GEOLOGY OF THE WILES AREA, RANGER DISTRICT, TEXAS.

By CARROLL E. DOBBIN.

INTRODUCTION.

Location of area.—The area described in this report is 6 miles square and lies in the extreme southeastern part of Stephens County, Tex., its east line corresponding approximately with the east boundary of the county and its south line with the south line of the county. (See fig. 1.) As no public-land surveys have been made in this region, the limits of the area were selected arbitrarily. On the map (Pl. VIII) this area is subdivided into 144 squares, which are lettered from A to L, inclusive, from east to west and numbered from 1 to 12, inclusive, from south to north. According to this system square H–6, for example, is eight squares west and six squares north from the southeast corner of the area as mapped. The town of Wiles is in square D–4.

Cultural features.—Wiles, on the Texas & Pacific Railway, is the largest settlement in the area. It consists of only a few houses and is used principally as a switch station for unloading equipment for adjacent oil operations. The nearest and most accessible town with good railroad facilities is Strawn, on the same railroad about 7 miles to the east. Ranger is about 6 miles southwest of Wiles. Lacasa, a short distance west of the northwest corner of the area, is not on a railroad but is showing considerable commercial activity because of the oil wells in the vicinity.

The main line of the Texas & Pacific Railway between Fort Worth and El Paso enters the Wiles area a little more than a mile north of the southeast corner, follows the course of the north fork of Palo Pinto Creek, and leaves the area 1½ miles east of the southwest corner. The entire area is accessible to vehicles, but several parts have to be reached by indirect routes because of the abundance of canyons with almost vertical walls. The roads are unimproved and in wet weather are nearly impassable, especially the roads constructed of shale and cut up by heavy traffic. Where they pass over the dip slopes of limestones the weathered hummocky surface of the underlying rock has made them very rough. Serious washouts are caused by large volumes of water rushing down the narrow canyons after

sudden rains. The road from Strawn to Lacasa passes across the northern part of the area and is joined in square G–12 by the road from Wiles, which follows the canyon of Flat Rock Creek. The road between Strawn and Ranger passes across the southeastern part of the area.

Topography.—The surface of most of the Wiles area is extremely rough. It is characterized by a series of escarpments which trend in a northeasterly direction and from whose crests the surface slopes gently to the northwest. The streams have cut narrow canyons and reentrants for long distances into the gently dipping strata. The

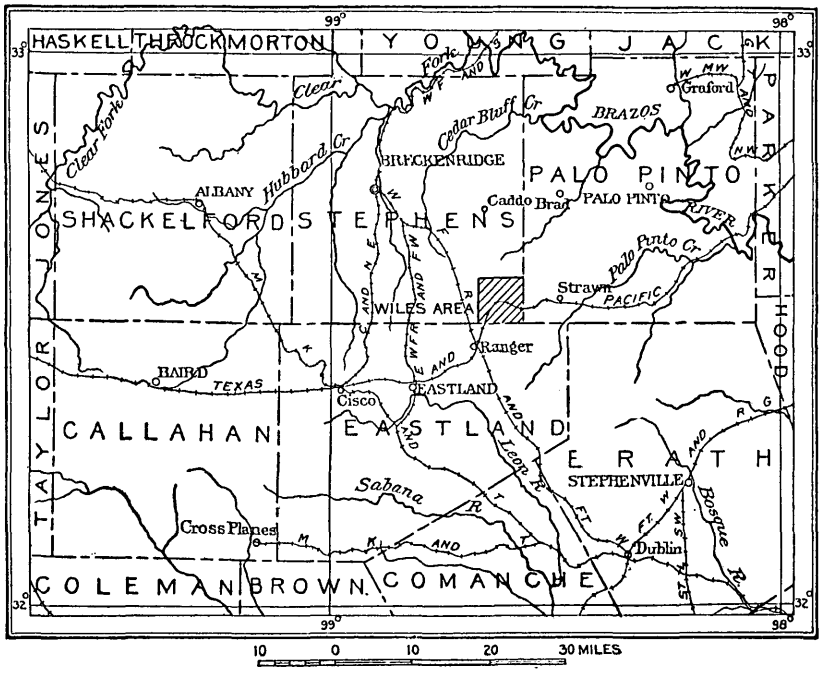

FIGURE 1.—Key map of north-central Texas showing location of Wiles area.

streams flow only during wet weather, but there are always pools in their courses from which water can be obtained for use in drilling and for drinking. The north fork of Palo Pinto Creek and its tributaries, Cottonwood Creek and Flat Rock Creek, make up the principal drainage system of the area. Bills Creek and its tributaries occupy the extreme northeastern part. The land is covered with a thick growth of mesquite and other vegetation of similar types. The lack of water and the roughness of the surface have kept away the prospective farmer.

