University of Texas Bulletin
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By

GEORGE G. HENDERSON

BUREAU OF ECONOMIC GEOLOGY

J. A. Udden, Director E. H. Sellards, Associate Director

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

Sam Houston

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

Mirabeau B. Lamar

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THE GEOLOGY OF TOM GREEN COUNTY

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INTRODUCTION

Tom Green County is located a little west of the central part of the State. It is bordered on the north by Coke County and a small part of Runnels County, on the east by Concho County and a small part of Runnels County, on the south by Schleicher County and on the west by Irion and Sterling counties. Near the northwest corner an extension from this county two miles wide and twenty-two miles long reaches westward to Reagan County, this extension forming the southern boundary of Sterling County and the northern boundary of Irion County. The geology of this narrow strip of land is not included in this report. The location of Tom Green County is shown in Figure 1.

Tom Green County has an area of 1829 square miles. San Angelo, the county seat, is the largest city. Other towns are Carlsbad, Water Valley, Knickerbocker, Wall and Christoval. A branch of the Santa Fe Railroad enters the county from the east and, passing through San Angelo, turns northwestward to Carlsbad and Water Valley. The Kansas City, Mexico & Orient Railroad enters the county near the northeast corner and passing through San Angelo, continues westward. A branch of the same railroad was begun, leading through Christoval and southward, but only the grade has so far been completed.

The field work for this report was begun November 1, 1925, and continued without interruption until March 15, 1926. During August, 1927, three weeks were spent in the field in Tom Green County and as far northward as Scurry and Stonewall counties. The object of the last work was to follow and map the outcrop of the San Angelo conglomerate and to study other conglomerates. As base maps, three topographic sheets, the San Angelo, the Sherwood, and the

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Hayrick, published by the United States Geological Survey, were available. For the northwest quadrant of the county there is no base map, except an ownership map compiled by J. J. Goodfellow, county engineer, which gave much valuable information. Various citizens of the county aided materially by giving information as to the names of creeks, boundaries of ranches and names of hills.

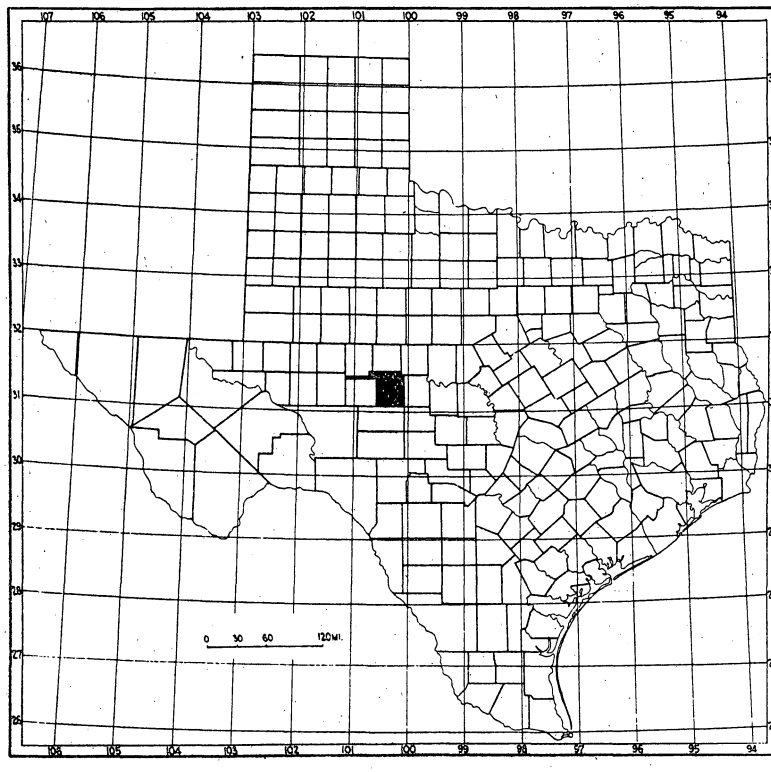

Fig. 1. Map of Texas indicating the location of Tom Green County.

The numerous creeks and rivers of the county afford some good exposures, from which the writer was able to trace out certain horizons, which will aid in working out the geology, particularly to the northwestward. Ten formations are recognized and described in the county. In these formations it

is believed that the key to the geology of a large part of west and northwest Texas is found.

Several United States Geological Survey bench marks are found in the county. These with their elevations and locations are as follows: Elevation, 1850.1 at fork of roads about 7 miles southeast of San Angelo on a cement culvert; elevation 1964.9 on telephone pole one-half mile west of the bridge over Middle Concho River, about 10 miles west of San Angelo; elevation 1874.9 on 7-mile bridge southwest of San Angelo; elevation 1940.7, 12 miles southwest of San Angelo along the Knickerbocker road; elevation 1968.7 on gate post of Door Key Ranch, one mile south of Pecan Creek Filling Station; elevation 1982.7 on gate three-fourths mile north of Pecan Creek Filling Station; elevation 1866.1 about 15 miles southeast of San Angelo at a corner where a country road leading south leaves the graded road. The following elevations on United States bench marks can be found along the road from Christoval going west to Knickerbocker: 2132 on gate; 2145.9 on gate post; 2122.5 on gate post, the last being about one mile southeast of Knickerbocker. The elevations in the various towns were not checked, but these should be readily available.

The county as a whole has good roads. The Robert Lee road leads north from San Angelo; the Carlsbad road, which is paved, leads northwest along North Concho River through Carlsbad to Water Valley. The Arden road leads west from San Angelo, but turns northwest up Middle Concho River. The Sherwood road leads west from San Angelo and is generally in good condition to the west boundary of the county and beyond. The Knickerbocker road, known as State Highway No. 4, leading southwest from San Angelo, is a graded dirt road. The Christoval road leading south from San Angelo is hard surfaced to the county line and for many miles beyond. The Brady road or State Highway No. 9, leading southeast, is graded and generally is in very good condition. The San Angelo-Paint Rock road leads due east from San Angelo. State Highway No. 7 is hard surfaced and leads northeast from San Angelo following the Santa Fe Railroad.

ACKNOWLEDGMENTS

In a large part of the work the writer was aided materially by his wife, Genevieve Beede Henderson, who examined well samples, made thin sections and aided in collecting wells logs. She also did all of the typing and copy work and helped to complete the index; her assistance has been invaluable. The writer is indebted to Dr. J. W. Beede for suggesting the problem and for the use of his library on the Permian. To Dr. J. A. Udden, Director of the Bureau of Economic Geology, Austin, Texas, the writer is indebted for the use of various books in his library. Dr. E. H. Sellards, Associate Director of the Bureau of Economic Geology, has extended many courtesies during the work and has read and criticized the manuscript, offering many valuable suggestions. Dr. J. T. Lonsdale and the other members of the Bureau also extended many courtesies. The Dixie Oil Company, of San Angelo, Texas, furnished several of the well logs included in the report. Mr. R. F. Imbt, chief geologist of the Pure Oil Company, of San Angelo, Texas, furnished the writer with several well logs of Irion County, and a sketch showing the locations of the wells. Thanks are due to Mr. W. B. McCarter, draftsman for the Bureau, who did the tracing of all the maps except the north-south cross-section, which was made by the writer aided by his wife.

PREVIOUS WORK

A considerable amount of previous work has been done in the region of which Tom Green county is a part. The more prominent reports on the area are discussed below. R. T. Hill[1] states that,

> Phillip Nolan, a frontier trader, an Irishman by birth, in 1797 made a trading expedition into the Province of Texas from Natchez, Miss., at that time the outfitting town of the southwestern border. He was a shrewd observer and recorded his impressions of the country, which, on his return to Natchez, he

[1]Hill, R. T., The Present Condition of Knowledge of the Geology of Texas. U. S. Geol. Surv. Bull. 45, 1887.

published in a small work accompanied by a topographic map, his being the first description of Texas by an actual observer printed in the United States. The results were trifling, the map was incorrect and restricted and, moreover, the book is practically out of existence. Upon returning to Texas, Nolan paid the penalty of death for his offense against Spanish jealousy, being shot while resisting capture March 21, 1801.

Professor Jules Marcou[2] in 1852 first reported an area of Permian sediments in the general region of Tom Green County. He was at that time geologist with the Pacific Railroad Survey from Fort Smith to the Pacific Coast. Later in 1890 Professor W. F. Cummins and Dr. Otto Lerch[3] published a brief review of the geology of the tier of the counties west of Runnels County, extending south past Tom Green County, with a geologic map showing the Permian, Cretaceous, and more recent formations. This paper describes some gypsum in the San Angelo region and names a thick sandstone and conglomerate the "San Angelo Beds." During this visit fossils were collected near Ben Ficklin.[4] This fossiliferous horizon is now known to be near the top of the Choza formation. Cummins believed, however, that only the Clear Fork beds and not the Double Mountain beds reached the southern extremity of the Permian, whereas, in fact both are present. Cummins[5] in his report divided the Permian into the following (lowest to highest): (1) Wichita beds, (2) Clear Fork beds, (3) Double Mountain beds, and defined each. Practically the same subdivisions are used in this report.

Other early workers in the general area, who have done more or less extensive work, are Professor E. D. Cope. Dr. C. A. White, Dr. G. C. Broadhead, and Professor Jacob Boll, the latter finding red beds of Permian age in this area in September, 1880.[6]

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[2]Cited in the Geol. Surv. Texas, 1st Ann. Rept., p. 186, 1889.

[3]Cummins, W. F., and Lerch, Otto, A Geological Survey of the Concho Country, State of Texas. Amer. Geol., Vol. V, pp. 321–325, map, 1890.

[4]Ben Ficklin is the site of a county seat, around which a small town grew up. The town was destroyed by a flood August, 1882. It was located about three miles southeast of San Angelo.

[5]Cummins, W. F., The Permian of Texas and Its Overlying Beds. Geol. Surv. Texas, 1st Ann., Rept., p. 181, 1890.

[6]Boll, J., Geological Examinations in Texas. Amer. Nat., Vol. XIV, pp. 684–686, 1880.

Cummins[7] later stated:

> Seven miles west of San Angelo and just west of the mouth of Bald Eagle Creek, in the bank of the river, the limestone is of Permian outcrops, underlaid by blue clay. This is the most northwestern outcrop of the Permian beds along the North Concho River.

The present writer finds this last statement to be true. The outcrop to which he referred is found in the bed of North Concho River southwest of the siding at Turnerdale. It consists of an outcrop of dolomite in the Blaine formation. A photograph illustrating it is included in this bulletin (Pl. IV, Fig. 1). As shown on the geologic map, this is not the most northwestern outcrop of the Permian beds along North Concho River.

PHYSIOGRAPHY

RELIEF

Topographically the county may be divided into three regions, as follows: (1) A hilly to mountainous region; (2) river valleys or lowlands region, and (3) a plains region. The hilly or mountainous region in general covers much of the north and western half of the county, and extends around to and includes the southeastern part. The river valleys region extends from San Angelo, or the central part of the county, northwestward in a gradually narrowing strip to the corner of the county. It extends south and southwest from San Angelo out to the edge of the county on the west and thence across to the town of Christoval on the south by way of Knickerbocker. In the east half of the county and south of Concho River is a broad flat area known as Lipan Flat. This area is included in the plains region and is bounded on the south by the higher land composed of Cretaceous limestones. North of Concho River and extending to the north edge of the county is another strip of flat land which is also included in the plains region.

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[7]Cummins, W. F., Report of the Geography, Topography, and Geology of the Llano Estacado or Staked Plains. Geol. Surv. Texas, 3rd Ann. Rept., p. 137, 1892.

The highest point in the county is found near the southwest corner where the elevation is a little more than 2500 feet. The lowest elevation is found in Concho River at the east edge of the county, the elevation at this point being about 1600 feet. There is a considerable area in the south and southeast part of the county which has an average elevation of 2000 feet. Entering the county from the west between North and Middle Concho rivers is a broad flat ridge. This ridge extends down to within a few miles of the central part of the county, narrowing to the eastward.

DRAINAGE

North Concho, Middle Concho and South Concho rivers unite near the center of Tom Green County to form Concho River, which flows nearly due east and out of the county near its east central part. The waters of the Concho eventually reach Colorado River. North Concho with its main tributaries on the north, Bald Eagle Creek or Dry Creek, Grape Creek, Chalk Creek and Walnut Creek, and on the south, Mulberry Creek, Dry Creek and Little Dry Creek, drains the northwest part of the county. Middle Concho with its tributaries, Brushy Creek, East Rocky Creek, Dry Rocky Creek and West Rocky Creek, drains a portion of the west-central part of the county. Spring Creek and Dove Creek drain the west-central and southwestern part of the county. South Concho River with its tributaries, Burks Creek and Pecan Creek, drain the southern part of the county. The southeastern part of the county is drained into Concho River through the following creeks: Erica Creek, Catelan Creek, Lipan Creek, Snake Creek, Hog Marsh Creek and Kickapoo Creek. The northeast portion of the county is also drained into Concho River through Red Bank Creek, Plum Creek, Valentine Branch Creek, Crow Nest Creek and Willow Creek. The names of several of these creeks have not heretofore been published on maps and were secured by the writer from the inhabitants of the county.

In general the streams have not carved steep walled or deep canyons. The steepest bluffs of the streams are found near San Angelo and eastward. However, Middle Concho

River is an exception, this stream having carved steep, high bluffs below and above the Seven-Mile Bridge, seven miles southwest of San Angelo. The rivers and large creeks have formed only a few terraces, and these are usually at no great height above the beds of the streams. The drainage system has been affected by the relations of the various rock formations. Cretaceous limestones rest on soft sand and clays, and the sandy strata of the San Angelo formation thin somewhat toward the southwest. The erosive work of Middle Concho River in the Blaine sandstone can be best observed one and one-half miles southwest of the Twin Buttes. The drainage waters from Middle Concho and South Concho rivers have been deflected to the northward by a ridge of Clear Fork sediments extending from the vicinity of San Angelo southward to Pecan Creek Filling Station, about 10 miles south of San Angelo. It is clear that there has been a former drainage line, previous to the deposition of the Trinity sediments, coming from the south or southeast, probably the latter, around the upturned edges of the Clear Fork dolomites, which are now found on the north bank of Pecan Creek at Pecan Creek Filling station. As soon as the Cretaceous limestones began to be cut away from this area, the drainage changed from the east or northeast to the north and is now flowing nearly due north through South Concho River parallel to this old ridge of Clear Fork dolomites and thin red and green shales. At the present time the base of the San Angelo conglomerate is about 100 feet lower at San Angelo than at Mount Margaret in Coke County, thus proving that a depression existed in this general area just previous to the time that the San Angelo conglomerate was laid down. A tongue of the lowest sandstones and conglomerates of the San Angelo formation runs up North Concho River but soon disappears beneath the red clays, thin sandstones, and sandy clays which compose the upper strata. Due to the fact that the Cretaceous limestones in the southeast area of the county are not underlaid by any amount of the soft Trinity sands they have remained longer in resistance to erosion than in other parts of the county, causing the eastward bend

of the Cretaceous sediments. Sections taken on the Door Key Ranch (p. 56), the Green Ranch (p. 57), and at Susan's Peak (p. 58), will show the lack of Trinity sands in this part of the county.

STRATIGRAPHY AND PALEONTOLOGY

The rocks exposed in Tom Green Couny comprise eleven formations, of Permian, Cretaceous and Pleistocene ages; these will be described in order from the earliest to the latest. A chart showing these formations is given below and detailed sections of the formations are given in another part of the report, beginning on page 39.

