minor structures of which the survey has no information, in the area between Baxter station and Aspen Mt. The prospective oil sands lie at a greater depth below the surface toward Aspen Mt and at the south end of the dome than at other points in Baxter basin north of Aspen Mts. The drilling done has been confined to the northern part of the basin, north of Aspen Mts, and as far as known, none of the wells have passed thro the Montana -Colorado shale series.

The Aspen formation probably contains the oil, if any exists, in the sands of the Rock Springs dome, and this oil should collect in the sandstones of the Aspen, itself or of the overlying Frontier. To test adequately all the sands of both these formations it may be necessary to drill 4000 to 5000 feet, the depth depending in part on the location of the well and in part on the variation in thickness of the beds from that measured in sections in nearby areas. The most favorable area to be tested lies along the main anticline crest between Baxter station and Aspen Mt., near the east side of the second tier of sections from the east, in range 104 west. In addition to, the favorable structure and the practical certainty that there are rocks beneath the dome which elsewhere in Wyoming serve both as sources of and as reservoirs for oil, a favorable prognostication is strengthened by the fact that traces of oil and a little gas have actually been struck in some of the shallow wells drilled on unfavorable parts of the dome. The principal unfavorable feature of this field, from the point of view of the oil prospect- or, is the depth to the supposed oil sands.

Resp.