Field work.—The geology of this area was studied by the writer in April and May, 1919. The detailed structural mapping was done with the telescopic alidade and 15-inch plane table. Locations and

MAP SHOWING GEOLOGIC STRUCTURE OF THE WILES AREA, RANGER DISTRICT, STEPHENS COUNTY, TEXAS

Scale 1/31,680

1 ½ 0 1 Mile

1922

Geology by C. E. Dobbin
assisted by V. E. Ekholm

EXPLANATION

Base of Home Creek limestone

Base of Ranger limestone

Base of Adams Branch limestone

Top of Palo Pinto limestone

900 Structure contours

(Drawn from surface observations to show structure of a theoretical bed 500 feet below top of Adams Branch limestone. Figures show elevation above sea level in feet. Contour interval 10 feet. Dashed lines, doubtful location)

Well being drilled

Oil well

Gas well

Oil and gas well

Dry hole

Dry hole with show of oil

Triangulation station

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elevations were determined by intersection from a number of carefully located primary-control points, whose elevations were checked on several bench marks established in that vicinity by the Coast and Geodetic Survey.[1] V. E. Ekholm acted as assistant in the detailed mapping, and the writer wishes to acknowledge his very efficient service.

STRATIGRAPHY.

GENERAL CHARACTER OF EXPOSED ROCKS.

The exposed rocks in the Wiles area belong to the Canyon group (Canyon division of Cummins[2]) of the Pennsylvanian series and are shown in columnar section in figure 2. They have an aggregate thickness of about 830 feet. The Canyon group in the Wiles area is distinguished from the overlying Cisco group, which is present in the Lacasa area, adjoining the Wiles area on the west, and the underlying Strawn formation, in that it is made up principally of limestone and shale and contains little sandstone. The limestone beds range from a few inches to 50 feet in thickness and are very fossiliferous, yielding a typical Pennsylvanian fauna. Interstratified with the limestone and sandstone are gray and brown shales that contain lenticular or nonpersistent beds of sandstone.

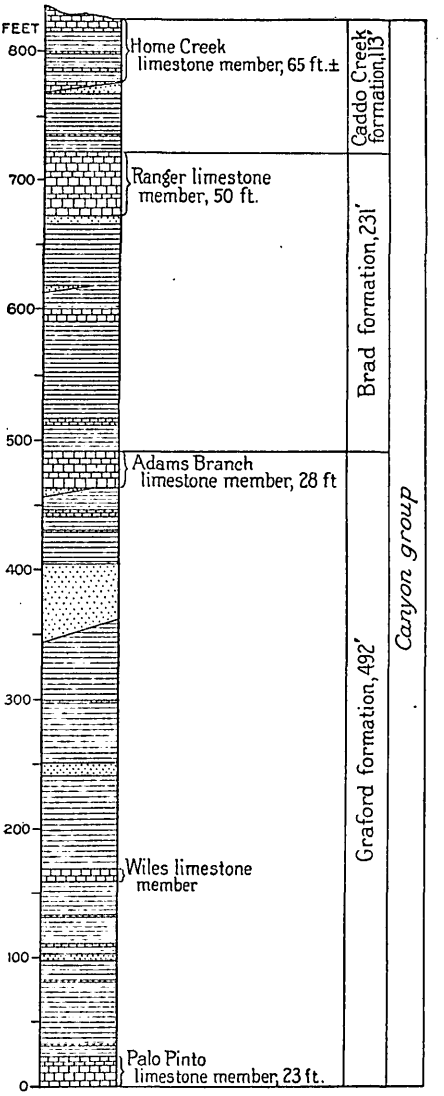


FIGURE 2.—Columnar section of Pennsylvanian rocks exposed in the Wiles area, Tex.

In the north-central Texas region the Canyon group has been divided by Plummer,[3] in ascending order, into the Graford, Brad,

[1] U. S. Coast and Geodetic Survey, Fourth general adjustment of the precise-level net in the United States and the resulting standard elevations, pp. 151, 161, 247, 1914.

[2] Cummins, W. F., Geology of northwest Texas: Texas Geol. Survey Second Ann. Rept., for 1889, p. 374, 1891.

[3] Plummer, F. B., and Moore, R. C., Stratigraphy of the Pennsylvanian formations of north-central Texas: Texas Univ. Bull. 2132, 1921.

and Caddo Creek formations, and these divisions are adopted in this report.