PERMIAN

WICHITA STAGE

ARROYO FORMATION

The oldest rocks exposed in the county are of Permian age and belong to the Arroyo formation of the Wichita-Stage. In Concho River one-half mile from the east county line about 50 feet of black and gray fossiliferous limestones and shales are well exposed at a bend in the river. This formation contains the only exposure of black and gray shales and limestones in the county. See geologic section, page 46.

The fossils collected from the formation include the following: *Leptacanthus* sp. (a fish spine); *Schizodus* sp.; *Euomphalus* sp.; *Pleurophorus* sp.; *Chaenomya* sp.; *Allorisma* sp.; *Pinna* sp.; *Myalina* sp.; *Bellerophon* sp.; *Pseudomonotis* sp.; and *Aviculopecten* sp. Several of the Permian fossils appear to be new species.

CLEAR FORK STAGE

VALE FORMATION

The Vale formation in Runnels County, Texas, according to Dr. J. W. Beede and V. V. Waite[8] consists of 154 feet of shales, the thickness having been estimated. According to

[8]Beede, J. W., and Waite, V. V., Geology of Runnels County. Univ Texas Bull. 1816, p. 47, 1918.

Chart of Rocks Exposed in Tom Green County, Texas

AGE	DIVISION OR STAGE	FORMATION	CHARACTER	THICKNESS FEET
Quaternary	Recent		Stream deposits of silt, sand, gravel, and caliche	0–40
	Pleistocene		Conglomerate of limestone and chert fragments cemented with sandy lime or caliche	0–50
Unconformity				
Cretaceous	Fredericksburg Division	Edwards	Massive Caprina limestone with layers of chert	0–250
		Comanche Peak	Soft, chalky and sandy limestones	0–98
		Walnut Clay	Yellowish, sandy marl	8–15
	Trinity		Soft sands, concretionary sandstones. White, red, and maroon clays. Conglomeratic phase at base. Fossil wood and bones, Psilomelane, quartzitic conglomerates and sandstones	20–103
Unconformity				
Permian	Double Mountain Stage	Blaine	Cream - colored sandstones somewhat limy, gypsiferous, and pyritic with thin layers of green sandy clay	80+
		Unconformity		
		San Angelo	Brick-red sandstones and clays. Some thin, white sandstone seams, some gypsum, little to no mica, one thin fossiliferous dolomite	126
	Unconformity			
	Clear Fork Stage	Choza	Gray dolomitic limestone, fossiliferous in places. Green and red shales, Sandy in places	625
		Bullwagon	Thick dolomites with yellow marly, fossiliferous layers. Green and red shales	65
		Vale	Red gypsiferous, sandy shales	50
	Wichita Stage	Arroyo	Black and gray fossiliferous limestones and shales	58+

Wrather's[9] description of the formation in Taylor County, Texas, along the Texas & Pacific Railway, it has a thickness of 340 feet, thus indicating a thinning between Taylor and Runnels counties of 186 feet. As exposed in Tom Green County the formation consists of about 50 feet, mainly of red, sandy, gypsiferous shales with green streaks. The formation has thinned 104 feet between the sections taken on Colorado and Concho Rivers. In one place just below the wagon bridge over Concho River south of Miles near the upper part of the formation the shale has a reddish-brown color. No fossils were found. See Geologic section, page 46.

BULLWAGON FORMATION

As drawn on the geologic map the Vale formation includes the Bullwagon formation. Wrather[10] states that,

> On Bullwagon Creek west of Abilene, Taylor County, Texas, the Bullwagon dolomite is composed of two layers and has a thickness of 5 feet with a 3-foot shale parting.

Beede and Waite[11] state,

> On the Colorado River the Bullwagon formation is 36 feet thick and is represented by a number of thin dolomites and blue shales.

As exposed south of Miles, in Tom Green County, on Concho River it consists of 44 feet of dolomites and green shales, 25 feet of this being dolomite, dolomitic limestones and yellow marls; and 19 feet of green shales. This shows a thickening of 8 feet in Tom Green County over the Colorado River section. As may be noted in the Geologic section, the formation contains two dolomites, each with a thickness of 10 feet and with a green shale parting of 3 feet. The formation stops with the first red clay. See Geologic section, page 46.

The fossils found in exposures near the mouth of Willow Creek, one-fourth mile northwest of the bridge across

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[9]Wrather, W. E., Notes on the Texas Permian. S. W. Assoc. Petr. Geol. Bull. 1, pp. 93–106, 1917.

[10]Wrather, W. E., *op. cit.*

[11]Beede, J. W., and Waite, V. V., *op. cit.*

Concho River south of Miles, include the following: *Orthoceras* sp.; *Aviculopecten* sp.; *Bellerophon* sp.; *Myalina* sp.; *Pleurophorus* sp.; *Allorisma* sp.; *Pinna* sp.; *Euomphalus* sp.; *Temnocheilus* sp.; *Phacoceras dumblii,* Hyatt; *Myalina* sp.

CHOZA FORMATION

Beede and Waite[12] state that

> The thickness of the whole Choza formation on the Colorado River is 870 feet. . . . There are 270 feet of shales with thin sheets of dolomitic limestones above the top of the Merkel dolomite.

This formation, as exposed in the Concho River in Tom Green County, shows a thickness of 565 feet. Thus the formation is here 305 feet thinner than on the Colorado. This reduced thickness, it is believed, is partly due to erosion. However, the rock quarry at Ben Ficklin shows distinctly some pinching out of beds, mainly shales, toward the south. Accordingly it seems probable that much of this difference is due to thinning of shale beds. As was stated under "Drainage" the base of the San Angelo conglomerate is now found about 100 feet lower at San Angelo than at Mount Margaret in Coke County, this is over a distance of 20 miles. Here it rests upon Choza beds known to be stratigraphically higher than at San Angelo. It is approximately 35 miles from the lowest point of the San Angelo conglomerate, at San Angelo, across to the Colorado River.

A point taken on the Clear Fork beds, at the Kansas City, Mexico & Orient Railway bridge in the east part of the city of San Angelo, has the elevation of about 1775 feet. On approximately the same bed 3 miles north of Pecan Creek Filling Station the elevation is 1982 feet. Over this distance of about 9 miles there is a rise of 207 feet or 23 feet to the mile. A small part of this rise may be due to erosion at San Angelo, but the rise is mainly due to the strata having been lifted up at the south and tilted to the north and northwest.

The horizon of the Merkel dolomite is found at the Kansas City, Mexico & Orient Railroad bridge in the northeast part

[12]Beede, J. W., and Waite, V. V., *op. cit.*, p. 49.

of the city of San Angelo. It is here composed of several thick layers of dolomites with green and red shales at the top and so markedly different from exposures on the Colorado River and in Jones County, Texas, that it can be correlated only by tracing it across the area. The Merkel dolomite, as mentioned by Beede and Waite in their Runnels County report[13] is probably 25 feet thick on the Colorado River, but, as may be seen in the Geologic section of Tom Green County, it is difficult to place the top or base of this member, due to the lithologic changes which have occurred. As stated, Beede and Waite, found 270 feet of shales with thin sheets of dolomitic limestones above the top of the Merkel dolomite in the Colorado River section. Above the Merkel dolomite horizon in Tom Green County, a little over 30 feet of mainly red clay with blue seams of clay and 6 thin beds of dolomite are found. Of this 30 feet of sediments above the Merkel dolomite not over 5 feet are composed of dolomitic limestones. It is most probable that both erosion and lack of deposition accounts for the 240 feet difference. The details of the Choza formation can be found in the Geologic section, pages 42–46.

The fossils of this formation are found in five localities as follows:

Locality 1: The following species were collected on the east bank of Willow Creek, about one mile above the mouth of the creek. *Aviculopecten* sp.; *Myalina* sp.; *Pleurophorus* sp. At this locality only a small number of species is available because of poor exposures.

Locality 2: At a high bluff on the south side of Concho River, about three miles east of San Angelo, a sandy limestone can be found, although at times it is partly covered by water. From this sandy limestone the following fossils were collected: *Aviculopecten* sp.; *Nucula* sp.; *Myalina* sp.; *Pecopteris* sp.; *Bryozoan,* unidentifiable, and *Productus* sp.

Locality 3: Below the dam in the east part of the city of San Angelo a fossil plant, *Pecopteris* sp., was found.

Locality 4: One-half mile north of the rock quarry at Ben Ficklin on the east bank of South Concho River the following fossils were collected: *Temnocheilus* sp.; *Aviculopecten* sp.; *Dentalium* sp.; *Bellerophon* sp.; *Myalina* sp.; *Pinna* sp.; *Schizodus* sp.; *Orthoceras* sp.; *Productus* sp. and *Euomphalus* sp.

[13]Beede, J. W., and Waite, V., *op cit.*, p. 50

DOUBLE MOUNTAIN STAGE

SAN ANGELO FORMATION

Resting unconformably upon the Choza formation of the Clear Fork stage of the Permian is found the San Angelo formation. This formation is conglomeratic at the base along its eastern outcrop throughout most of Tom Green County, but farther west, the formation probably contains no conglomerate. From near the northern line of the county as far northward as Taylor County thick sandstone layers are often found beneath the conglomeratic horizon. From 75 to 100 feet of this sandstone is found beneath the conglomerate around Fort Chadbourne in Coke County. The San Angelo formation has in general a brick-red color and usually contains no mica, although in a few places a very small amount of very finely divided mica is found. The San Angelo formation contains occasional thin layers of white sandstone, never exceeding four or five inches in thickness. These layers have been seen by the writer in this formation as far north as Taylor County.

The basal conglomerate of this formation is composed mainly of small iron-stained quartz pebbles and some black chert, and is always cemented with either iron or red clay mixed with fine red sand grains which are always angular to subangular. The conglomerate in Tom Green County is hardly as coarse as in Coke County. The extreme western exposure of the San Angelo formation southwest of Robert Lee, Coke County, shows that this formation has thinned considerably to the westward. The conglomeratic phase has not only thinned greatly but the pebbles have pinched out in places and become very much finer. It is possible that a few miles farther west there is a complete sequence of beds from the Clear Fork into the Blaine with no conglomerate. During August, 1927, the San Angelo conglomerate was followed as far as Jones County to the northward and mapped as shown on page 20. This map shows that

the San Angelo conglomerate passes below the Blaine sediments to the northward with, in places, only a few feet of sediments between it and the Blaine sediments. All of the sandy sediments to the east of the outcrop of the San Angelo conglomerate are of Clear Fork age, as shown by the fossils of the San Angelo formation found southeast of the Twin Buttes, in Tom Green County. These fossils appear to be the same species as those of the Clear Fork stage of the Permian. Some forty samples of the conglomerate were collected along the outcrop and an examination of these was made. In some places a clayball conglomerate is present above the basal conglomerate in Tom Green County. The pebble content of this conglomerate consists of red or blue clay, the cementing material is always red clay or red sandy clay. No wood, bones, or mica were found in the conglomerate.

The sandy parts of the San Angelo formation thins somewhat in Tom Green County to the southward and southwestward, while the red shales and clays thicken, as shown by remnants left by erosion. The formation has the appearance of a large fan which has spread northwestward from the Central Mineral region to the southeast of the county. Some of the material of which it is composed must have been carried around the upturned edges of the Clear Fork sediments through an old channel or depression, which has existed yet in pre-Trinity time, to a depth of 170 feet to the southward of Pecan Creek Filling Station. (Note thickness of blue clay in the log of Door Key well, p. 75, and sections taken on Door Key Ranch, pp. 56–58.) The Devil's Courthouse section, p. 60, shows 119 feet of the San Angelo formation between the base of the San Angelo conglomerate of Permian age, and the base of the maroon shale, of Cretaceous age. The best exposures of the San Angelo formation can be seen from the junction of Plum Creek and Red Bank Creek up to the base of the Devil's

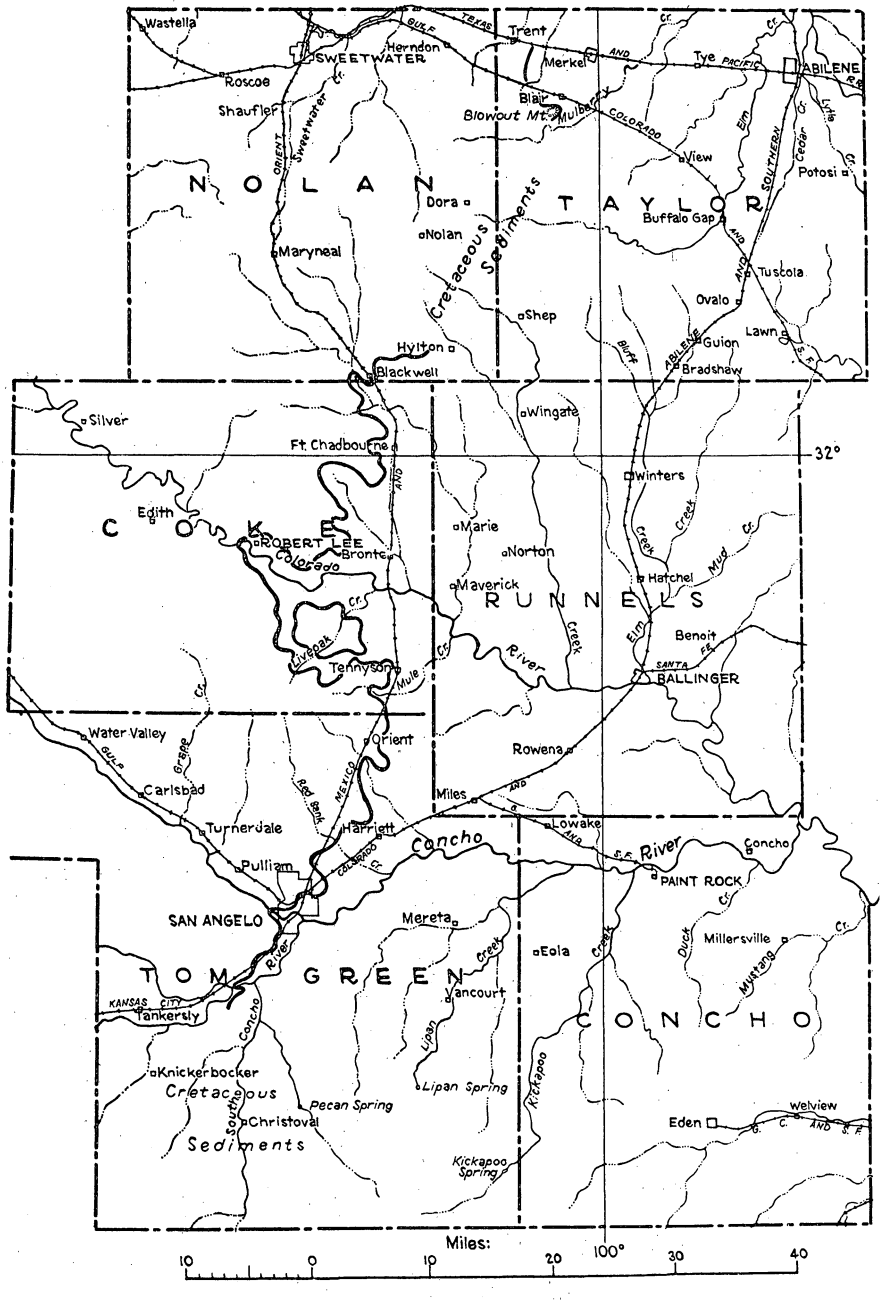

Fig. 2. Map showing western outcrop of the San Angelo conglomerate in Tom Green, Coke, southern Nolan, and northwestern Tyler counties.

