

South Dakota
Geological and Natural History Survey

FREEMAN WARD, State Geologist

CIRCULAR 24

The
Ragged Butte
Structure

By
ROY A. WILSON

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LOCATION

The area included in this report is situated in southwestern Dewey County. It lies on the north side of the Moreau River about twelve miles south of Isabel, the terminal point on a branch line of the Chicago, Milwaukee and St. Paul Railway. The region covers much of the southern and eastern part of T. 15 N., R. 21 E., and extends into the three adjoining townships, viz., the southwestern part of T. 15 N., R. 22 E.; the northwestern part of T. 14 N., R. 22 E.; and the northeastern part of T. 14 N., R. 21 E. Figure 1 gives the location of this tract in reference to the rest of the State. Ragged Butte, a prominent feature of the landscape in the area, has given the name to the structure.

EXPLANATION

The Survey issues two series of publications as follows:

BULLETINS—Some subjects have been investigated a longer time, full data have been gathered, such preparatory or experimental work as was necessary has been entirely or nearly finished. In other words, the study of the subject is actually completed or so nearly so that the results can be relied on and published with a degree of confidence as to their value; and the treatment is full and thorough. In such a case the matter is published as a bulletin.

CIRCULARS—But often during the progress of the work enough information is at hand to be of value to those interested, yet not enough for a complete treatise. A part of a county or a part of a certain subject may be finished, perhaps, and publication waiting for the complete investigation of the whole county or the whole subject. There may be a demand for statistical matter, or lists of references, or current information, etc., which would hardly do for a formal bulletin. Such partial reports, summary reports, reports of progress, lists, or unit fragments of larger subjects, etc., are handled in circulars.

It is planned to publish the circulars frequently and the bulletins at longer intervals. With this arrangement much information will reach the public with a minimum of delay.

Inquiries may be addressed to the State Geologist, Vermillion, S. D.

FIELD WORK

The geologic features of this region, especially in Tps. 15 and 16 N., Ranges 21 and 22 East, were mapped during the field season of 1922 by the State Geological and Natural History Survey and are discussed in Circular No. 9, "The Possibilities of Oil in Western Dewey County," and Circular No. 13, "The Possibilities of Oil in Northern Ziebach County."

The plans for the field work of that season, however, did not permit detailed structural mapping in this locality, and hence the presence of a structure of some importance was not disclosed at that time.

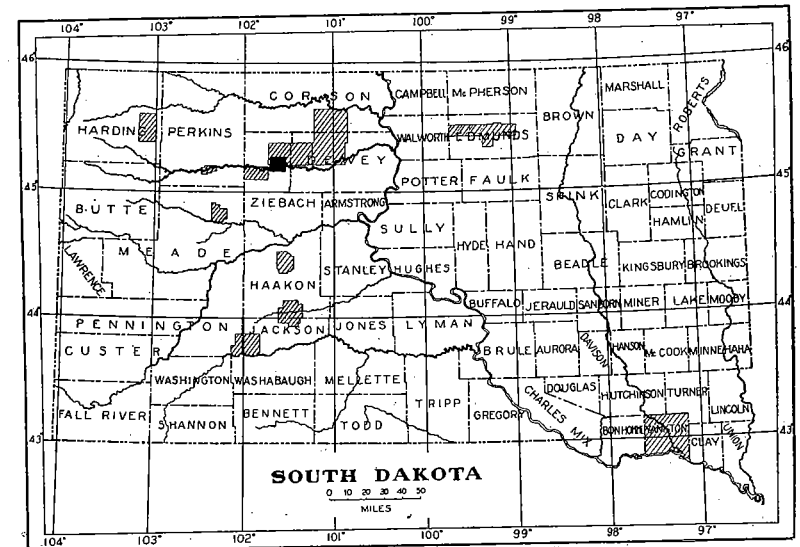


Fig 1. Index Map
Black portion shows area covered by this report.
Shaded portions give locations of other reports already published.