The Graford formation in the Wiles area is about 492 feet thick and is made up largely of gray and brown shales, thin sandstones, and many thin limestones. As originally defined by Plummer[4] the name was applied to the beds between the top of the Palo Pinto limestone and the top of the Adams Branch limestone. In an unpublished manuscript, however, Plummer includes the Palo Pinto limestone in the Graford formation, as its basal member, and that definition has been adopted by the United States Geological Survey. The Adams Branch limestone forms the top member of the formation. The Graford formation is so named on account of its exposures at the town of Graford, Palo Pinto County, Tex.

The Brad formation in this area is about 231 feet thick and is made up of brown and gray shales with thin beds of calcareous sandstone and one prominent bench-forming limestone near the middle of the formation. The Ranger limestone member constitutes the top of the formation, and the base is the top of the Adams Branch limestone member of the underlying Graford formation. As thus defined the Brad formation replaces Plummer's "Ranger formation" as described in the paper just cited, the name Ranger being retained by Mr. Plummer and the United States Geological Survey for the top limestone member of the Brad ("Ranger") formation. The Brad formation is so named on account of its exposures at Brad, Palo Pinto County, Tex.

The Caddo Creek formation in the Wiles area is about 113 feet thick and consists of alternating beds of shale and limestone with thin beds of sandstone. The Home Creek limestone member forms the top of the formation, and the base is the top of the Ranger limestone member of the underlying Brad formation. As thus defined the Caddo Creek formation replaces Plummer's "Eastland formation," the name Eastland having previously been reserved for a Pennsylvanian shale in Tennessee. The Caddo Creek formation is so named on account of its exposures along Caddo Creek, Stephens County, Tex.

At scattered localities in the Wiles area a Tertiary (?) conglomerate lies unconformably on the Pennsylvanian rocks. It is made up of wind-worn and waterworn chert, jasper, and vein-quartz pebbles, some of which show very regular polished faces. Patches of this conglomerate can be observed at many localities in the northwestern part of the area.

[4] Plummer, F. B., Am. Assoc. Petroleum Geologists Bull., vol. 3, pp. 132–145, 1919.

Section of rock formations that crop out in the Wiles area.

System.	Series.	Group.	Formation.	Character.	Thickness (feet).
Tertiary (?).				Conglomerate made up of wind-worn and waterworn pebbles of quartzite, chert, jasper, and vein quartz. Conglomerate has a siliceous matrix.	0–2
				Unconformity	
Carboniferous.	Pennsylvanian.	Canyon.	Caddo Creek formation.	Home Creek limestone member at top of formation.	113
				Gray shale, thin sandstone, and thin limestone.	
			Brad formation.	Ranger limestone member at top of formation.	231
				Brown and gray shale with thin calcareous sandstone and one prominent bench-forming limestone near middle of formation.	
			Graford formation.	Adams Branch limestone member at top of formation.	492
				Gray, blue, and brown shales with many thin limestones and thin sandstones. One prominent calcareous sandstone in upper part of formation. Wiles limestone member about 136 feet above Palo Pinto limestone.	
				Palo Pinto limestone member at base of formation.	

KEY BEDS.

Palo Pinto limestone.—The Palo Pinto limestone, which is the basal member of the Graford formation, is the lowest bed exposed in the Wiles area. This member was originally called the "Coral limestone" by Drake[5] but was later named by Plummer[6] the Palo Pinto limestone, a name which now stands accepted. The total thick-

[5] Drake, N. F., Report on the Colorado coal field of Texas: Texas Geol. Survey Fourth Ann. Rept., p. 387, 1892.

[6] Plummer, F. B., Am. Assoc. Petroleum Geologists Bull., vol. 3, pp. 132–145, 1919.

ness of this limestone is not exposed in the Wiles area, but a short distance to the east it is about 23 feet thick. The top is well exposed in the creek by the side of the Texas & Pacific Railway in square A–3 and in a creek near the southeast corner of the county. Lithologically it is a fine-grained limestone of uneven texture and presents a rough platy structure on weathering. This limestone is readily recognized in the field, as it forms an escarpment, and in well logs, as it is the first prominent limestone to be encountered above the thick sandstones and shales of the Strawn formation. At short distances to the south and east of this area the Palo Pinto limestone is overlain by a sandstone that in places is 30 feet thick, but in the Wiles area this interval is occupied by thin beds of limestone and shale; the limestone carries an abundance of fossil corals.