Courthouse Mountain, and from one mile below Seven-Mile Bridge, seven miles southwest of San Angelo, nearly up to the Twin Buttes six miles west of San Angelo. A good section of the basal strata of the San Angelo formation is found one mile east of the Seven-Mile Bridge southwest of San Angelo. The break in sedimentation between the Blaine formation and the San Angelo beneath is easily traced by a thin layer of hematite from one mile south of the Twin Buttes to about three miles to the northward. About three-fourths mile east of the Twin Buttes a collection of fossils included the following: *Myalina* sp.; *Schizodus* sp.; *Dentalium* sp.; and a gastropod which was unidentifiable.

BLAINE FORMATION

Resting with a distinct unconformity upon the San Angelo formation is found the Blaine[13]* formation of the Permian age, the break being best observed southeast of the Twin Buttes. The formation consists in Tom Green County of 80 feet or more of cream-colored, even-bedded, gypsiferous and pyritic sandstones and thin green shales. These sandstones sometimes change to a pink or brown color and have been logged as sandy lime by drillers. The east-west cross-section also shows them as sandy limes. It is believed that from 75 to 100 feet of Blaine sediments are missing here compared with a section of the Blaine studied seven miles northwest of Robert Lee, in Coke County. At the latter place sandstones of the same character and about the same thickness are found capping the hills and conformable beneath them is a considerable thickness of red, gypsiferous and very sandy clay. These red sandy clays are totally absent in Tom Green County at the base of the cream-colored sandstone, excepting at one place to the eastward of the Twin Buttes. Here 20 to 30 feet are locally present (Pl. I, Fig. 2). Several miles to the west and northwest the red strata appear to be present in the subsurface. (See east-west cross-section in pocket.)

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[13]*The name "Blaine" is adopted from Beede and Christner, The San Angelo Formation, The Geology of Foard County, p. 83. Univ. Texas Bull. 2607, 1926.

The best locality for study of the Blaine formation is near the Twin Buttes, six miles west of San Angelo. To the east of the Twin Buttes it rests upon the San Angelo formation, and the contact can be traced around to one mile southwestward from the Twin Buttes (Pl. III, Fig. 1). Another good exposure is found one mile southeast of Monument Mountain in a small unnamed creek which flows northeastward into North Concho River. Here 80 feet of sandstone is exposed and it is certain that a considerable part is covered. Another exposure is found along Middle Concho River on the Abe Mayer Ranch just across the county line in Irion County. Here the upper strata dip steeply to the westward (Pl. III, Fig. 2). One other fair exposure is to be found on the March Ranch in north-central Tom Green County along Grape Creek (Pl. III, Fig. 3.) At this locality and the one in Irion County local unconformities seem to be present. These probably have been formed by near shore deposits with cross currents.

It seems clear that after the Clear Fork sediments were laid down they were elevated and eroded before the San Angelo formation was deposited, probably along the margin of a shallow sea. Following the deposition of the San Angelo formation another elevation took place and the Clear Fork sediments as well as the San Angelo formation underwent erosion before the sinking of the land beneath the seas to permit the deposition of the Blaine formation.

The Blaine formation is quite well hidden in the county, excepting at the places mentioned. This is due to the fact that it has weathered to long sandy slopes which are covered with catclaw and other thorny bushes. The sandstones and soft sands and clays of the Cretaceous often lie immediately upon the Blaine and in this way serve to confuse and hide the outcrops. The Blaine sandstones with finely divided gypsum flakes were at first thought to be of probable Triassic age and it was necessary to do considerable work outside the county both on the Blaine and Triassic sediments to the north and northwestward before a definite conclusion could be reached.

Attention is called to the fact that the Blaine formation in Stonewall County is composed of beds of dolomite as well as red gypsiferous sandy clays. Farther south in Coke County it has changed to red, gypsiferous, sandy clays and red and yellow sandstones with blue and red clays with few dolomites present. In Tom Green County the Blaine is further changed to cream-colored gypsiferous sandstones with thin green shales and one dolomite present which occurs near the base of the formation exposed at Turnerdale, eight miles northwest of San Angelo in the bed of North Concho River (Pl. IV, Fig. 1). Considerable work both on the surface and in the subsurface convinces the writer that nearly all of the salt and gypsum beds of the Permian basin are found in the Blaine formation, although there is some evidence shown by well logs in Tom Green and Irion counties which indicates that some of the earlier salt and gypsum layers may have been deposited in the late Clear Fork beds. No fossils were found in the Blaine formation.

CRETACEOUS

TRINITY DIVISION

Beds which are here described as the Trinity division of the Cretaceous rest unconformably upon the Permian, and as would be expected where materials were available, the Cretaceous Sea, as it advanced upon the land, laid down a conglomerate. When an advancing sea reworks an uneven surface the conglomerate may not necessarily be found continuously and, in Tom Green County is altogether absent in places.

The conglomerate is found exposed in several places in the county, and ranges from 0 to 10 feet in thickness, black, green or brownish chert pebbles making up from 5 to 30 per cent of the pebble content. The main part of the conglomerate is made up of white or iron-stained quartz pebbles cemented with a siliceous or irony material so hard in places that the quartz pebbles break off as smoothly as the

quartzitic material of the cement. In some places the sand has changed to a quartzite. This basal conglomeratic phase is best observed at the following localities:

1. About one mile southeast of Pecan Creek Filling Station just above the road crossing Pecan Creek on the Door Key Ranch, the conglomerate is 5 feet thick and rests upon Clear Fork dolomites.
2. About two miles west of Pecan Creek Filling Station where a ranch road crosses the Orient Railroad grade, the conglomerate is 3 feet thick and rests upon Blaine sediments. At this place two fragments of black chert were found bearing imprints of *Productus* sp.
3. About two miles west of Tankersley in the Orient Railroad cut, where the thickness of the conglomerate is uncertain, but probably is 1 foot or more. It is underlain by the characteristic yellow Blaine sandstone which is found outcropping in the bed of Spring Creek one-fourth mile to the southeast.
4. About one-fourth mile southwest of the Twin Buttes the thickness is 1 foot, resting upon cream-colored Blaine sandstone.
5. About two miles southeast of Monument Mountain in a small creek there is 0 to 3 feet underlain by cream-colored Blaine sandstone and overlain by maroon and yellow clays.
6. Eleven miles due north of San Angelo, on the Robert Lee road, in a creek at the milestone, the outcrop continues to about one mile southeast. The thickness of the formation here is from 1 to 10 feet and the conglomerate overlies San Angelo sediments. In places here maroon shales are found beneath it.

The basal Trinity conglomerate is poorly shown at several other places in the county, as for example on the south side of the Devil's Courthouse Mountain. Careful search will disclose many black chert pebbles farther north at its horizon between the upper San Angelo sandstone and the basal maroon clays of Cretaceous age.

Above the horizon of the basal conglomerate the character of the sediments varies considerably. First a maroon shale or clay with white and pink streaks and layers, sometimes sandy, ranging up to 25 feet in thickness, is generally found. This shale or clay may change to a white color with yellowish, maroon or purple streaks. However, the colored clays and shales predominate in the base and the yellowish to white clays are found higher up. This gradation offers proof that the Trinity Sea laid down these strata after first reworking the red Permian sediments. Many places were found where maroon or purplish clay ranged well up

toward the Walnut clay. Throughout the Trinity division, horizons of lenticular and quartzitic sandstones are found, generally three in number, lying parallel to the overlying Cretaceous limestones. These sandstone lenses may be found near the base of the Trinity, near the middle, or at the top. The sandstones are peculiar in that they weather to various shaped concretions, some being very small and round, others flat, cone-shaped or bowl-shaped, and in nearly all cases bunchy or botroidal in nature. Some have been found to range up to 5 feet in length, with a diameter of from 4 to 6 inches. These were found on the Abe Mayer Ranch, just across the county line in Irion County, on the south side of Middle Concho River. The cementing material seems always to be calcareous or siliceous. The concretions often are found to weather out of soft quicksand, but some layers, several feet in thickness, are composed entirely of the botryoidal concretions. The thicknesses and locations of the sandstones and soft, vari-colored clays, and shales can best be studied in the various sections given in a later section of the report, beginning on page 47.

The maroon, purplish, pink and yellow streaks of clays and shales are often found in the Trinity division several miles west of the present limits of the San Angelo formation as well as in the Trinity division just above it. This is well observed at the Devil's Courthouse Mountain, the Twin Buttes, or around Monument Mountain, where the Trinity rests upon Blaine sediments. In the southeast part of Tom Green County, where the San Angelo formation is absent, no red, purplish, maroon or yellowish streaks were observed in the thin Trinity division, thus suggesting that the highly colored clays and shales of the Trinity in the west part of the county came as a result of the reworking of the red San Angelo formation by the Trinity Sea. In the southeast area of the county the blue clays of the Trinity are present as well as very thin botryoidal sandstones.

At the top of the Trinity division and just below the Walnut clay, is found a peculiar, soft, white nodular limestone, ranging up to 2 feet or a little more in thickness

and containing in places nearly round or oval nodules, some of which are as large as hens' eggs. In some localities it is divided by a thin layer of Trinity sand, which may be either soft or hard. This limestone is fairly persistent over the county, excepting in the southeastern area, where it was not laid down, due to the general thinning of the Trinity. This layer often contains the mineral psilomelane but only in small amounts. Similar descriptions of the Trinity division of northwest and west Texas and Oklahoma have been given by Bullard,[14] Liddle and Prettyman,[15] Taff[16] and others.

About one-fourth of a mile south of the Twin Buttes a large bone was found in a gravel bed, at the same horizon as the basal conglomerate. The specimen was about three feet in length, but so fragmentary that only small pieces could be put together. Flat portions of the bone near the joints suggest that the animal had an aquatic existence. Silicified wood is found in quite large amounts at various horizons from the base of the Trinity up to within a few feet of the base of the Walnut clay. Psilomelane is found in some places near the base of the Trinity, for instance, at a point one mile southeast of Monument Mountain.

FREDERICKSBURG DIVISION

WALNUT CLAY FORMATION

The Walnut clay is found to be present in the county and lies conformably upon the Trinity. It ranges from 6 to 15 feet in thickness, is quite soft and is of yellowish to light brown color. Its rapid erosion often causes the overhanging cliffs of limestone so numerous throughout west and northwest Texas. The formation is remarkable for its persistency and the large number of species of fossils found in it. In some places it is found to be more sandy and

[14]Bullard, Fred M., Geology of Love County, Oklahoma. Okla. Geol. Surv. Bull. 33, pp. 16–21, 1925.

[15]Liddle, R. A., and Prettyman, T. M., Geology and Mineral Resources of Crockett County. Univ. Texas Bull. 1857, pp. 42–44, 1918.

[16]Taff, J. A., The Cretaceous Area, North of Colorado River. Geol. Surv. Texas, 3rd Ann. Rept., pp. 282–288, 1891.

harder than in others. This is found to be true in the northwest and north-central, as well as in the southeast part of the county. In these localities the fossil content is considerably less. At the Devil's Courthouse Mountain and at the Twin Buttes, a ledge of limestone from 1 to 3 feet thick parts it, and at these places the fossils are greater in number and larger. At the Twin Buttes there are found about as many gastropods as pelecypods with quite a number of echinoderms. This is true also at the Devil's Courthouse, but in the northwestern and northern parts of the county the pelecypods exceed the gastropods in number. In the southeastern area gastropods and echinoderms seem to predominate.

As is usual in the Walnut clay of Texas, many species of gastropods were found that were unidentifiable, due to the poor state of preservation. Among the pelecypods collected from this formation are several new species, which with several new species of the Permian will subsequently be described.

A complete list of the identified fauna of the Walnut clay of Tom Green County is as follows:

Pelecypods: *Cucullaea* sp.; *Exogyra weatherfordensis* Cragin; *Protocardia texana* Conrad; *Mytilus* sp.; *Exogyra texana* Roemer; *Pachymya* sp.; *Pecten (Neithea) georgetownensis* Kniker; *Lima waconensis* Roemer; *Caprina* sp.; *Gryphaea marcoui* Hill and Vaughan; *Tapes austinensis* Whitney (probably came from the limestones a few feet above the Walnut clay); *Pecten (Neithea) irregularis* Böse; *Modiola* sp.; *Inoceramus* aff. *comancheanus* Cragin; *Inoceramus* sp. (larger and has a different outline than the preceding one); *Anatina texana* Vaughan; *Solemya* sp.; *Protocardia* sp.; *Cucullaea* sp.; *Cyprimeria texana* Roemer; *Pholadomya* sp.; *Anatina austinensis* Vaughan; *Pachymya compacta* White (probably weathered from the limestone just above the Walnut clay).

Gastropods: *Hydrotribulus* sp.; *Tylostoma harrisi* Whitney; *Cinulia pelleti* Whitney; *Acteonina* sp.; *Calliomphalus* sp.; *Trochus* sp.; *Pyropsis* sp.

Cephalopod: *Engonoceras piedernale* Von Buch.

Coral: *Parasmilia austinensis* Roemer.

Echinoderms: *Holectypus planatus* Roemer; *Enallaster texanus* Roemer; *Cyphosoma texanum* Clark.

COMANCHE PEAK FORMATION

Conformable above the Walnut clay is found about 95 feet of Comanche Peak limestones, which are in places slightly sandy. In general the limestones are thick bedded, soft and chalky, and weather to slopes. There is an occasional hard layer, as for example, the bed containing *Requienia*. Near the top of the formation, limestones are found which, due to hard and soft sandy streaks, weather full of round holes. The soft streaks are often filled with white, soft, very fine sand, while the parts around it are composed of a flinty limestone. These layers are often called "skully limes" because at a distance they somewhat resemble piles of skulls. Most of the fossils of the Comanche Peak formation are microscopic, although an occasional cast of a gastropod or pelecypod was found. All the pelecypods and gastropods found were unidentifiable, except two species of pelecypods found in the bed here called the Requienia Bed. This bed is persistent over the county, and everywhere contains great numbers of large *Requienia* as well as a very large *Pecten*. In some places two beds containing *Requienia* are present. The more persistent bed ranges from 2 to 4 feet in thickness. The large fossils obtained from this formation are *Pecten (Neithea) duplicicosta* Roemer; and *Requienia texana* Roemer. For microscopic fossils see the descriptions of the thin sections which follows. A section examined at Mount Nebo shows this formation to have a thickness of 95 feet.

Samples of this entire 95 feet were collected and thin sections made and examined. Mrs. Henderson aided in making the sections and wrote the descriptions, but the fossils were identified jointly.

Thin Sections Made of the Limestone from the Mount Nebo giving the Microscopic Content of Comanche Peak Limestone

Slide No.

1. 0–8 feet above Walnut clay.
   Fine-grained limestone about 25 per cent sand, the quartz grains being angular, with a few subangular grains.

Fossils: Sponge spicule, corals, *Nodosaria* sp.; *Biloculina* sp.; *Cristellaria* sp.; *Ostracod* sp.; other fragments too small to be determined.