The mapping of the structure considered in this report was carried on with a telescopic alidade and plane table by both the triangulation and stadia traverse methods. Both the vertical and horizontal control were determined entirely by the use of the alidade and rod.

Grateful acknowledgements are given the citizens of Isabel for their aid and cooperation in carrying on the mapping and in providing the field party with a rodman at their own expense.

THE FORMATIONS

The Pierre, Fox Hills, and Lance formations are exposed in this area. The position of these formations in the stratigraphic column is shown in the appended table (Fig. 4). Their distribution is shown on the geologic map (Fig. 2). The description of these formations as given in Circular 13 also applies to this area.

"The Pierre Formation.—Outcrops of this formation are restricted to the southern part of the area along the banks of the Moreau River and its immediate tributaries. The formation is essentially a uniform blue gray shale, which becomes sandy as it passes upward into the overlying dark basal shales of the Fox Hills formation. Since the Fox Hills and Pierre formations are transitional, it is difficult to draw any sharp line of demarcation between them. Approximately 100 feet of the Pierre is exposed along the banks of the Moreau River in the southeastern part of the area, but in the southwestern part nearly all of the Pierre is under cover, the basal Fox Hills beds lying near the river level.

"The Fox Hills Formation.—The Fox Hills formation as developed in this area may be divided into three phases:

"The lower phase, which is transitional into the underlying Pierre formation, is made up of dark sandy shales with thin, interbedded sand layers. These shales become increasingly somber downward as they pass into the typical Pierre. About 50 feet of strata are represented in this phase.

"The middle phase consists of banded, sandy shales of medium to light gray color, the color becoming increasingly lighter upward. The individual strata tend to be thin and uniform. Biscuit-shaped concretions of ferruginous clay and thin beds of pure sandstone are irregularly distributed through the general horizon. In general, this middle part of the Fox Hills formation can be distinguished by the banded appearance of the outcrops. The average thickness of this phase of the formation is 80 feet.

"The upper phase is largely composed of sandstone with some interbedded sandy shale. In general, the sections of this part of the Fox Hills formation show about 35 feet of light gray and yellowish gray shaly sandstone, which passes upward into ten to fifteen