Wiles limestone.—The Wiles limestone, which is also a member of the Graford formation, occurs about 136 feet above the Palo Pinto limestone and is so named because of its exposure near the town of Wiles. It has a persistent thickness in this area of 8 to 10 feet and forms a distinct bench along the hillside. Where the overlying rocks have been eroded it forms a minor escarpment and caps a dip slope extending in a northwesterly direction. The Palo Pinto Oil & Gas Co.'s Swenson No. 1 well, in the southwest quarter of square B–4, is on a minor escarpment of this limestone. The limestone is massive, dark gray, and not very fossiliferous. The interval between the Wiles limestone and the Palo Pinto limestone is occupied by shale, thin limestone, and thin sandstone. One thin bed of limestone occurring about 58 feet below the Wiles limestone has a constant thickness of about 30 inches in this area and is thus a valuable horizon marker and datum plane. The rock has a green surface and is very fine grained. Where exposed it shows well-developed joint planes and weathers into blocks that lie on the surface slumped down a little from their original position. This limestone can be observed by the side of the road in square B–4.

Adams Branch limestone.—The Adams Branch limestone, the top member of the Graford formation, was originally described by Drake[7] and was so-called because it is typically exposed on the head of Adams Branch, west of Brownwood, Brown County. In the Wiles area this limestone forms a prominent topographic feature throughout its outcrop, being the cap rock of a continuous escarpment that can be followed over a large part of the area. It is about 28 feet thick and about 440 feet above the Palo Pinto limestone. It forms the escarpment near Wiles and retreats for long distances up the creeks west and north of Wiles. In the northeastern part of the area it forms an extensive dip slope with a gentle

[7] Op. cit., p. 391.

northwesterly inclination. On the surface it is light gray, massive, hard, of uneven texture, and very fossiliferous. At the top of this limestone there is a zone that differs in color and lithology from the rest of the bed. This zone is about 1 foot thick and consists of dark-gray to black rock that is heavily pitted on the weathered surface and forms a valuable horizon marker.

At 45 feet below the Adams Branch limestone there is a 5-foot bed of limestone which forms a distinct bench on the face of the escarpment and is persistent throughout the area. On a weathered surface it is dark brown, but on fresh fracture it is dark gray, fine grained, and even textured. Locally in the northeastern part of the area this limestone is very fossiliferous, being made up chiefly of species of *Myalina*. A few feet below this limestone there is another thin bed of limestone about 2 feet thick which is profusely fossiliferous, with *Fusulina* and crinoids predominating.

About 60 feet below the Adams Branch limestone occurs the most prominent and persistent sandstone of the Canyon group in this area. It ranges from 45 to 70 feet in thickness and is composed of fine translucent grains of quartz, loosely cemented with a calcareous cement. It is cross-bedded throughout and at the base is conglomeratic. It contains many impressions of plants, most of which are undeterminable. The interval between this sandstone and the Wiles limestone is composed chiefly of gray and brown shales, thin sandstone, and thin limestone. One of the limestones about 73 feet above the Wiles limestone consists largely of *Fusulina*.

Ranger limestone.—The Ranger limestone was originally described by Drake[8] and called the "Cherty limestone," because of the frequent occurrence of chert in the bed, but was later named the Ranger limestone by Plummer,[9] because of its occurrence near the town of Ranger. It is about 181 feet above the Adams Branch limestone and forms the top member of the Brad formation of the Canyon group. It maintains a constant thickness of about 50 feet and in the Wiles area is the cap rock of the second high escarpment on the road from Strawn to Lacasa and on the road from Wiles to Lacasa. It is light gray, massive, cherty, even textured, and very fossiliferous. In mapping this bed the base and top were used as horizon markers. The top may be recognized by the occurrence of a thin bed of shale immediately above it, and the base is usually in contact with a thin calcareous sandstone. Streams have dissected this limestone, giving rise to long, narrow canyons with vertical walls.

The interval between the Ranger limestone and the Adams Branch limestone is occupied by brown shale, thin sandstone, and one prominent limestone. This limestone is about 10 feet thick in the central

[8] Op. cit., p. 395.

[9] Plummer, F. B., op. cit.

part of the area but grows thinner toward the northeast and southwest. It makes a persistent and easily recognizable bench below the Ranger limestone scarp. In the southwestern part of the area it has either thinned out completely or is concealed by rock débris, as no evidence of its presence could be observed. Along its outcrop there is a remarkable southwesterly diminution in the interval between this bed and the base of the Ranger limestone. In square D–11 this interval is 77 feet, but in square I–6, 3½ miles to the southwest, it is only about 40 feet. About 15 feet above the Ranger limestone there is a thin bed of limestone, separated from the Ranger by shale, which makes a valuable horizon marker. This limestone is brown, flaggy, and fossiliferous and makes a persistent and distinct bench a short distance back from the Ranger scarp.