2. 8–14 feet above the Walnut clay.
   Fine granular limestone with several angular quartz grains present.
   No fossils noted.
3. 14–17 feet above the Walnut clay.
   Fine granular limestone. Only a few quartz grains present.
   No fossils.
4. 17–19 feet above the Walnut clay.
   Fine granular limestone. Only a few quartz grains present.
   Fossils: *Miliolina* sp.; a piece of a *Nodosaria; Orbitolites?*
5. 19–25 feet above the Walnut clay.
   Very fine-grained limestone, one or two pieces of quartz, very small.
   Fossils: Apparently several *Triloculinae* sp.; a piece of a *Nodosaria; Miliolina* sp.
6. 25–28 feet above the Walnut clay.
   Very fine-grained limestone.
   Fossils: *Anomalina* sp.; *Triloculina* sp.; *Miliolina* sp.; fragments of other fossils.
7. 28–31 feet above the Walnut clay.
   Like the above sample.
   Fossils: *Textularia* sp.; *Miliolina* sp.; coral; *Triloculina* sp.; sponge spicules; *Anomalina* sp.; and other fragments.
8. 31–37 feet above the Walnut clay.
   Requienia beds.
   Fossils: *Miliolina* sp.; *Planorbulina* sp.; *Textulariae* in abundance, two species or more; *Biloculina;* sponge spicules; coral, probably two species; *Orbitolina* sp.; in abundance, several ostracods.
9. 37–44 feet above the Walnut clay.
   Very fine-grained limestone.
   No fossils.
10. 44–47 feet above the Walnut clay.
    Like No. 9.
11. 47–53 feet above the Walnut clay.
    Like No. 9.
12. 53–56 feet above the Walnut clay.
    Like No. 9.
13. 56–59 feet above the Walnut clay.
    Like No. 9.
14. 59–62 feet above the Walnut clay.
    Like No. 9.

15. 62–75 feet above the Walnut clay.
    Like No. 9.
16. 75–78 feet above the Walnut clay.
    Like No. 9.
17. 78–82 feet above the Walnut clay.
    Like No. 9.
18. 82–86 feet above the Walnut clay.
    Like No. 9.
19. 86–105 feet above the Walnut clay.
    Caprina beds.
20. 105–108 feet above the Walnut clay. Top.
    Like No. 9.
    Apparently few fragments of fossils, but too small to be determined.

EDWARDS FORMATION

Above the Comanche Peak formation is found the Edwards limestone resting conformably upon the Comanche Peak. Its basal members are easily recognized by their thick layers of brown to yellow or whitish chert layers as well as by the peculiar fossils known as Caprinas which are very abundant in some places. Fifteen feet of the Edwards limestone remains on top of Mount Nebo and the Devil's Courthouse Mountain. Over most of the county the Edwards limestones have been removed by erosion. On the high divide in the northwestern part of the county between the Middle and North Concho rivers it is found as remnants up to probably 50 feet in thickness. In the southeast and southwest corners of the county it is also present, up to over 200 feet in thickness. Time did not permit the mapping of the contact of the Edwards and Comanche Peak formations in as careful detail as the contacts of the other formations, although these contacts are believed to be essentially correct.

Caprinas were the main fossils present in the basal members but these were too poorly preserved for identification. At Mount Nebo a small pelecypod and one gastropod were found, but neither was identifiable.

CORRELATION OF THE CRETACEOUS

The Trinity division as described in this report does not include all of the formations of the Trinity division developed in Central Texas. As will be noted in the descriptions the Trinity is usually conglomeratic at its base, which the writer believes probably corresponds to some of the sediments now mapped as Triassic to the northwestward. In Tom Green County there are often red clays at the base of the division which grade upward into bluish and light clays. There is no stratum or strata of rocks in the Trinity division of the county which can be correlated with the Glen Rose formation. Near the top of the Trinity division, as mentioned elsewhere in this report, is found a fairly persistent loose, fine to coarse-grained sand. The concretionary nature of this sand as well as that of the Paluxy sand in Tarrant County was mentioned. This sand grades laterally into indurated ledges which are found also at lower horizons. Above this upper sand there is found generally a thin peculiar nodular limestone layer, which may be correlated with the thin sandstone ledge at the top of the Trinity in Crockett County as described by Liddle and Prettyman in their Crockett County report. The Walnut clay also is divided by a thin layer of limestone in a few places. Since no identifiable fossils were found in the Trinity division it seems best to not attempt a positive long distance correlation until further work has been done.

The following points are mentioned with regard to the thickness of the lower Cretaceous in central Texas and in Tom Green County. The thickness of the Trinity, Glen Rose and Paluxy formations combined amounts to 750 or 800 feet in north-central Texas. In Tom Green County the thickness of the Trinity division ranges from 20 to 200 feet. The Walnut clay is 200 feet in maximum thickness in central Texas, while in Tom Green County its maximum thickness is 15 feet, with an average of not more than 8 feet. The Comanche Peak formation in central Texas is seldom over 50 feet, while in Tom Green it has a maximum of 120 feet. Due to erosion in Tom Green County the full

thickness of the Edwards limestone could not be measured, but it is safe to say that its minimum thickness was at one time as much as 50 feet. In the vicinity of Tarrant and Johnson counties it ranges from a few feet to a thickness of 35 feet.

It is interesting to compare the fossil content of the Walnut clay of Tom Green County with the Fredericksburg division of Tarrant County.[17] In the Walnut clay of Tom Green County *Exogyra texana* is the most abundant species. In the Comanche Peak *Requienia texana* Roemer is most frequently found. In the basal Edwards, *Caprina* sp. is the most plentiful. *Exogyra texana* Roemer was not found anywhere except in the Walnut clay, and likewise *Requienia texana* Roemer was found at only one general horizon in the Comanche Peak. Only one specimen of *Caprina* sp. was found in the Walnut clay. Most of the species of fossils found in the Walnut clay of Tom Green County are found below the top of the Fredericksburg division in Tarrant County, excepting the new species.

QUATERNARY

PLEISTOCENE

Resting unconformably upon several formations in the county is found a coarse conglomerate of limestone and chert pebbles. The cementing material in the oldest of the conglomerate is mostly a sandy to quartzitic, very hard material, though in places the cement is calcareous. This conglomerate is found on both sides of Concho River from near the east line of the county up to San Angelo. Here it forks and follows North Concho River and South Concho River, being in places 35 or more feet thick. Some of the best exposures are found along the banks and in the bed of North Concho River in and around San Angelo. Exposures are found along North Concho River well up toward the northwest corner of the county, as shown on the geologic map. It covers extensive areas along the banks

[17]Winton, W. M. and Adkins, W. S., Geology of Tarrant County, Univ. Texas Bull., 1931., p. 33, 1920.

and in the beds of South and Middle Concho rivers, as well as Spring and Dove creeks. The conglomerate is also found as outliers in certain localities, as in the river valley about one-fourth of a mile northwest of the graveyard at Ben Ficklin. It has remained longer on the sandy formations, being held in place by caliche tongues of cement fastening it to the sandy layers. In several places, as shown on the geologic map, the rivers and creeks are still flowing over it.

The conglomerate has been found stratigraphically nearly as high as the Walnut clay, and at these levels the cementing material seems to be composed entirely of soft caliche. The geologic map shows this formation only where it appeared to be the oldest conglomerate cemented with the hard sandy, siliceous-calcareous cement. The limestone boulders of the formation came originally from the cretaceous sediments, as is shown by the many chert nodules characteristic of the Edwards and the presence of *Requienia* from the Comanche Peak limestones.

A portion of a large tusk of possibly an elephant was found in the gravel of a creek bed, about five miles northwest of San Angelo. Its location was well within the area of the Blaine sediments and as there are remnants of the conglomerate still above where it was found it is certain that it came from the conglomerate. It is too poorly preserved for definite identification. Mr. C. B. Metcalfe, living one mile southeast of San Angelo, has in his possession a large joint which appears also to be that of an elephant. It was found in the bed of South Concho River two miles south of San Angelo.

RECENT

Covering the beds of the streams is found silt and sand, and in many places gravel, which have been freed by the disintegration of the Pleistocene conglomerate. Occasionally this material is found to be loosely cemented by caliche or calcium carbonate carried and deposited by the rivers or creek water. Its thickness varies from zero to 25 feet or more.

The following chart gives a description of Cretaceous, Triassic and Pleistocene conglomerates collected in various places from Tom Green County to Scurry County. Careful study of these conglomerates reveals that there are distinct differences between them in mineralogical character; in the kind of cementing material; in the angularity of the sand grains; in the phosphatic content present and in the kind of fossils which they contain. The chart shows the localities from which the writer has collected conglomerates as well as the ages to which he believes they belong. Enough work has not been done for complete proof, but the writer is of the opinion that future work will prove that a large part of the conglomerates, to the northwest of Tom Green County now classd as Triassic in age, are of Cretaceous age. For descriptions of San Angelo conglomerate see pages 18 and 19.

Chart of Conglomerate Descriptions

AGE	LOCATION	CHARACTER	SAND	CEMENTING MATERIAL	PHOSPHATE, WOOD, MICA, BONES
Cretaceous	Panther Gap, N.W. Coke County	Considerable black chert, white and red quartz pebbles	Well-rounded to subangular	Iron	Mica
Cretaceous	Double Mountains, Stonewall County	White quartz, black chert	Well-rounded	Calcareous	
Cretaceous	2 miles S.E. of Hobbs, Fisher County	White iron-stained quartz and black chert	Angular to well-rounded	Calcareous fine sand and iron	Wood and bones
Cretaceous	4 miles S.W. of Sweetwater, Nolan County	White and red quartz pebbles and black chert	Well-rounded	Calcareous and iron	Wood and mica
Cretaceous	Panther Gap, N.W. Coke County	Brown iron-stained and white quartz and black chert abundant	Subangular to well-rounded	Calcareous and iron	
Cretaceous	1 mile S. of Camp Springs, in Scurry County	Brown and white quartz and black chert	Well-rounded	Siliceous	Wood
Cretaceous	¼ mile S.W. of Twin Buttes in Tom Green County	Black chert and white quartz pebbles	Subangular to well-rounded	Calcareous Siliceous	Wood
Cretaceous	3 miles S.E. of Rosco, Nolan County	Black chert and white quartz pebbles	Angular to well-rounded botryoidal	Calcareous	Wood and mica
Cretaceous	20 miles N., 3 miles E. of San Angelo, Coke County	White and red quartz pebbles, some black chert	Well-rounded	Iron and calcareous	

Chart of Conglomerate Descriptions (Continued)

AGE	LOCATION	CHARACTER	SAND	CEMENTING MATERIAL	PHOSPHATE WOOD, MICA BONES
Cretaceous	5 miles E., 1 mile S. of Hobbs, Fisher County	White quartz, red quartz, and some black chert	Fine well-rounded	Calcareous and fine sand	Wood
Cretaceous	3 miles W., 2 miles N. of Sweetwater, in Nolan County	Iron-stained quartz, little black chert	Well-rounded to subangular	Iron	
Cretaceous	Hills due S. and 2 miles E. of Trent, Taylor County	White and red quartz and black chert	Well-rounded to subangular	Fine sand, siliceous, and calcareous	
Cretaceous	3 miles S., 1 mile E. of Rosco, Nolan County	White and red quartz pebbles, black chert	Medium to well-rounded	Calcareous and iron	Wood and bones
Cretaceous	1½ miles S.E. of Pecan Creek Station, Door Key Ranch, Tom Green County	White quartz and black chert	Sub-angular to well-rounded	Calcareous and iron	
Cretaceous	2 miles S.E. of Monument Mt. in Tom Green County	Red and white quartz, black chert	Well-rounded	Calcareous and siliceous	
Cretaceous	2 miles W. of Tankersly in Tom Green County	White and red quartz, black chert	Sub-angular to well-rounded	Calcareous	
Cretaceous	2 miles W. of Pecan Creek Filling Station, Tom Green County	White and red quartz, black chert pebbles	Well-rounded to sub-angular	Calcareous	

Chart of Conglomerate Descriptions (Continued)

AGE	LOCATION	CHARACTER	SAND	CEMENTING MATERIAL	PHOSPHATE WOOD, MICA BONES
Cretaceous	11 miles N. of San Angelo, Tom Green County	White quartz and black chert	Well-rounded to sub-angular	Calcareous	
Cretaceous	Due N. of Robert Lee in hills in Coke County	Mainly white quartz, black chert	Sub-angular to well-rounded	Calcareous	
Cretaceous	1 mile N. of Camp Springs, Scurry County	White and red quartz pebbles, black chert	Well-rounded	Siliceous	Wood
Triassic	2 miles E., 1 N. of Camp Springs, Scurry County	White lime and clay pebbles	Fine angular	Calcareous	Mica and phosphate
Triassic	I mile N. E. of Camp Springs, Scurry County	Sandstone, soft	Very fine, angular	Calcareous	Wood, Mica, Phosphate
Triassic	3 miles S., 1 E. of Rosco, Nolan County	Sandstone, soft below conglomerate	Fine, angular		Mica
Triassic	About 20 miles S. of Colorado City, Mitchell County	White lime and clay pebbles, few quartz pebbles	Fine, angular	Calcareous	Mica and wood
Triassic (probable)	About 10 miles S., 2 miles W. of Colorado City, Mitchell County	White lime and clay particles, few iron-stained quartz	Fine and subangular	Calcareous	Mica

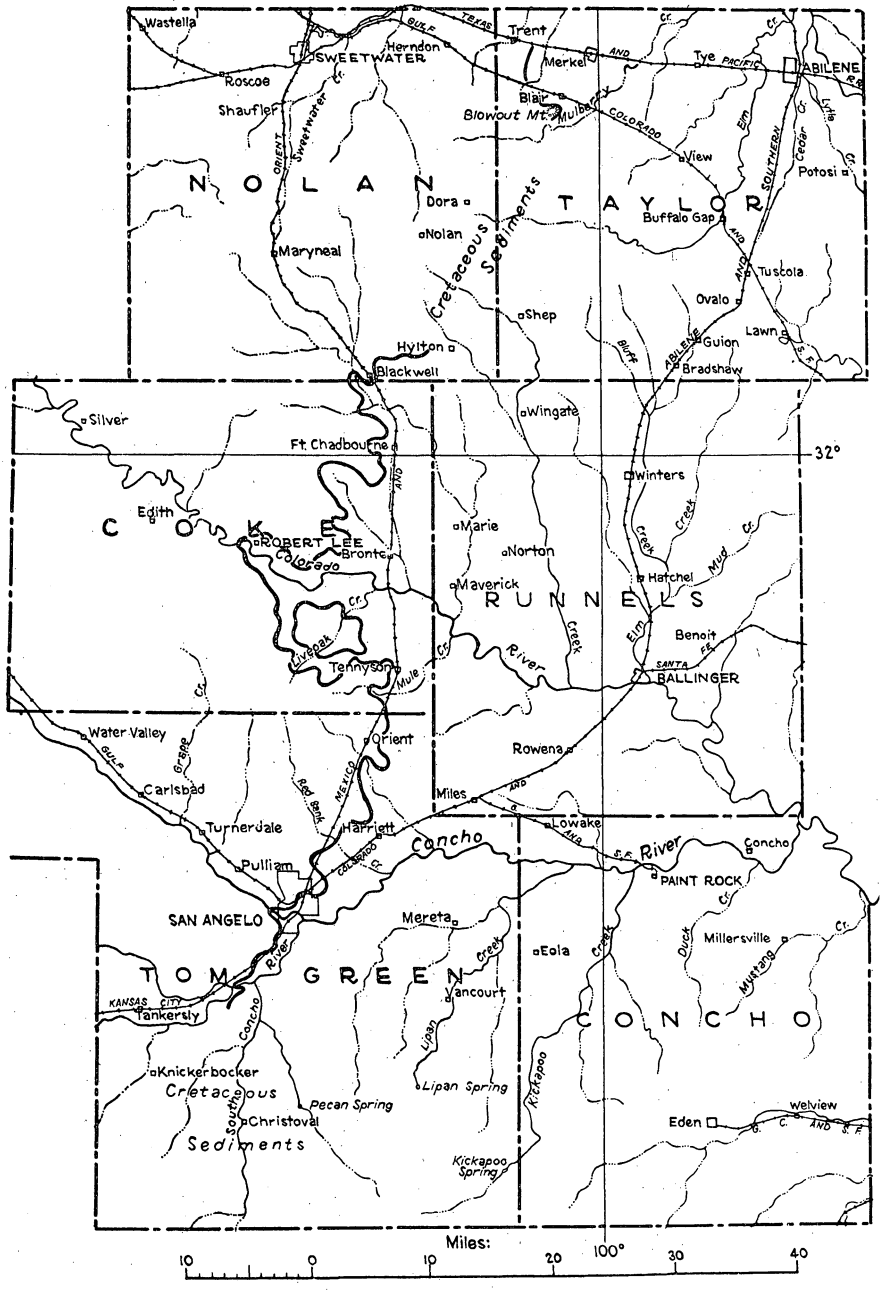

Fig. 2. Map showing western outcrop of the San Angelo conglomerate in Tom Green, Coke, southern Nolan, and northwestern Tyler counties.