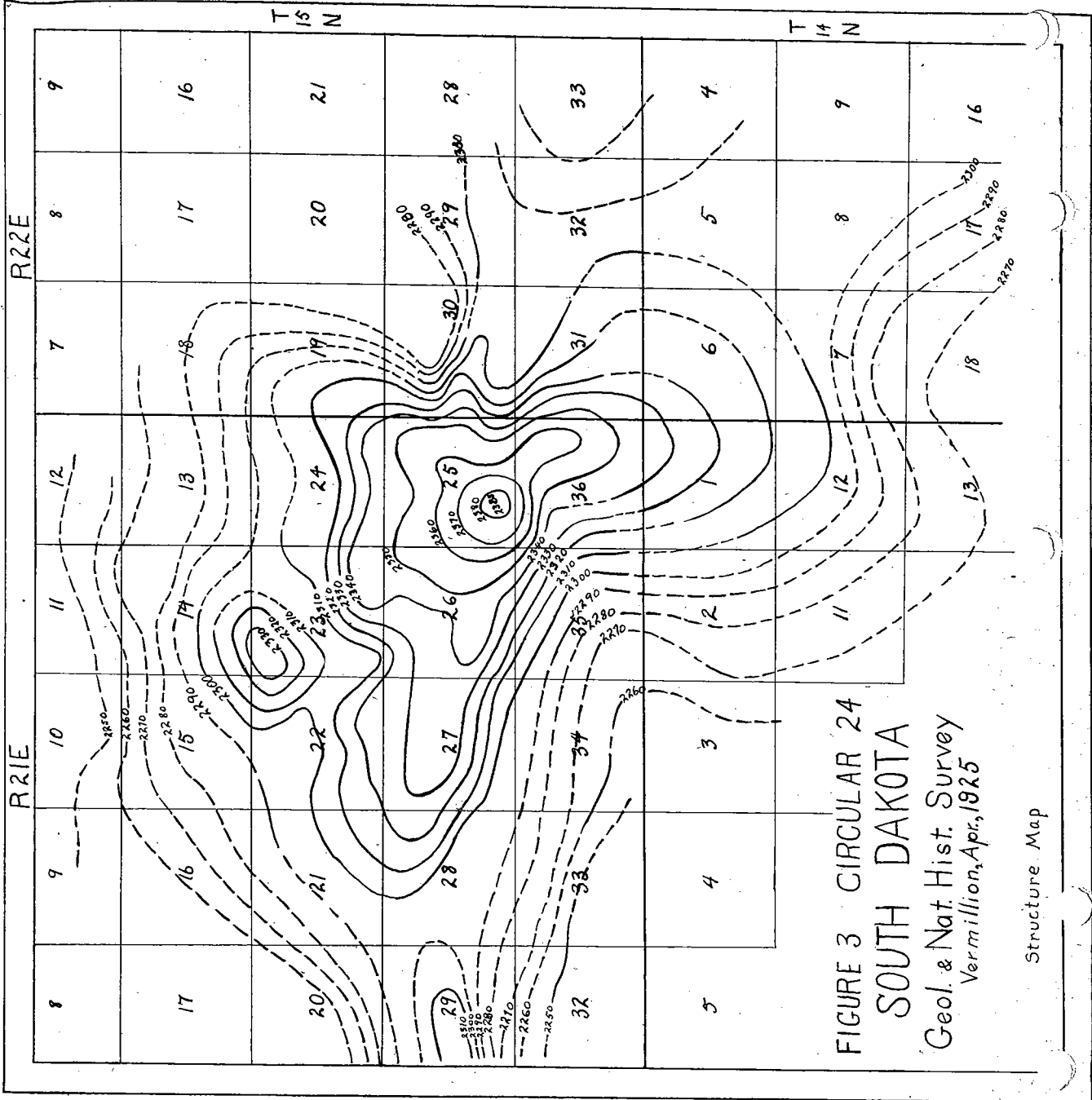


FIGURE 3 CIRCULAR 24
SOUTH DAKOTA

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Vermillion, Apr., 1925

Structure Map

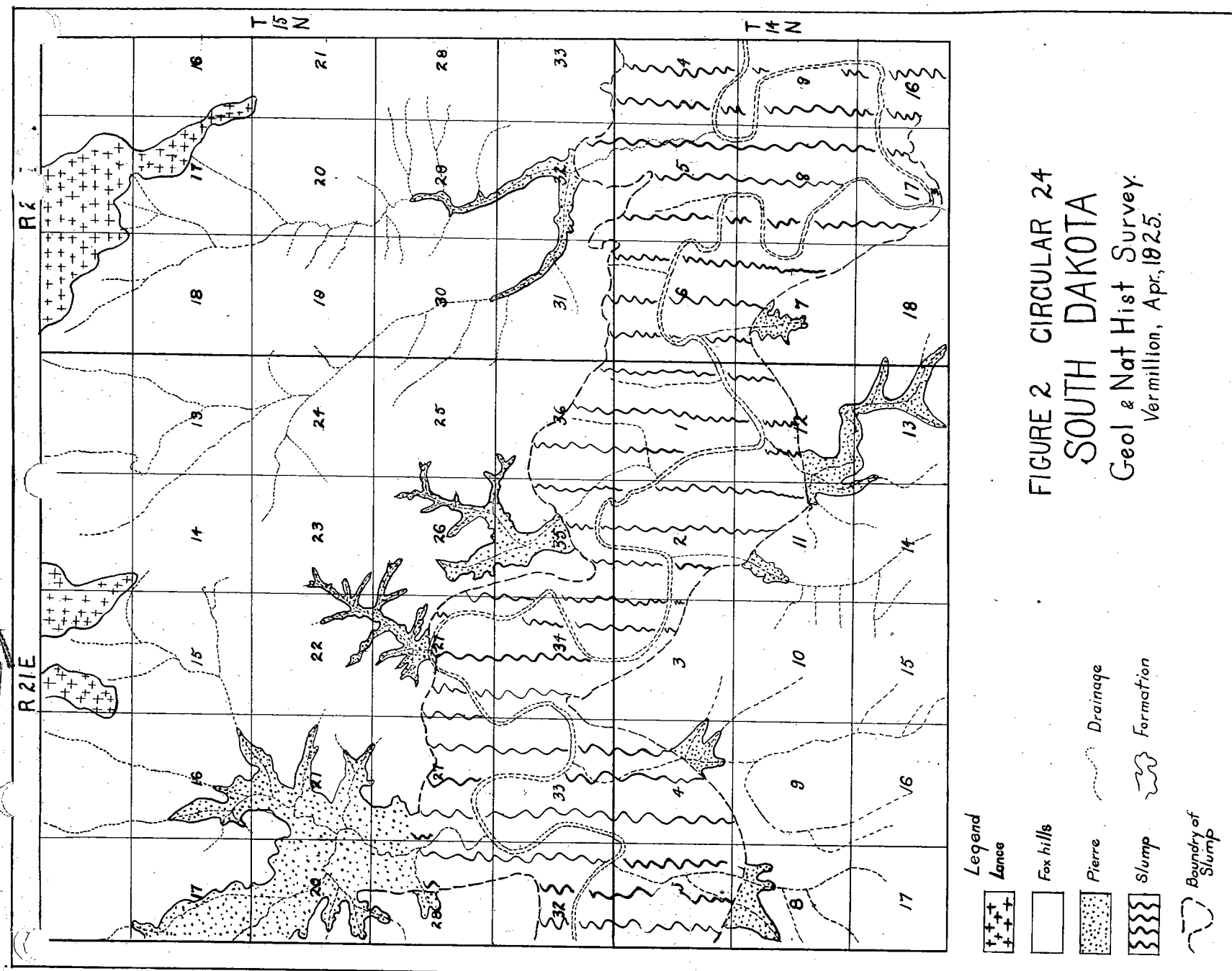









FIGURE 2 CIRCULAR 24
SOUTH DAKOTA

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- Legend
-  Lance
 -  Fox hills
 -  Pierre
 -  Slump
 -  Boundary of Slump
 -  Drainage
 -  Formation

feet of massive yellowish gray sandstone—the latter sandstone tending to weather out in large, rounded masses. It is these rounded masses of sandstone, outcropping at fairly frequent intervals over the area, which have served so satisfactorily as a key bed for structure mapping. This harder sandstone was found to be restricted to the same definite horizon everywhere. Above this key bed sandstone lies about 35 feet of light gray and yellowish gray sandstone. Iron concretions are common and the upper part of this last mentioned sandstone was found to contain a bed of fossil oyster shells which was more or less developed over the entire area.

“The contact of the typical Fox Hills formation with the Lance is transitional, the change being represented by the above described shaly sandstone becoming interbedded with thin coal seams and carbonaceous shale layers. The first layer of coal or carbonaceous shale generally occurs just above the previously described oyster bed.

“The average total thickness of the Fox Hills formation as exposed over this area is 210 feet.

“**The Lance Formation.**—From 75 to 100 feet of the Lance formation is exposed over this area. The exposures are largely restricted to the northern half of the district. In general, the Lance consists of a varying series of sand, shale, clay, coal, and carbonaceous shale beds. The coal and carbonaceous shale are largely confined to the lower fifty feet of the formation. The upper 25 to 50 feet of the Lance as exposed in this area consists mainly of soft, yellowish, gray sandstone and sandy shale.

“The lower part of the formation, owing to the numerous layers of coal and carbonaceous shale, has a dark or somber color, which is broken here and there by light gray layers of sandstone that stand out in marked contrast.