Home Creek limestone.—The Home Creek limestone is the top member of the Caddo Creek formation, the top formation of the Canyon group. It was originally described by Drake [10] and named from the type locality on Home Creek, in Brownwood County, and was later correlated by Plummer [11] with a limestone in the Wiles area. Here this member, as interpreted, consists of alternating limestone and shale about 65 feet in maximum thickness, occurring about 50 feet above the Ranger limestone. It forms a small escarpment that crosses the northwestern part of the area and becomes progressively more prominent to the southwest. The character of this member is indicated by the following section, measured by K. C. Heald and the writer in square K–9:

Section of Home Creek limestone in square K–9.

	Feet.
Limestone, gray; many fossils on the surface	4
Limestone, smooth, uniform, brown, very hard; breaks into sharp-pointed pieces; fossiliferous; *Spirifer* predominating	2
Limestone, light brown on fresh fracture; weathers gray; medium hard, lithographic, cherty; top marked with dark-brown hematite and limonite	6
Limestone, gray, lithographic, hard; few fossils, many chert nodules	2
Concealed, probably shale	4
Limestone, lithographic, dark, nonfossiliferous	1
Shale, brown	14
Limestone, in two benches; upper bench on fresh surface is little darker than the lower bench; top bench conglomeratic in places, rarely fossiliferous; lower bench homogeneous, lithographic, hard, brittle; weathers gray	3
Limestone, top oolitic, much recrystallized, hard, slabby; base of Home Creek limestone	3
Shale, dark brown.	
Sandstone.	

[10] Op. cit., p. 398.
[11] Plummer, F. B., and Moore, R. C., op. cit.

The interval between the Home Creek limestone and the Ranger limestone is occupied chiefly by thin sandstone and shale. The beds of sandstone are thicker and more numerous toward the west.

ROCKS NOT EXPOSED.

The unexposed rocks in the Wiles area that have been penetrated by the drill comprise the Strawn formation, Smithwick shale, and Marble Falls limestone, of Pennsylvanian age, and an undetermined thickness of limestone and shale of Mississippian age, as shown in the following section:

Section of rocks not exposed but passed through by the drill in Wiles area.

System.	Series.	Formation.	Character.	Thickness (feet).
Carboniferous.	Pennsylvanian.	Strawn formation.	Thick sandstones, blue to black shale, conglomerate, thin to thick lenticular limestones; no coal.	2,000–2,280
		—Unconformity—		
		Smithwick shale.	Black fissile shale and black limestone.	530–605
		Marble Falls limestone.	Gray to black crystalline limestone interbedded with black shale and thin sandstone.	560
	Mississippian.		Black limestone.	20±
			Black shale.	60

Strawn formation.—The Strawn formation in the Wiles area is from 2,000 to 2,280 feet thick and is in marked contrast to the overlying Canyon group, which is made up largely of limestone, in that it consists predominantly of blue and brown shales, sandstone, and thin beds of conglomerate. The coal beds in this formation that are mined farther east are not reported in well logs in the Wiles area, and it is probable that they either pinch out or are replaced by black shale. In some well logs limestone to a total thickness of 80 feet has been reported, but it is assumed that this is a misinterpretation of the well cuttings. An examination of the well logs plotted on Plate IX shows that at the base of the Strawn formation in Veale No. 1 well is 160 feet of blue sandy shale that apparently represents the "Millsap division" of Cummins, which is now included in the Strawn formation, and that the change from this sandy shale to the underlying black Smithwick shale is very abrupt. This blue sandy shale may be represented in the other wells either in the strata reported as sandstone by the drillers and here included in the Strawn

formation or in the upper part of the dark shale here assigned to the Smithwick shale.

Smithwick shale.—In the Wiles area the Smithwick shale is from 530 to 605 feet thick and is made up of black fissile shale and black limestone. The base of the formation is assumed to be at the top of the first thick, persistent bed of black limestone. The logs of all the wells in this area show a persistent zone of thin beds of limestone near the middle of the Smithwick shale. These beds are known to drillers as the "Caddo lime" or "Breckenridge lime."

Marble Falls limestone.—In the Gholson No. 1 well of the Gulf Production Co., in square L–7, the total thickness of the Marble Falls limestone is assumed to be 580 feet, although this thickness may include at the base some limestone of Mississippian age, which properly is not a part of the Marble Falls limestone. The Marble Falls is made up principally of massive beds of black limestone, black shale, and oil and gas bearing sandstone. A persistent light-gray limestone in this formation, locally called the "gray lime," is of much value in correlating well logs.

Mississippian shale.—The Mississippian ("Lower Bend") shale was encountered in the Gholson well above referred to and was penetrated to a depth of 60 feet. As the top of the Ellenburger limestone, which normally underlies this shale, was not reached, the thickness of the shale in this area is not known.

STRUCTURE.