GEOLOGIC AND LOCAL SECTIONS OF TOM GREEN COUNTY

The following is a section of the formations of Tom Green County as established along the Concho River from the east line of the county to San Angelo, and from San Angelo to the Twin Buttes. The Comanche Peak and Edwards portions of the general section were taken from the strata of these formations exposed at Mount Nebo.

Geologic Section in Tom Green County

Cretaceous

Fredericksburg Division

Top of the hill Mount Nebo

Edwards formation.

		Feet
247.	Gray, hard limestone contains chert and weathers to slopes. Top of Mt. Nebo	1
246.	Gray, hard, massive limestone	3
245.	Gray, soft limestone weathers to slopes	3
244.	Gray, hard, sandy limestone, the sand in streaks, one small pelecypod found, many *Caprinas* present	4
243.	White, hard, massive limestone, with quite a large amount of chert nodules, some 8 and 12 inches in diameter and brown to gray colors. *Caprinas*	4.5
242.	Medium hard limestone, weathers to slopes	11

Comanche Peak formation.

241.	Limestone filled with holes, caused by weathering of sandy streaks	10
240.	Brown limestone, soft, weathers to slopes	6
239.	Gray, hard massive layers of limestone	10
238.	Gray limestone	7
237.	Nodular limestone, brownish sand streaks	4
236.	Gray, hard, limestone	6
235.	Massive, solid limestone, containing microscopic fossils	4
234.	Gray limestone beds	11
233.	Gray hard limestone, containing *Requienia*, and large *Pecten*	4
232.	Gray, hard limestone, slightly sandy, thin beds	20

Walnut Clay formation (exposed at Twin Buttes)

231.	Yellowish to brown marl, fossiliferous	8.5
230.	Nodular limestone, a few fossils	3
229.	Yellow to brown marl, fossiliferous	7

Trinity Division (exposed at Twin Buttes)

228.	Yellowish, hard, botryoidal sandstone, containing *Exogyra texana*, abundant at top	1.5
227.	Yellowish, soft, cross-bedded sand, many peculiar shaped concretions, silicified wood	19.5
226.	White to yellowish, soft sand, peculiar concretions	6
225.	White to bluish clay	35
224.	Deep red clay	1
223.	Whitish, sandy clay	1
222.	Deep red clay	5
221.	White sandy clay	2
220.	Botryoidal, hard, brownish sandstone, 1 inch of hematite at top	2
219.	Whitish to brown, soft sand	12
218.	White to brown, hard botryoidal sandstone	2
217.	Deep red, maroon to purplish clay	20–25
216.	Yellow, sandy, fine-grained conglomerate; this horizon contains considerable fossilized wood. One large bone was found	0–10

UNCONFORMITY

Permian

Double Mountain Stage

Blaine formation.

(NOTE.—The following section was taken one-half mile southeast of the Twin Buttes, and shows the condition of deposition in this area of the Blaine formation and the Trinity division just above it, as well as the San Angelo formation below the Blaine. In the small creek one-half mile southwest of the Twin Buttes 80 feet of yellow sandstone containing thin beds of green sandy gypsiferous shales can be found. This exposure should be considered representative of the Blaine formation.)

215.	Brown, hard sandstone	2.5
214.	Yellow, cross-bedded sandstone	2.3
213.	Red clay, interlayered with thin, white, sandy seams containing gypsum	1.6
212.	Pink sandstone with yellow seams	2.2
211.	Thin seams of yellow sandstone	1
210.	Fine, red, hard sandstone	1
209.	Brown, thin-bedded sandstone, ripple marked	3
208.	Green, sandy, gypsiferous shale	0.5
207.	Hard, massive, brown sandstone	2
206.	Pink and yellow sandstone layers, weathers full of large, smooth, round holes	4.5

		Feet
205.	Red sandstone in thin layers, changing to white in places, with gypsum	8
204.	Salmon-colored sandstone, soft in places, weathers smooth, filled with large holes, thin-layered in places	7
203.	Thin-bedded nearly white, ripple marked, gypsiferous sandstone	2.5
202.	Red sandstone with two three-inch layers of white, gypsiferous sandstone	6
201.	Cross-bedded, white to brown or red in places, coarse sandstone, contains generally considerable iron in the base	15
	Angular unconformity.	
San Angelo formation.		
200.	Greenish clay, hematite layer at top, 1 to 3 inches thick, representing unconformity	15
199.	Red clay, changing to pure dolomite in places, fossiliferous, containing *Schizodus*, *Pleurophorus*, *Myalina*, and others of the same species present in the Clear Fork stage	10
198.	White sandstone	0.3
197.	Green clay	0.5
196.	Red clay	1.7
195.	Green clay	0.3
194.	Red clay	6
193.	White, soft sand	0.25
192.	Red, soft sand	3
191.	Red sand and clay layers	6
190.	Red and white, cross-bedded sandstone, interlayered with red clay ball conglomerate	8
189.	Blue clay	0.16
188.	Red blocky-shale	2
187.	Red, clay-ball conglomerate	0.3
186.	Red, blocky clay and shale	15.5
185.	White, sandy clay, salty and gypsiferous. This horizon contains some layered gypsum where it outcrops along the Orient Railroad, two miles southeast of the Twin Buttes, Numbers 185–200, exposed from Seven-Mile Bridge northeast toward Twin Buttes	5.5
184.	Brown, thick to thin-bedded sandstone, containing some iron	23
183.	Light brown clay, impregnated with gypsum	11

		Feet
182.	White, sandy clay	6
181.	San Angelo conglomerate, fine-grained, containing considerable iron. The pebbles are mainly iron-stained, yellowish or redish and are composed of quartz mainly. Many black chert pebbles are present. Pebbles average size of navy beans	16

(NOTE.—Numbers 181 to 184, inclusive, represent a section of the base of the San Angelo formation taken one mile below Seven-Mile Bridge southwest of San Angelo.

Clear Fork Stage

Choza formation.

180.	Green shale	5
179.	Dolomitic limestone, brown and sandy	1.5
178.	Red, blocky shale	3–6
177.	Green shale	1–3
176.	Red and green clay	1
175.	Thin dolomites	1.5
174.	Dolomitic limestone, massive	0.8
173.	Green clay	0.5
172.	Red clay	11
171.	White, nodular dolomite	0.3
170.	Red shale	0.7
169.	White, sandy dolomite	0.4
168.	Red shale	1
167.	Gray dolomite	0.4
166.	Red shale	2.5
165.	Massive, gray dolomite. This dolomite outcrops beneath the Orient Railroad bridge at San Angelo, and is approximately the same horizon as the fossiliferous dolomites found at the rock quarry at Ben Ficklin as well as being the approximate horizon of the Merkel dolomite	5
164.	Green shale	2
163.	Gray, hard dolomite	1
162.	Green shale	0.7
161.	Gray dolomite	0.5
160.	Green shale	2
159.	Gray dolomite	0.7
158.	Green shale	2
157.	Covered by water just east of the dam in the east part of San Angelo. Probably a dolomite	3
156.	Green shale	3
155.	Gray dolomite	3
154.	Green slate	2.5

		Feet
153.	Gray dolomite	1.5
152.	Impure coal. This seam is found about 200 yards above the Government water gauge station on the south side of the river and just across the river from a gravel pit on the Concho River about one and one-half miles east of San Angelo	0.5
151.	Blue slate	2
150.	Gray dolomite	0.7
149.	Green, marly clay, fossiliferous. Fossils not collected on account of water	4.5
148.	Gray dolomite	3
147.	Green clay	3
146.	Gray, massive dolomite	4
145.	Green clay	8
144.	Gray to white dolomite	3
143.	Green shale	3
142.	Brown to yellowish sandy limestone, fossiliferous. This horizon is found on the south side of the Concho River about three miles east of San Angelo. It is partly covered by water and is in a very difficult place to collect fossils	4
141.	Green shale	2
140.	Red shale	3
139.	Brown dolomitic limestone	4
138.	Formation covered by water for about one mile, but the water is standing practically level	2–10
137.	Green shale	1–2
136.	Gray dolomite	0.5
135.	Dolomite and shale	1
134.	White dolomite containing holes filled with calcite	0.7
133.	Green shale	0.3
132.	Nodular dolomite	0.8
131.	Green shale	2.5
130.	Gray dolomites. This horizon is found about one and one-half miles southeast of the hospital in the east part of San Angelo. It has here caused a fall in the river of several feet at a point where the river makes a bend to the north	10–15
129.	Green shale	5
128.	Red shale	2–4
127.	Green clay	2
126.	Red clay	6
125.	Green clay	3

		Feet
124.	Red clay	15
123.	Green shale	0.8
122.	Gray dolomite	0.5
121.	Green shale	0.5
120.	Red shale	5
119.	Green shale	4
118.	Dolomite	4
117.	Covered, probably shale	4–6
116.	Gray dolomite	3
115.	Green shale	8
114.	Gray dolomite	6
113.	Green, nodular dolomite and shale	5
112.	Gray dolomite in thin layers	2.5
111.	Green shale	1
110.	Red shale	4.5
109.	Gray dolomite	1.25
108.	Green shale	4
107.	Gray dolomite	1–3
106.	Covered, at this point the Concho River flows over Pleistocene conglomerate due east of San Angelo along highway	3–5
105.	Red, sandy shale	10
104.	Red sandstone	2
103.	Red, sandy shale with thin bands of green to white shale	8
102.	Red shale with a two-inch layer of soft limestone on top	2
101.	Green sandy shale containing some sand and lime seams	4
100.	Red shale with an eight-inch layer of red sandstone and six-inch layer of green sandy shale	5
99.	Green shale	0.5
98.	Nodular dolomitic limestone	4
97.	Red, sandy shale	10
96.	Green clay mixed with dolomite	2
95.	Red sandstone	4.5
94.	Gray dolomite	3
93.	Covered	6–10
92.	Red, sandy shale	18
91.	Covered, probably dolomite	7–10
90.	Red shale	8
89.	Gray dolomite	2
88.	Green shale	5
87.	Red shale	6
86.	Brown to red shale	8
85.	Green shale	0.3
84.	Red shale	4

		Feet
83.	White, hard dolomite and shale	1
82.	Green shale	0.4
81.	Red shale	4
80.	Green shale	0.3
79.	Red shale	3.5
78.	Green shale	0.7
77.	Red shale	5
76.	Gray dolomite	0.5
75.	Red and green shale	3
74.	Red shale	8
73.	Green shale	1
72.	Green shale and dolomite seams	0.7
71.	Red shale	1
70.	Green shale and dolomite seams	1
69.	Brown shale	0.7
68.	Red shale	1
67.	Soft, green shale with dolomite seams	1
66.	Green shale	3
65.	Covered (dolomite?)	1–3
64.	Covered	15–20
63.	Massive dolomite, gray	3
62.	Green shale	1
61.	Gray dolomite	1
60.	Covered, but contains at least one foot of dolomite	5–6
59.	Green shale	3
58.	Gray dolomite	0.3
57.	Green shale	0.3
56.	Gray dolomite	1
55.	Nodular dolomite	3
54.	Red shale	1
53.	Dolomite with thin layers of green shale; this is found on Piser farm just at the east edge of the Johnson Ranch at pumping station	9
52.	Dolomitic limestone containing calcite geodes	4
51.	Green shale	0.7
50.	Gray dolomite	2
49.	Green shale	0.75
48.	Dolomite	1
47.	Green shale with a two-inch layer of dolomite	2
46.	Brown to red shale, gypsiferous	8
45.	Gray dolomite	2
44.	Green shale	1
43.	Gray dolomite	0.25
42.	Green shale	3
41.	Gray, massive dolomite	6

		Feet
40.	Covered	5
39.	Red to brown shale	8
38.	White to gray sandstone	3
37.	Yellow marl, fossiliferous; this horizon is found in Willow Creek on the east bank about one and one-half miles southwest of the town of Miles	1
36.	Gray dolomite	5
35.	Green shale	2
34.	Gray dolomite	1.3
33.	Green shale	0.3
32.	Gray dolomite	1.3
31.	Green shale	3
30.	Gray dolomite	0.5
29.	Red shale, Numbers 29–40, from outcrops in Willow Creek, 40–52 below Piser farm	12
Bullwagon formation.		
28.	Dolomite, abundant *Pleurophorus*	1
27.	Green shale	3
26.	Gray dolomite	2
25.	Green shale	2
24.	Gray dolomitic limestone	10
23.	Green shale	3
22.	Gray dolomite, with two-foot layer of yellow marl, both the dolomite and the marl are fossiliferous	10
21.	Green shale with thin layers of limestone; this is the base of the Bullwagon dolomite. The Bullwagon formation is here considered to include only those strata which contain dolomite, however, it might have included eight feet of green shale which is here placed in the upper Vale formation	15
Vale formation.		
20.	Green shale	8
19.	Red sandy and gypsiferous shale with thin streaks of green	30–40
Wichita stage		
Arroyo formation.		
18.	Covered	10–15
17.	Gray limestone	0.5
16.	Yellowish to gray shale	6
15.	Gray limestone	0.5
14.	Gray to yellow shale	5
13.	Gray limestone, most all of these limestones and shales are fossiliferous	4
12.	Gray shale	2

11.	Gray, nodular limestone	4.5
10.	Gray shale	1
9.	Gray to brown limestone	2.6
8.	Gray shale	2
7.	Brown limestone	1
6.	Brown to gray shale	8
5.	Blackish limestone and shale, contained several fossils, among the rest a fish spine	4
4.	Black shale	4
3.	White lime	3
2.	Black limestone	4
1.	Covered to county line, one-fourth mile	15–25

Locations of the following sections taken at various places in the county are indicated by numbers on the geologic map.

Section No. 1 at Mount Nebo, About Ten Miles Northwest of San Angelo

This section may be taken as typical of the Comanche Peak formation in Tom Green County.