“The individual beds of the Lance lens out over short distances and any given section shows a rapid vertical alteration in the character of the deposits. Cross-bedded sandstones are common.”

STRUCTURAL FEATURES

In mapping the structural features of this area two key horizons were used. The hard sandstone stratum developed near the top of the Fox Hills, which outcrops in rounded, nodular masses, was used in the northwestern part of the region. The important key horizon, however, and the one which was primarily used in mapping the structural features consists of a layer of fossil-bearing, ferruginous concretions which lie in the dark, sandy shales at the base of the Fox Hills. This concretionary layer was found to be widespread and persistent in stratigraphic position. Lying below this key horizon are two other layers of ferruginous concretions at vertical distances of 10 and 25 feet respectively. These were found developed over the entire area mapped and hence serve as a convenient check.

Cretaceous	Lance		75-100	
	Fox Hills		210	
	Pierre		1500	
	Niobrara		275	
	Carlile		300	
	Greenhorn		25	
	Graneros	400		225
			Mowry	25
				25
			Newcastle (Muddy)	25
			100	
Dakota		150		
Comanchian	Fuson		50	
	Lakota		200	

Fig. 4

As indicated on the structure sheet (Fig. 3), the mapping has disclosed a structure of considerable magnitude as structures go in this part of the State. The main trend of the fold is approximately NW.-SE. Another set of folds with a NE.-SW. axial trend crosses the main fold in T. 15 N., R. 21 E., and at the point of intersection has developed dome shaped uplifts in the southwest part of section 25 and the northwest part of section 23.

As a result of this cross folding, a moderately symmetrical and clean cut anticline has been developed in the southeast part of T. 15 N., 21 E., with the high point formed by the dome shaped uplift in the southeast quarter of section 25. This structure has a proven closure of eighty feet and covers approximately seven sections. It is of further importance to note that aside from the west-

ern and southeastern part of the area mapped, where the above anticline terraces out, the general fold upon which it is superimposed drops on the north and south sides as much as 135 feet.

The writer considers this structure especially worthy of testing in the light of present evidence relative to oil possibilities in western South Dakota from the structural standpoint.

POSSIBLE OIL HORIZONS

The statement in Circular 9 is also applicable to this area and is here quoted in full: "Although a suitable oil structure has been located, the two other necessary conditions for oil have not been proved to exist. If there is no source of oil below or reservoir rock in which oil may accumulate, the dome has no value. Since there are no deep well records available for the area nor, indeed, for any of the region nearer than 45 miles to the southeast and several times that distance in other directions, very little definite information is at hand concerning the deep underground conditions. But from a study of the nearest evidence it is believed that the following table (Fig. 4) gives in a general way the most probable conditions.

"It is not believed that there are sands of any consequence in the Pierre.

"The first possible horizon which may act as a reservoir rock is the Graneros. The Mowry member of that formation often contains a sandstone. The Newcastle, also known as the Thermopolis or Muddy, is another sandy member of the Graneros. Sometimes a water bearing bed is encountered above the Mowry.

"The Dakota and Lakota are well developed sandstones and would make excellent reservoir rocks under suitable conditions. The latter has the most favorable prospects of the whole series."

At present, the information relative to the formations developed below the Dakota-Lakota sandstones in this region is so vague that it is not possible to make any statements relative to reservoir rocks below the above named horizons. However, if it is at all feasible and not prohibitive from the standpoint of expense, the strata below the Dakota-Lakota formations should be tested before any area in this general region is finally condemned.

DEPTH OF DRILLING

The best location for a drilling site from the standpoint of surface structural evidence would be in the W. $\frac{1}{2}$ of the SE. $\frac{1}{4}$ of the SW $\frac{1}{4}$ of section 25, T. 15 N., R. 21 E. In this area there would be at least 50 feet of Fox Hills to drill through. On this basis the Mowry should be found at 2,375 feet, the Newcastle at 2,400, the Dakota at 2,550, and the Lakota at 2,750 feet.