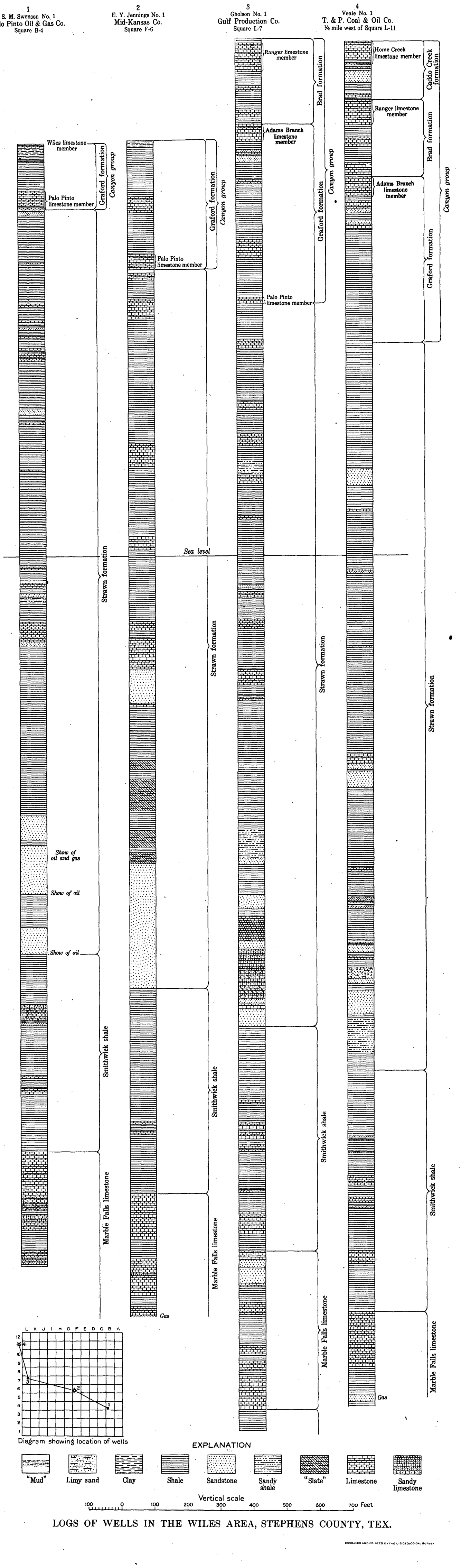
REGIONAL STRUCTURE.

Two or more distinct types of regional structure may occur in a single area where rocks of one age rest unconformably on rocks of a widely separated age. This condition prevails in the north-central Texas fields, where Pennsylvanian rocks, with a regional dip to the northwest, are exposed in part of the area, and Cretaceous rocks, with a regional dip to the southeast, in other parts of the area. The following discussion deals entirely with the structure of the Pennsylvanian rocks.

The regional structure in the Wiles area is that of a monocline dipping to the northwest. The dip is constant throughout most of the area but is not uniform in amount. It averages between 45 and 50 feet to the mile but in some parts of the area is as great as 120 feet to the mile. Locally, however, the beds lie flat or dip in other directions.

LOCAL STRUCTURE.

Of the minor or local structural features, closed anticlines, plunging anticlines, and structural terraces have been found to be commonly



LOGS OF WELLS IN THE WILES AREA, STEPHENS COUNTY, TEX.

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associated with commercially important accumulations of oil and gas. A brief description of these features is given below.

Closed anticline.—A closed anticline (see fig. 3) is a fold or flexure of the rock beds from whose crown or summit the beds dip in every direction. The outline of a closed anticline, as revealed by the outcrop of its constituent beds where the anticline has been worn down by erosion to a nearly horizontal plane, ranges from a circle to a convoluted, highly irregular line. An anticline that is not more than twice as long as it is broad is commonly called a dome, but dome is an elastic term, and no hard and fast rule may be laid down for its application.

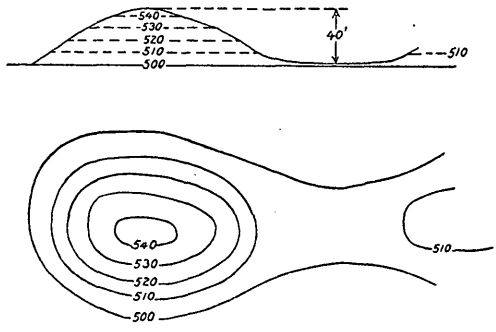

FIGURE 3.—Sketch showing an anticline with a closure of about 40 feet.