		Feet
Cretaceous		
	Edwards formation.	
19.	Gray massive limestone containing chert nodules	1
18.	Gray hard massive limestone	3
17.	Gray limestone weathering to slopes	3
16.	White, hard, sandy limestone weathers full of holes, found one small pelecypod and one small gastropod. Much of the limestone is made up of Caprinas, some as much as one foot in length. Chert in the top of this layer averages about five inches in thickness and covers about one-half of the surface of the bed	4
15.	White, hard massive limestone with an abundance of brown to gray chert as nodules; some as large as a man's head. *Caprina* present	4.5
	Comanche Peak formation.	
14.	Soft, gray limestone, weathers to slopes	11
13.	White, hard, sandy limestone, weathers full of holes caused by weathering out of the soft sand streaks	10
12.	Brown, soft, limestone, weathers to even slopes	6
11.	Hard, gray, massive layers of limestone	10
10.	Brownish, sandy limestone	7

9.	Nodular, brownish, sandy limestone	4
8.	Massive, hard, microscopically fossiliferous, gray limestone	6
7.	Massive, gray limestone	4
6.	Soft and hard, gray limestone beds	11
5.	Hard, gray limestone containing *Requienia* and *Pecten (Neithea) duplicicosta*	4
4.	Thin gray limestone beds	20
	Walnut Clay formation.	
3.	Walnut clay	5–10
	Trinity division.	
2.	Covered	20
1.	Botryoidal sandstone, brown	15
0.	Base covered.	

Section No. 2 at Hill about One Mile North of Carlsbad

In this section the Walnut clay varies somewhat from its typical appearance in the county.

Cretaceous

	Comanche Peak formation.	
10.	Nodular to massive gray limestone	35
9.	Massive gray limestone	15
	Walnut clay formation.	
8.	Nodular marl, brown to yellowish, few fossils	8
	Trinity division.	
7.	Yellowish, cross-bedded to even-bedded soft sand	30
6.	Whitish clay, nodular in places containing psilomelane	24
5.	Hard, yellowish, botryoidal sandstone	8–12
4.	Yellowish to white limey clay	22
3.	Yellowish, botryoidal sandstone	4
2.	White to yellowish clay	22 +
1.	Base covered.	

Section No. 3 One Mile North of Mount Nebo on East Side of the Road

In this section no changes in lithology worthy of note were found.

Cretaceous

	Comanche Peak formation.	
6.	Soft, gray, thin limestone beds	8
	Walnut Clay formation.	
5.	Brown to yellowish sandy marl	13
	Trinity division.	
4.	Brown sandstone, botryoidal at base and at top	20
3.	White clay	4

		Feet
2.	White, chalky clay	15 +
1.	Based covered.	

Section No. 4 on the March Ranch about Two Miles North of Mount Nebo, on the East Side of the Road

The similarity between this section and the Mount Nebo section can easily be seen. It was impossible here to find a sharp contact between the Trinity and Blaine strata.

Cretaceous

Edwards formation.

32.	Hard, gray limestone ledges at top, chert scattered over the top of the hill	3
31.	Hard, gray limestone containing large chert nodules	1
30.	Hard limestone ledge	7.5
29.	Soft, white, sandy limestone with chert in the top. This is apparently the Caprina bed, but found none present	4
28.	Hard, massive limestone	7

Comanche Peak formation.

27.	Rather hard, gray limestone, weathers to slopes	6
26.	Hard, gray, sandy limestone filled with holes	4
25.	Soft, gray limestone, weathers to slopes	6
24.	Hard, white, sandy limestone full of holes	4
23.	Soft, gray limestones, weathers to slopes	10
22.	Soft, gray limestone, weathers to slopes	6
21.	Hard, gray, sandy limestone	4
20.	Hard, gray limestone forms ridge around the hill	12
19.	Soft, gray, nodular limestone, weathers to slopes	8.5
18.	Hard, white, sandy limestone	4
17.	Hard, gray limestone filled with microscopic fossils and a few small Requieniae	6
16.	Soft, gray limestone, weathers to slopes	15
15.	Hard, gray limestone	2
14.	Hard, gray limestone, contains Requieniae and large *Pecten*	4
13.	Hard, sandy, gray limestone	6
12.	Soft, thin-bedded limestone	15
11.	Hard, gray limestone, microscopic fossils	1
10.	Hard, sandy limestone	6

Walnut Clay formation.

9.	Yellowish to brown marl	10

Trinity division.

8.	Yellowish, botryoidal sandstone	8
7.	Peculiar nodular limestone, small amounts of Psilomelane	4
6.	Soft, yellowish, cross-bedded sand	13
5.	Yellowish to white clay	6
4.	Yellowish to white, cross-bedded, soft sandstone	15
3.	White clay	17.5
2.	Covered	65

Permian

Blaine formation.

(NOTE.—The following exposure was taken in Grape Creek at the base of the hill, on March Ranch.)

1.	Brownish to yellow, or white cross-bedded to even-bedded sandstone. This sandstone contains fine flakes of gypsum. In places pink streaks are found. A thin layer of hematite was found dividing two ledges of the sandstone. At this point a local unconformity is developed as shown in the photograph illustrating the unconformity on the March Ranch	35 +

Check of Geologic Formations One Mile South of the W. B. Turner House on Turner Ranch, about Three Miles Southeast of Carlsbad (No. 5)

Cretaceous

The checking of the strata began in the Trinity and continued through the Comanche Peak and up into the basal Edwards. All characteristic horizons were present as at Mount Nebo, but on account of slumping in the Trinity, the horizons were not measured. The botryoidal sandstone and white clay horizons of the Trinity were present, Walnut clay present, Requienia and beds of large *Pecten* present. The microscopic fossil horizon and the white sandy limestone containing Caprina and chert beds were present. One foot above the Caprina horizon a chert layer was found and another 3 feet below. Still another chert horizon came 12 feet above the horizon containing the Caprina limestone. Since many chert nodules were scattered over the top of the hill other chert horizons must have come in higher.

Section No. 6 One-Half Mile Northeast of the Roxana Oil Well, Clark No. 1, in the Extreme Northwest Corner of the County

This section shows nothing unusual. The covered base indicates here that the Blaine sandstone has eroded to long slopes.

Cretaceous		Feet
Edwards formation.		
28.	Hard, gray limestone	5
27.	Hard, white, cherty limestone, nodular	1.5
26.	Hard, gray limestone filled with holes	2.5
25.	Hard, gray limestone containing chert	1
24.	Hard, gray limestone	3
23.	Hard, white limestone containing chert and *Caprinas*	4.5
22.	Hard, gray, cherty limestone	1
21.	Hard, gray, limestone with chert nodules	4
20.	Hard, gray limestone	3
19.	Solid band of chert	0.3
18.	Hard, white, sandy limestone	8
Comanche Peak formation.		
17.	Soft, gray limestone, weathers to slopes	33
16.	Hard, gray limestone filled with holes	3
15.	Gray, sandy limestone, weathers to slopes	3
14.	Hard, gray limestone with soft layers at the top, contains *Requieniae*	4
13.	Gray limestone, softer than No. 14, a few *Requieniae* present	3
12.	Gray limestone with *Requieniae*	3–4
11.	Soft, white limestone layer	3
10.	Hard, massive limestone layer	4
9.	Soft, gray limestone layers	20
8.	Hard, gray limestone	4
Walnut Clay formation.		
7.	Yellow, sandy marl with characteristic gastropods and pelecypods	8
Trinity division.		
6.	Soft, yellowish sandstone	20
5.	Hard, white sandstone	0.5
4.	Peculiar, nodular, gray limestone, Psilomelane not found	4
3.	Soft, yellowish to white sandstone	6
2.	Soft, yellowish clay containing characteristic pink streaks and nodules	18
1.	Base covered, but long slopes characteristic of Blaine sandstone weathering.	

Section No. 7 about Seven Miles West of San Angelo along the Arden Road

This section begins one-fourth of a mile northwest of the first round-topped hill south of the road, in a small creek which crosses the road. This creek was followed northeastward to the North Concho River.

Above the Arden road is found the characteristic red clay of Trinity age and above this red clay can be found the usual strata of the Trinity up to the Walnut clay exposed at the round-topped hill. This section as worked out down the creek shows excellent contacts of the San Angelo and Blaine formations.

Gypsum is found in all of the Blaine sandstones in greater or less amounts down to the base of the formation. The sandstones are all even-bedded.

		Feet
Blaine formation.		
25.	Massive, red to brown sandstone	3
24.	Thin-bedded, red, white, and brown, even-bedded sandstone	6
23.	Massive, red to brown, even-bedded sandstone	3
22.	Red and white, thin-bedded, friable and hard sandstone	4
21.	Massive, red to brown, even-bedded sandstone	4
20.	White, thin-bedded, sandstone	4
19.	Hard, brown, even-bedded sandstone	3
18.	White sandstone	2
17.	Yellow sandstone	0.5
16.	White sandstone, streaks of green shale	2
15.	White, thin-bedded sandstone in places changes to brown	3
14.	Yellow, thin-bedded sandstone	4
13.	Green, sandy shale	0.5
12.	Yellow sandstone with thin layers of small concretions covering the surface	2
11.	Brown sandstone	11
10.	Yellow sandstone, thin beds	0.67
9.	Brown sandstone	1
8.	Yellow sandstone	0.5
7.	Covered	5–10
6.	Yellow sandstone, salty. This point was reached about five miles northwest of San Angelo and due north of the point where the Arden road makes a bend to the south. There is a windmill found at this point in the creek. About 100 yards below the windmill a part of a tusk	

		Feet
	of an elephant was found in the gravel of the stream	3
5.	Yellow to white sandstone containing thin beds of green shale	3
4.	White to brown, cross-bedded sandstone with ripple marks	15
	Unconformity.	
San Angelo formation.		
3.	Green clay with a seam of hematite near the middle and one near the top, salty in places	20
2.	Red clay	22 +
1.	Base covered.	

Section No. 8 about Eight Miles Northwest of San Angelo

Section taken from about eight miles northwest of San Angelo and about one and one-half miles north of the Arden road eastward from two lone buttes to the river.

		Feet
Cretaceous		
Comanche Peak formation.		
18.	Gray limestone at top of the hill, *Requieniae* bed	8
17.	Hard, gray limestone	11
16.	Nodular to marly limestone	2.5
15.	Nodular to solid limestone	2
14.	Marly limestone, some fossils	8
13.	Gray, nodular limestone	4
Walnut Clay formation.		
12.	Yellow, sandy marl, characteristic fossils collected	15
Trinity division.		
11.	Brown, botryoidal sandstone	4
10.	Whitish to yellow sandy formation containing a layer of peculiar nodular limestone, Psilomelane quite abundant	15
9.	Brown, botryoidal sandstone	6
8.	Whitish, sandy clay	22
7.	Yellow clay	4
6.	Red clay	11
5.	Thin-bedded, [illegible] ndstone	8
4.	Red sand	5
3.	Third botryoidal sandstone	5 +

Permian — Feet

Blaine formation.

2. It is about three miles from the base of the hill east to the river down a long gradual slope. In the west bank of the river is exposed from 10–20 feet of white sandstone with streaks of green clay. The outcrop is found at an old house 10–20

1. On the west bank of the river about one-half mile south of this house is found the hematite layer in the unconformity between the Blaine and San Angelo formation. This hematite layer is traceable most all the way southward to the Twin Buttes a distance of four or five miles.

Section No.9 about One Mile East of the Seven-Mile Bridge on the North Side of the Middle Concho River just below the Dam

This section shows best in detail the lower part of the San Angelo formation. In the river bank at the Country Club, south of San Angelo, the strata which come in just below the San Angelo formation can be best studied.

Permian — Feet

San Angelo formation.

4. Brown, thick-bedded sandstone, containing some iron. In places the sandstone is altered to quartzite 22

3. Light brown clay impregnated with gypsum, in places changes to soft brown sand 11

2. White, sandy clay with streaks of limonite and a one-inch seam of pure white kaolin 6

1. At base along the river bank, and party covered with water, fine-grained conglomerate containing considerable iron 12–15

Section No. 10 from the Bed of the North Concho River One Mile Southeast of Monument Mountain up to the Top of the Mountain

Monument Mountain is located across the river about one mile south of the town of Water Valley.

Cretaceous — Feet

Edwards formation.

39. Hard, gray lime at top of the hill, many loose chert fragments on top showing that formerly chert horizons have existed above 6

38.	Hard, gray ledge of limestone with a few chert nodules	2
37.	Hard, gray limestone ledges	13
36.	Slate-colored, hard limestone containing considerable chert	2
35.	Hard, gray limestone	3
34.	Hard, slate-colored limestone, chert covers one-third of the surface	3
33.	Very hard, slate-colored limestone filled with chert	3
32.	Layer of slate-colored chert	0.4
Comanche Peak formation.		
31.	Soft, white, sandy limestone. Horizon of Caprinas but none observed	3.5
30.	Soft, gray limestone, weathers to slopes	4
29.	Hard, flinty limestone	6
28.	Soft, white limestone, weathers full of holes	4
27.	Soft, gray limestone, weathers to slopes	28
26.	Hard, gray ledge of limestone	5
25.	Soft, gray limestone	10
24.	Hard, gray ledge of limestone	8
23.	Soft, gray limestone	11
22.	Hard, gray limestone, *Requienia* unusually large	3
21.	Soft, gray limestone	5
20.	Slightly sandy limestone	15
19.	Sandy limestone	5
Walnut Clay formation.		
18.	Brown, sandy clay, few fossils	6
Trinity division.		
17.	Brown to yellow sandstone	13
16.	Ledge of brown, cross-bedded sandstone	10
15.	Soft, yellowish to brown sandstone, partly covered	14
14.	Ledge of brown botryoidal sandstone	5
13.	Yellow, pink and white sandy clay, pink iron nodules	40
12.	Yellow clay	8
11.	Yellow sandstone. Psilomelane noted	3
10.	Covered, apparently yellow clay	38
9.	Brownish, botryoidal sandstone	4
8.	Cross-bedded yellow sandstone	18
7.	Wine-colored clay, in places slate-colored, gypsiferous	6
6.	Yellow, pink and white, very cross-bedded sandstone	11

		Feet
5.	Yellow to pink sandstone, very cross-bedded	6
4.	Maroon clay, with gypsum geodes	5–8
3.	Deep red sandstone containing gypsum and Psilomelane	6
2.	Fine to coarse-grained conglomerate containing many black chert pebbles	0–3

Permian

Blaine formation.

1.	From the river up a small creek, yellow even-bedded sandstone with a few white streaks, mainly soft, all filled with gypsum	75 +

Section No. 11 Two Miles Northwest of Cargile's Ranch Northwest of San Angelo, and Northwest yet of Arden

This section was taken a short distance from the west line of the county. The 44 feet of No. 2 and the layers of Trinity above it indicate a slight change here of the Trinity. This section was taken the farthest west of any in the county. The Blaine is probably present below No. 2 and may include part of it.

Cretaceous

		Feet
	Comanche Peak formation.	
10.	Soft, gray limestone, weathering to slopes	25
9.	Sandy limestone	4–6
	Walnut clay formation.	
8.	Sandy, brown marl, fossils few	5
7.	Brown, nodular limestone	3
6.	Yellow, sandy marl, fossils collected	10
	Trinity division.	
5.	Peculiar nodular limestone, no Psilomelane noted	6
4.	Soft, yellow sand	16
3.	Characteristic botryoidal, cross-bedded sandstone	3
2.	White to light brown cross-bedded soft sandstone with pink streaks	44
1.	Base covered.	

Section No. 12 on Door Key Ranch about Two Miles Southeast of Pecan Creek Filling Station, beginning in Pecan Creek

Mention is here made of the 55 feet of clay in No. 5 of the section. This is shown to increase in thickness to the south by the log of the well drilled on the Door Key Ranch.