The closure of an anticline is measured by the shortest vertical distance in any direction from the summit to a point where the direction of dip is reversed. In the accompanying sketch of a closed anticline (see fig. 3) the highest closed contour represents an elevation of 540 feet and the lowest an elevation of 510 feet. The difference between these two elevations, plus an indefinite distance, not exceeding a contour interval, which the saddle lies below the 510-foot contour and a similar indefinite distance which the crest of the dome rises above the 540-foot contour, gives the amount of closure—about 40 feet.

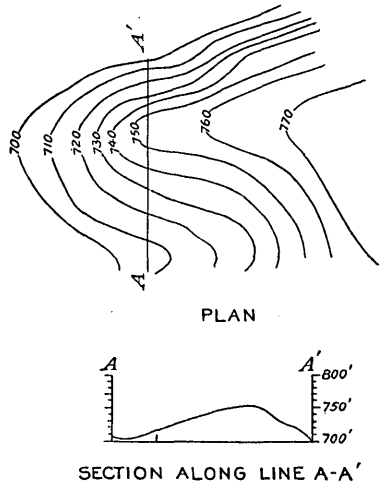

FIGURE 4.—Sketch and cross section of a plunging anticline.

Plunging anticline.—A plunging anticline (see fig. 4) differs from a closed anticline in that there is one direction in which the rocks do not dip away from the crest. It may be either symmetrical or steeper on one side than the other.

Terrace.—The term "terrace" in structural geology means approximately the same as in topography or landscape gardening, indicating a nearly level surface with a slope falling away rather steeply on one side and rising sharply on the other. (See fig. 5.)

The flat portion of the terrace is called the step, the part consisting of beds sloping upward from the step is called the upper slope, and the part consisting of beds dipping downward from the step is called the lower slope.

STRUCTURAL FEATURES OF THE WILES AREA.

In the Wiles area the structural features of the types that are known elsewhere to be associated with oil accumulation are limited to the terrace and the plunging anticline. Three of the anticlines cross the area in a northwesterly direction, and several pronounced terraces occur in different parts of the area. It is not improbable that all the surface structural features observed are but slight reflections of more pronounced features occurring in the Marble Falls and Ellenburger formations below the surface.

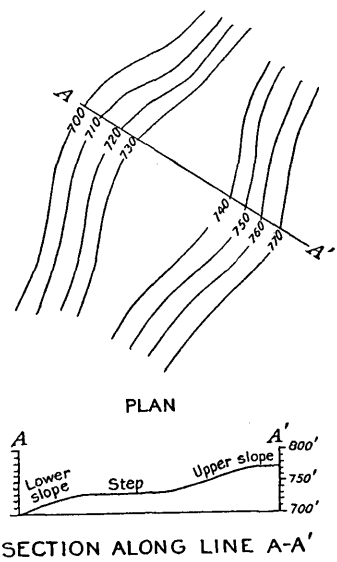

FIGURE 5.—Sketch and cross section of a structural terrace.

Bills Creek plunging anticline.—In squares A–9 and B–10 there is a pronounced anticline plunging to the northwest. The north-south cross section of this flexure is an arch which is slightly steeper on the south side than it is on the north. The portion of the fold nearest the east margin of the area is the most pronounced, and it is possible that the continuation of the anticline in the Strawn area, to the east, which has not been mapped, may be more pronounced than the part that falls within the Wiles area. At the time of mapping no wells had been drilled in this vicinity, and thus no data are available concerning the presence of oil in this anticline.

Wiles plunging anticline.—The Wiles plunging anticline extends entirely across the Wiles area, from square B–3 on the east to square L–8 on the west, the trend being approximately N. 45° W. It is an extremely gentle fold, although in squares G–5 and L–8 there are local accentuations that make it more prominent, and in squares A–3, B–2, and B–3 there is a terrace-like flattening. This plunging anticline is intersected in square E–6 by the Flat Rock Creek terrace. The fact that this anticline is so continuous and regular points to the probability that it is merely a reflection of a much more pronounced fold in the deeper beds.

The first oil produced in the area of this anticline was obtained in the Palo Pinto Oil & Gas Co.'s Swenson No. 1 well, in the south-

western part of square B–4. This well is on the lower slope of a prominent structural terrace and was reported to have had an initial production of 200 barrels of oil a day at a depth of about 3,280 feet.

In the southwestern part of square F–6 the Mid-Kansas Oil & Gas Co. completed two wells on the north flank of the anticline. The first of these wells, known as the Jennings No. 1, struck a flow of 12,000,000 cubic feet of gas and a small show of oil at 3,440 feet. The second well, known as the Satterfield No. 1, was reported to have had an initial production of 411 barrels of oil a day at 3,495 feet.

In the northeastern part of square L–7 a well drilled on this anticline by the Gulf Production Co. was reported to have had an initial daily production of 5 barrels of oil at 4,125 feet.

Tiffin plunging anticline.—The Tiffin plunging anticline is a small fold that extends across squares I–2 and H–2 and probably continues farther to the southeast beyond the limits of the area mapped. No wells had been completed on this anticline at the time it was mapped.

Flat Rock Creek terrace.—The step of the Flat Rock Creek terrace covers parts of squares C–9, C–8, D–8, D–7, and D–6 and extends from square E–6, where it joins the Wiles anticline, to square C–10, where it joins the Bills Creek anticline. The step of this terrace dips gently to the northwest, but the dip is much less than that of either the upper or lower slopes.

In the northeast corner of the area there are three wells that obtain gas from the shallow sands of the Strawn formation. A widening of the contours in this area suggests that two of these wells are on the lower slope of a terrace which is more pronounced in the area to the north than it is in the Wiles area. The easternmost well is on the highest part of the step of the terrace.

Hagaman terrace.—In the southwestern part of the area the rocks dip to the northwest at about half their normal rate, giving rise to a prominent terrace. Only the step and upper slope of this terrace are exposed in the Wiles area, but the terrace is known to extend into the Lacasa area on the west.[12] The first oil produced on this terrace in the Wiles area was obtained in the Brazos River Oil Co.'s Massenburg No. 1 well, in square L–4. This well had an initial flow of 2,427 barrels of oil a day. In square L–3 the Superior Oil & Gas Co.'s Hagaman No. 1 produced 150 barrels of oil a day when first brought in.

A well drilled by the Columbia Oil & Gas Co. on this terrace in the southwestern part of square K–2 is reported to have had an initial production of 5 barrels of oil a day at a depth of 3,479 feet but later was nonproductive. A short distance north of this well,

[12] Ross, C. S., The Lacasa area, Ranger district, north-central Texas: U. S. Geol. Survey Bull. 726, p. 309, 1921.

in the same square, the Weimer Oil Co. drilled a well which had an initial production of 15 barrels of oil a day at 3,475 feet.

Other terraces.—In the northwest corner of the Wiles area a well drilled by the Texas & Pacific Coal & Oil Co. in square J–12 was reported to have had an initial production of 700 barrels of oil a day at 3,600 feet. This well is on the lower slope of a slight terrace. The Texas & Pacific Coal & Oil Co.'s Veale No. 1 well, a short distance west of square L–11, in the Lacasa area, had an initial production of 725 barrels of oil a day with some gas at 3,992 feet.

RELATION OF SURFACE TO SUBSURFACE STRUCTURE.

The contours on the accompanying structure map (Pl. VIII) are drawn to represent the attitude of the rocks near the surface and do not represent the exact structure of the deeper beds. At the time the mapping was done only a few wells had been drilled in this area, and information on the relation of surface to subsurface structure was not available. In the Ranger field,[13] where many wells have been drilled and the subsurface structure has been worked out, most of the surface terraces are expressions of subsurface terraces and most of the plunging anticlines are the surface expressions of subsurface closed anticlines.

OIL AND GAS SANDS.

Sands of the Strawn formation.—In the vicinity of Strawn, about 5 miles east of the Wiles area, the sandstone beds of the Strawn formation have been yielding oil for a number of years. The wells are shallow, and the production averages only a few barrels of oil a day per well. In the logs of wells in the Wiles area (see Pl. IX) sandy beds or zones are recorded throughout the Strawn formation, but no mention is made of oil coming from the upper sands. Toward the base of the Strawn the sands are much thicker and more persistent. The log of the Swenson No. 1 well of the Palo Pinto Oil & Gas Co., in square B–4, reported showings of oil from the Strawn sands at 2,075 and 2,370 feet.

Sands of the Smithwick shale.—In the Wiles area the Smithwick shale is made up almost entirely of black fissile shale and black limestone. A few well logs record sandy zones in this formation, but it is not believed that they are of sufficient thickness and persistency to be productive. North and west of the Wiles area the limestone (Caddo lime or Breckenridge lime of drillers) which occurs near the middle of the Smithwick shale is the principal producing bed.

[13] Reeves, Frank, Geology of the Ranger oil field, Tex.: U. S. Geol. Survey Bull. 736, pp. ——, 1922 (Bull. 736–E.

Sands of the Marble Falls limestone.—The larger part of the oil that was being produced in the Wiles area at the time the work here reported was done was obtained from a sand about 300 to 450 feet below the top of the Marble Falls limestone. Other sands in the Marble Falls were recorded, but they are not productive. Since this work was done there has been extensive development in this area, and it is probable that other producing beds have been found.