	Feet
Cretaceous	
Comanche Peak formation.	
9. Soft, gray nodular limestone	25
Walnut Clay formation.	
8. Yellowish, sandy marl, large collection of fossils, no new species	11
Trinity division.	
7. Peculiar nodular limestone, no Psilomelane noted	1
6. Yellow, fine sandy clay	4
5. Yellowish to white clay	55
4. Conglomerate containing many black chert pebbles, some iron in the form of limonite	5
Permian	
Clear Fork stage	
Choza formation.	
3. Light gray dolomite	2
2. Covered	3
1. Green shale	3 +

Section No. 13 on E. P. Green's Ranch about Nineteen Miles Southeast of San Angelo, and Four Miles Northeast of Susan's Peak Mountain

In this section attention is called to the thinness of the Trinity division.

	Feet
Cretaceous	
Comanche Peak formation.	
5. Soft, gray limestone, weathers to slopes	40
Walnut Clay formation.	
4. Yellow, sandy marl, *Exogyra texana* and other characteristic fossils, fossils collected	8
Trinity division.	
3. If the Trinity sand is represented here it could not exceed more than 3–5 feet, but a search failed to show any present. This may be a significant fact. To the northwest and west, as the other sections show, the sand is quite thick. It seems that during Trinity time the sea came to this area from the southward and washed a highland on the east	3–5
2. Covered. Probably white to yellow clay as this is found outcropping in the road about one-half mile west at the same level	20–25
Unconformity.	

Permian
Clear Fork Stage
Vale formation.
1. Brick-red clay ..... 10 +

Formations No. 14 at Susan's Peak Mountain, Fifteen Miles Southeast of San Angelo

A complete section was not made in this area on account of the long-covered slopes. However, the following was noted: The *Requienia* and large *Pecten* beds of Comanche Peak age were found on the first bench of limestone above the Robertson windmill and tank. Just above this bed is found a one to two-foot layer of very yellow sandy limestone. This limestone was noted at several places in the southeast part of the county, one of the places being on the Campbell Ranch near the east edge of the county. Loose chert was found at many points along the slopes of the hill and at the top. There is about 35 feet of limestone in the interval between the *Requienia* bed at the top of the hill and from 60–80 feet of limestone below the *Requienia* bed. This is about twice as much limestone as is general over the west and northwest part of the county in this interval. It seems from this that the Comanche Peak formation in this area has thickened at the expense of the Trinity division. The Walnut clay is probably present, but thin and poorly developed. No Trinity sand was found in this area, and if present, must be very thin, that is five feet or less. West of this point, about two miles, the Walnut clay is present, but thin, and only one layer of botryoidal Trinity sand from one to three feet thick is found. Beneath this layer of Trinity sand was found a white clay. It is believed that the thickness of it could not have exceeded 15 or 20 feet. The gentle slope of the surface away from the Cretaceous sediments and its red color shows that the Permian sediments are only a few feet below.

Section No. 15 about Four Miles North of Christoval just East of the Old Orient Railroad Cut, at the only High Bluff along the Grade

Cretaceous	Feet
Comanche Peak formation.	
11. Gray, nodular limestone to top of hill	8
10. Hard, gray limestone	4
9. Soft, gray, nodular limestone	10
8. Brown limestone, slightly sandy	2

		Feet
Walnut Clay formation.		
7.	Yellow, sandy marl, *Exogyra texana* very abundant, collection of fossils, no new species	5
Trinity division.		
6.	Very cross-bedded, hard, brown to yellow botryoidal sandstone	10
5.	Yellow, soft sandstone	12
4.	Yellowish to white gypsiferous clay	25
3.	Thin-bedded, white gypsiferous sandstone, cross-bedded	0.5–1
2.	Yellowish to white clay	22 +
Permian		
Blaine formation.		
1.	Two miles southwest of this point on the east bank of the South Concho River at a horizon approximately 10 feet lower is found typical gypsiferous Blaine sandstone.	

Section No. 16 on Abe Mayer's Ranch in Irion County One and One-Half Miles West of the West Line of Tom Green County, on the South Side of the Middle Concho River

		Feet
Cretaceous		
Comanche Peak formation.		
18.	Gray, soft limestone, mainly nodular to top of hill	25
Walnut Clay formation.		
17.	Yellow, sandy marl, fossils collected, but no new species	10
Trinity division.		
16.	Red to brown sandstone, filled with worm burrows and is botryoidal	6
15.	Peculiar nodular limestone, no Psilomelane noted	1
14.	Soft, yellowish sand	14
13.	White, sandy clay	14
12.	Brown sandstone, 4 feet at top botryoidal	12
11.	White, sandy clay	22
10.	Maroon, sandy clay	6
9.	Maroon and pink clay	4
8.	Brown to gray, slightly botryoidal sandstone, some gypsum found in this sandstone	6
7.	Soft, white to brown sand-quartzite	15
6.	Brown, slightly botryoidal sandstone	3
5.	Hard, pink to yellow sand and shale, mainly sand	10
4.	White to yellow, soft and hard, cross-bedded botryoidal sandstone	25–30

		Feet
3.	Typical, brown, botryoidal sandstone	10
2.	Maroon and pink clay	30
	Distinct unconformity.	

Permian

Blaine formation.

1.	Yellow, pink and white or brown sandstone standing with a dip to the west	50 +

Section No. 17 from the Top of the Devil's Courthouse Mountain to about Two and One-Half Miles Southeast

Cretaceous

Edwards formation.

40.	Solid gray limestone with thin layer of chert in the top	4
39.	Massive limestone with 2-inch layer of chert in the top	15
38.	Hard, white limestone with sandy streaks, heavy chert layer in top	2
37.	Hard, gray limestone ledges	5
36.	Nearly solid layer of nodular chert	0.5
35.	Hard, gray, massive limestone ledge	6

Comanche Peak formation.

34.	Hard, gray limestone ledge with sand streaks and weathers full of holes	5
33.	Soft, white, chalky limestone	4
32.	Sandy limestone	12
31.	Soft, white lime, weathers to slopes	10
30.	Hard, sandy limestone, full of holes	4
29.	Soft, gray limestone	8
28.	Hard, gray limestone, *Requienia* and large *Pecten*	1
27.	Soft, white limestone, weathers to slopes	10
26.	Hard, gray limestone, *Requienia* and *Pecten*	2
25.	Sandy limestone	6
24.	Soft, gray nodular limestone	5.5
23.	Nodular to massive limestone	4

Walnut Clay formation.

22.	Yellow, sandy marl, unusually large gastropods	8
21.	Hard, gray limestone	3
20.	Yellow, sandy marl	10

Trinity division.

19.	Cross-bedded, yellowish, slightly botryoidal sandstone	4

18.	Peculiar nodular limestone, no Psilomelane	4
17.	White to yellowish clay	6
15.	Yellowish, sandy clay	10
14.	White clay with pink streaks	18
13.	Brown botryoidal sandstone	3
12.	Pink, yellow and maroon clay	20
11.	Brick-red, maroon and yellow clay, some quartz gravel and black chert present in base	31

Distinct unconformity.

Permian

Double Mountain Stage

San Angelo formation.

10.	Brown to whitish, thick ledges of sandstone and thin brick-red clays	19
9.	Brick-red, sandy clay	18
8.	Brick-red sandstone and white seams	8
7.	Brick-red, sandy clay	8
6.	Red and white thin-bedded sandstone	5
5.	Brick-red, sandy clay	18
4.	Thin-bedded white and red, sandy clay	3
3.	Red sandy clay	10
2.	San Angelo conglomerate, has white and yellowish quartz pebbles and a good many black chert pebbles, in places only slightly conglomeratic	25–30

Unconformity.

Clear Fork Stage

Choza formation.

1.	Characteristic blue and red clays and thin seams of dolomite.	

Section No. 18, Eleven Miles North of San Angelo on Dr. Johnson's Ranch from about One Mile east of the Ranch House to Top of Highest Peak

The 55 feet of clay of No. 4 indicates that a depression in pre-Trinity time has existed to the west of the Devil's Courthouse.

Cretaceous		Feet
	Edwards formation.	
25.	Hard, white, sandy lime, full of holes with chert in the top	3
24.	Hard, massive limestone	8
23.	Nearly solid chert layer	0.33
22.	Hard, gray limestone	5

Comanche Peak formation.

21.	White, sandy limestone, filled with holes	15
20.	Hard, gray limestone	6
19.	Light, sandy limestone, filled with holes	12
18.	Light, sandy limestone	12
17.	Gray limestone, with small *Requienia* and large *Pecten*	2
16.	Soft limestone, weathers to slopes	10
15.	Gray limestone, *Requienia* and large *Pecten*	3
14.	Whitish sandy limestone, weathers to slopes	15
13.	Hard, gray limestone	4
12.	Soft, nodular limestone	4
11.	Light, sandy limestone	3

Walnut Clay formation.

10.	Yellow, sandy marl, large gastropods and other common fossils	3
9.	Gray, nodular limestone	3
8.	Yellow, sandy marl, usual Pelecypods	12

Trinity division.

7.	Yellowish, botryoidal sandstone fairly soft	6
6.	Soft, cross-bedded, yellowish sandstone	17
5.	Yellowish, botryoidal sandstone; has peculiar concretions, some one foot in diameter, others disk-shaped and some long and round	10
4.	White to bluish or yellowish clay, but mostly deep red	55
3.	One-half mile west of this point is found characteristic black chert conglomerate, containing from 15 to 40 per cent black and green chert pebbles. The conglomerate in many places is very quartzitic. The pebbles range up to one-half inch in diameter. This conglomerate was traced laterally and pinched out in a deep red clay. At the farthest south point of the exposure the conglomerate has the red clay of No. 2 below it	10–20
2.	Deep red clay	25
1.	An exposure in the creek just below this deep red clay and conglomerate shows a cross-bedded white and pink sandstone, in places containing gypsum	6–10

The conglomerate in this area rests at a horizon from 15 to 20 feet lower than the top of the sandstones of the San Angelo formation in the base of the Devil's Courthouse

Mountain, about one-half mile to the southeast, thus showing that there was a ridge or escarpment of San Angelo sandstone in pre-Trinity time, in the vicinity of the Devil's Courthouse. The fact that 25 feet of maroon clay is here found beneath the black chert conglomerate is important and shows that the Trinity waters advancing from the south reworked the irregular, very red San Angelo formation to the eastward, first laying down this deep red clay and at the same time carrying some gypsum into the Trinity layers.

The San Angelo conglomerate now outcrops about one mile southeast of the Devil's Courthouse Mountain and there is no reason to suppose that at the time that the Trinity Sea advanced into this area, the San Angelo conglomerate was not outcropping somewhere within a radius not too distant for the Trinity waters to have carried some of the materials from it to help form the black chert conglomerate of basal Trinity age, now found one-half mile west of the Devil's Courthouse Mountain. The basal Cretaceous conglomerates in West-Central Texas seem to lie between the the escarpments of the outcropping Blaine dolomites. The writer is of the belief that when the Trinity Sea advanced into northwest Texas the San Angelo formation with its conglomerates was exposed over a considerable area. The Trinity Sea reworked this formation and carried some distance over the irregular surface as basal Trinity, a large amount of the brick-red clays and changed some of them to maroon and pink clays. This process may eventually account for at least some of the conglomerates and maroon clays thought to be of Triassic age farther to the north and northwest. At places where the San Angelo formation was not exposed it is possible that the upper Double Mountain stage of the Permian was exposed, or they both may have been exposed and reworked by the Trinity Sea into red clays and sandstones, and to some extent conglomerates. That the San Angelo formation as well as the Blaine formation has been reworked and now forms a large part of the basal Trinity of Tom Green County seems evident to the writer.

ECONOMIC GEOLOGY

SAND

Sand in sufficient amounts for local use may be found as bars along the rivers and largest creeks, but the amount is too small for much commercial development.

A considerable source of fairly pure sand may be found at a few places in the Blaine formation. Crushing might be necessary and commercial sand be thus obtained. The exact localities cannot be given. Considerable searching and testing of the sands would be necessary. Sands of Trinity age are abundant in various localities, and may be, in places, pure enough for building purposes.

GRAVEL

An abundance of gravel is to be found in the main streams of the county. It is made up mainly of limestone and chert fragments, ranging up to five or six inches in diameter. It generally can be found comparatively free of silt. The original source of most of this gravel is the Pleistocene conglomerate. In places the Pleistocene conglomerate itself can be used by crushing.

CLAY

Clays probably suitable for the manufacture of brick or tile are found in the Choza and Vale formations. Formerly a brick kiln was in operation two miles west of San Angelo, the clay of the San Angelo formation being utilized. Clay in quite large amounts can also be found near the top of the San Angelo formation four miles west of San Angelo. Clays and clay-shales are found outcropping along the Concho River east of San Angelo in both the Choza and Vale formations. These clays or clay-shales are red or light green in color. The clays of the Trinity division are generally sandy and unfit for use.

GYPSUM

Gypsum is not present in Tom Green County in commercial quantity, one thin bed only being found in the San

Angelo formation. This is seen near the Kansas City, Mexico & Orient Railway, three and one-half miles southwest of San Angelo. Many of the clay horizons of the Choza and Vale formations contain gypsum, but in too small quantities to be of any commercial value.

LIMESTONE

Limestones of good quality and in large quantity can be found in the basal part of the Comanche Peak formation and at some horizons above the base. The upper layers are generally soft and in places slightly sandy. In the south, southwest, north and northwest parts of the county some limestones of good quality are found in the Edwards formation, although cherty layers lower the quality of some of it.

At Turnerdale, eight miles northwest of San Angelo, a peculiar layer of dolomite is found outcropping in North Concho River. It ranges up to one foot or a little more in thickness and is of a flinty hardness. At this place it is being crushed for road material. It rests upon white sandstone from which it is separated by a thin layer of very gypsiferous shale. It is peculiar in that it rests upon a sandstone to which it closely conforms, the surface being very undulating. (Pl. IV, Fig. 1.)

LIME

Some of the limestones of the Comanche Peak formation are of sufficient purity to be used for lime. Usable layers of limestone may be found also in basal Edwards formation.

ROAD METAL

Stream gravel suitable for road-making occurs abundantly. Crushing is necessary due to the uneven sizes of the pebbles. Some limestone of the Comanche Peak and Edwards formations could be found, which if crushed, would also make excellent road metal.

At the rock quarry at Ben Ficklin much dolomitic limestone has been crushed, and used in building the roads radiating from San Angelo. A quarry has been opened on the Door Key Ranch three miles northeast of Christoval. Here limestones of the Comanche Peak formation have been crushed furnishing a good road metal. The *Requienia* bed has here been used as well as other strata.

WATER SUPPLY

The water supply of the county should receive more consideration than can be given here. A few of the problems to be solved are here suggested. One of the most important questions refers to the locations and depths of the water-bearing horizons of the county. The boundaries of formations may be located fairly accurately on the geologic map. The approximate depths may be secured by study of the geologic and local sections of the county (p. 39), or local sections (p. 47).

The water-bearing sandstones of the San Angelo formation are in two layers, separated by a clay layer impregnated with gypsum. This is found true one mile below the Seven-Mile Bridge southwest of San Angelo, and may be found true around San Angelo. The upper layer of sandstone may be the only one that bears pure water. Logs of the water wells around San Angelo which are known to supply the good water for irrigation purposes should be carefully studied so as to determine the position of the gypsum-bearing horizon. The Blaine sandstones in the west part of Tom Green County undoubtedly contain a large supply of water, but it is generally impure. These sands and the basal Cretaceous sands are the main sources of the water supply for irrigation around San Angelo. The water coming down the drainage basin of North Concho River has been impounded in the San Angelo formation.

The problem of finding good water for ranch purposes is a difficult one and varies in different parts of the county.

It must eventually be studied in detail if the best results are obtained. In the eastern part of the county there seem to be layers of good water and layers of impure water. In some places water is very abundant and in others deep wells have been drilled which supplied no water. This occurs at one place within one-fourth mile of the Concho River a few miles east of San Angelo. The poor and good water horizons seem to lie in streaks across the county.

OIL AND GAS POSSIBILITIES

Careful study of the Permian formations of Tom Green County shows that black sandy shales are found near the top of the Arroyo formation at the east edge of the county. Above these, as shown by the geologic section (p. 39), is found a long series of dolomites, dolomitic limestones and green or red shales with few sands or other porous layers present.

The shallow showings of oil in the wells in the northwest corner of the county and those near Christoval in the south-central part of the county give some encouragement for the belief that shallow oil may be found, although ten wells have been completed in the county and three others are now drilling with only showings thus far encountered. Surface indications were found at one place in the county, consisting of beds of asphaltic sandstones outcropping in the Blaine formation along Grape Creek in the north-central part of the county on the March Ranch. This residue of oil may have reached its present position by lateral migration.

The general dip of the lower Permian formations is toward the northwest. A fold is present in the county beginning near San Angelo and extending northwestward out of the county. Between this fold and a general subsurface high in Schleicher County there appears to be a syncline plunging steeply to the westward. It is known that there is a general high area of Permian sediments just beneath the Cretaceous of Schleicher County, this fold extends for many miles to the southwestward. The small fold in Tom

Green County seems to be a minor feature of it. The fold in Schleicher County is not yet well defined. This long fold is here named the Schleicher fold. The minor fold of Tom Green County cannot be definitely outlined with the number of wells completed at this time. For this reason a contour map of Tom Green County is not included.

The sediments of the Blaine formation have a steep dip toward the west or northwest, while the dip of the Cretaceous layers is toward the southeast. Two cross-sections which are included in the report will give a general idea of the dip of the strata of the various formations. (In pocket.)

WELL DATA

The logs and description of samples given in this section are of wells in Tom Green County unless otherwise specified.

CAIN NO. 1

Located two miles west of San Angelo. Elevation 1875 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Red sandstone and chert	8	13	5
Boulders	13	25	12
Sandstone, hard	25	45	20
Red clay	45	50	5
Boulders	50	95	45
Red clay	95	111	16
Blue shale	111	120	9
Limestone	120	123	3
Sandstone—salt water	123	129	6
Limestone	129	183	54
Sandstone	183	189	6
Red clay	189	194	5
Limestone	194	205	11
Sandstone, pyrite, mica	205	209	4
Flinty rock	209	212	3
Hard sand rock	212	271	59
Shale, blue	271	272	1

	Depth in Feet		
	From	To	Thickness
Hard shell	272	305	33
Shale, blue	305	336	31
Limestone, hard	336	341	5
Sandstone, hard	341	346	5
Sand, slate and sulphur water	346	347	1
Shell, hard	347	372	25
Shale, gray	372	380	8
Clay, blue	380	382	2
Lime, hard	382	400	18
Sandstone	400	412	12
Limestone	412	420	8
Sandstone	420	442	22
Sandstone, pyrite, hard	442	447	5
Clay, blue	447	470	23
Lime, very hard	470	477	7
Limestone, pyrite	477	479	2
Clay, blue	479	482	3
Gypsum, white	482	486	4
Clay, blue	486	488	2
Lime, hard, gray	488	493	5
Gypsum, white	493	499	6
Clay, blue	499	503	4
Gypsum and blue clay	503	509	6
Clay, blue	509	512	3
White crystal gypsum	512	518	6
Clay, blue	518	521	3
Shell, hard	521	523	2
Clay, blue, and gypsum	523	526	3
Shell, hard	526	532	6
Clay, blue	532	536	4
Gypsum, white	536	537	1
Clay, blue	537	545	8
Lime, white	545	600	55
Clay, blue	600	610	10
Lime, gray, hard	610	635	25
Gumbo, blue	635	670	35
Lime, hard, gray	670	850	180
Clay and shale, blue	850	857	7
Light blue, sandy shale	857	868	11
Gumbo and blue shale	868	928	60
Shale, black	928	985	57
Shale, blue	985	995	10
Blue gumbo, satinspar	995	1067	72
Hard shell lime	1067	1390	323

	Depth in Feet		
	From	To	Thickness
Shales, light, dark to very dark blue	1390	1417	27
Black limestone	1417	1436	19
Light blue shale	1436	1438	2
Blue gumbo, bituminous	1438	1477	39
Lime, gray	1477	1518	41
Shale, light, sandy	1518	1578	60
Lime, gray	1578	1581	3
Blue gumbo	1581	1595	14
Light blue sandy shale	1595	1659	64
Lime, gray	1659	1661	2
Blue gumbo	1661	1768	107
Gray lime	1768	1770	2
Dark blue shale	1770	1820	50
Gray lime	1820	1831	11
Blue shale	1831	1902	71
Lime, gray	1902	1959	57
Black gumbo	1959	1965	6
Gray lime	1965	1995	30
Black gumbo	1995	2061	66
Gray lime	2061	2065	4
Blue gumbo, pyrite	2065	2103	38
Gray lime	2103	2106	3
Black gumbo	2106	2186	80
Light blue shale	2186	2206	20
Black lime	2206	2231	25
Blue gumbo	2231	2242	11
Sandy shale	2242	2303	61
Dark blue gumbo	2303	2825	522
Limestone, light gray	2825	2826	1
Black shale, pyrite	2826	2842	16
White lime	2842	2846	4
White and light blue shale	2846	2850	4
Dark shale, fossils	2850	2864	14
Black lime	2864	2883	19
Streaks of shale, lime and pyrite	2883	2895	12
White lime	2895	2902	7
Dark shale, lime concretions	2902	2990	88
White lime	2990	2999	9
Dark blue shale	2999	3026	27
Gray lime	3026	3027	1
Dark shale	3027	3065	38
Gray lime	3065	3066	1
Dark shale	3066	3073	7
Gray lime	3073	3102	29

	Depth in Feet		
	From	To	Thickness
Dark blue shale	3102	3106	4
Gray lime	3106	3258	152
Light blue shale, fossils	3258	3263	5
Limestone	3263	3305	42
Black shale, coal seam	3305	3315	10
White silica sand-water	3315	3321	6
Gray lime	3321	3850	529
Dark shale, lime concretions sandstone	3850	3860	10
Dark shale	3860	3897	37
Limestone, mottled, fossils	3897	3920	23
Black, rotten limestone and shale, some oil	3920	3965	45
Black arenaceous lime, very hard to bottom	3965	3970	5
Shale, black limy	3970	3972	2
Black lime	3972	3975	3
Black shale	3975	3979	4
Black lime	3979	3984	5
Black shale	3984	3987	3
Black lime	3987	3990	3
Black shale	3990	3992	2
Black lime	3992	3995	3
Black shale	3995	4002	7
Black lime	4002	4052	50
Calcareous shales	4052	4062	10
Black limestone	4062	4085	23
Dark rotten lime	4085	4109	24
Dark shale and lime	4109	4235	126
Dark shale with hard streaks of brown rock (intrusions)	4235	4240	5
Brownish sandy rock	4240	4280	40
Black shales, brown concretions	4280	4312	32
Black shales with streaks of sandstone and black sandy shales	4312	4314	2
White sandstone	4314		

CLARK NO. 1, ROXANA PETROLEUM CORPORATION

Located in Section 5, Block A, G. C. & S. F. Survey, in northwestern part of the county. Elevation 2224 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Soil	0	3	3
Shale	3	65	62

	Depth in Feet		
	From	To	Thickness
Gravel	65	116	51
Lime, white	116	160	44
Red rock, shelly with lime showing	160	185	25
Red rock	185	260	75
Lime, white	260	305	45
Shale, blue	305	320	15
Lime, white	320	340	20
Shale, blue	340	525	185
Lime, white	525	535	10
Sandy shale, red	535	710	175
Shale, blue	710	740	30
Sand, three bailers salt water	740	770	30
Red rock	770	860	90
Sand, ten bailers of water	860	870	10
Sand, gray	870	885	15
Shale, blue	885	1000	115
Lime, white	1000	1009	9
Shale, blue	1009	1034	25
Lime, gray, good show of oil	1034	1035	1
Lime, gray, ten barrels oil, nine bailers of water	1035	1040	5
Shale, blue	1040	1065	25
Shale, lime shell, blue	1065	1102	37
Sand	1102	1115	13
Ten bailers sulphur water at 1115.			
Shale, blue	1115	1125	10
Sand, lime, gray	1125	1130	5
Shale, lime shell, blue	1130	1145	15
Sandy lime, gray	1145	1175	30
Shale, blue	1175	1205	30
Shale, lime shell, blue	1205	1210	5
Shale, blue	1210	1250	40
Lime, hard	1250	1260	10
Sand, water	1260	1270	10
Sand, sulphur water	1270	1280	10
Shale, blue	1280	1305	25
Lime, hard	1305	1310	5
Sandy lime, blue	1310	1325	15
Shale, blue	1325	1335	10

CLEGG NO. 3, SANTIAGO OIL COMPANY

Located on Section 18, Block 16, H. & T. C. Railway Survey, about four miles northwest of Carlsbad. Elevation 2130 feet. Set 10-inch casing at 1884 feet and 8-inch casing at 2800 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Sand and gravel	0	30	30
Red rock	30	65	35
Blue shale, first water 200 feet	65	265	200
Sandy lime	265	275	10
Blue shale	275	335	60
Gypsum	335	340	5
Sandy shale and broken lime; salt water at 350 feet	340	380	40
Blue slate	380	430	50
Brown slate	430	603	173
Sandy lime	603	633	30
Blue slate	633	638	5
Sandy lime	638	642	4
Red rock, set 15½ inches	642	652	10
Sand, traces of oil	652	654	2
Shale	654	674	20
Sandy shale	674	714	40
Shale, brown	714	730	16
Lime	730	747	17
Lime, broken, show of oil	747	760	13
Shale	760	800	40
Lime	800	804	4
Shale, good show oil 857	804	874	70
Lime shell	874	879	5
Shale	879	890	11
Lime	890	892	2
Sand, good show oil	892	896	4
Shale	896	946	50
Sand	946	956	10
Lime	956	961	5
Shale	961	966	5
Pyrites of iron	966	978	12
Sand	978	988	10
Shale, light	988	1015	27
Lime	1015	1100	85
Shale	1100	1110	10
Lime	1110	1140	30
Slate	1140	1145	5
Lime	1145	1155	10
Slate	1155	1165	10
Lime	1165	1190	25
Shale and slate	1190	1220	30

	Depth in Feet		
	From	To	Thickness
Lime	1220	1230	10
Slate and shale	1230	1240	10
Lime	1240	1260	20
Shale	1260	1290	30
Lime	1290	1310	20
Shale	1310	1320	10
Lime	1320	1340	20
Shale	1340	1360	20
Lime	1360	1400	40
Shale	1400	1420	20
Lime	1420	1470	50
Shale	1470	1480	10
Lime	1480	1500	20
Shale	1500	1515	15
Lime	1515	1770	255
Shale	1770	1775	5
Lime	1775	1780	5
Shale	1780	1790	10
Lime	1790	1800	10
Shale	1800	1815	15
Lime	1815	1820	5
Shale	1820	1840	20
Lime	1840	1845	5
Shale	1845	1855	10
Lime	1855	2015	160
Lime, sandy, water	2015	2020	5
Shale and lime	2020	2025	5
Shale	2025	2035	10
Lime	2035	2045	10
Shale	2045	2052	7
Lime	2052	2060	8
Shale	2060	2068	8
Lime	2068	2080	12
Shale	2080	2090	10
Lime	2090	2096	6
Shale	2096	2110	14
Lime	2110	2117	7
Shale	2117	2150	33
Lime	2150	2225	75
Shale	2225	2230	5
Lime	2230	2270	40
Shale	2270	2280	10
Lime, sandy	2280	2350	70
Lime	2350	2445	95

	Depth in Feet		
	From	To	Thickness
Lime, sandy, good gas show	2445	2550	105
Lime and crystals	2550	2560	10
Lime	2560	2700	140
Shale	2700	2705	5
Sandy lime water	2705	2714	9
Lime, fine	2714	2863	149
Sandy lime water	2863	2875	12
Lime, broken	2875	2945	70
Lime	2945	3015	70
Sandy lime	3015	3023	8
Lime	3023	3045	22
Sandy lime	3045	3053	8
Lime	3053	3120	67
Lime, hard	3120	3185	65
Lime, soft	3185	3190	5
Lime, sandy, oil and gas showing	3190	3220	30
Lime, soft, oil and gas showing	3220	3230	10
Lime, sandy	3230	3330	100
Lime	3330	3365	35
Lime squares	3365	3370	5
Lime	3370	3535	165
Lime and shale	3535	3630	95

DOOR KEY RANCH NO. 1, WHITESIDES ET AL.

Located near center of Section 541, H. & T. C. Railway Survey, in the south-central part of the county. Elevation 2070 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Lime, white, hard	0	70	70
Shale, blue, soft	70	240	170
Lime, white, hard	240	300	60
Shale, blue, soft	300	380	80
Lime, white, hard	380	500	120
Shale, white, soft	500	525	25
Lime, white, hard	525	1190	665
Sand, white, soft, water	1190	1200	10
Lime, white, hard, water	1200	1250	50
Lime, white, hard	1250	1500	250
Sand, white, hard	1500	1510	10
Shale, white, soft	1510	1525	15

Lime, white, hard	1525	1580	55
Sand, white, soft	1580	1590	10
Shale, white, soft	1590	1600	10
Lime, white, hard	1600	1690	90
Shale, blue, soft	1690	1700	10
Lime, white, hard	1700	1850	150
Shale, white, soft	1850	1880	30
Lime, white, hard	1880	2140	260
Shale, white, soft	2140	2150	10
Shale, blue, lime, soft	2150	2300	150
Lime, yellow, hard	2300	2305	5
Shale, black, soft	2305	2311	6
Sand, white, soft, oil and gas showing	2311	2321	10
Sand, gray, hard, filled up with salt and sulphur water	2321	2401	80
Shale, blue, soft, cave	2401	2461	60
Lime, whit, hard	2461	2476	15
Shale, black, soft, cave	2476	2540	64
Lime, gray, hard	2540	2550	10
Shale, blue, soft	2550	2577	27
Lime, gray, hard	2577	2584	7
Shale, black, soft, lime shell, cave	2584	2850	266

FARR NO. 1

Located on Section 2, Block 16, H. & T. C. Railway Company, three and one-half miles northeast of Carlsbad. Elevation 2000 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Limestone	0	15	15
Red clay and sand	15	17	2
Red clay	17	35	18
Hard shell	35	39	4
Blue shale	39	80	41
Hard black shale	80	85	5
Hard white sand	85	98	13
Hard gray sand	98	125	27
Gray sand and blue shale	125	150	25
Blue shale	150	160	10
Gray sand	160	190	30
Sand, water	190	195	5
Blue shale	195	225	30
Gray sand	225	240	15

	Depth in Feet		
	From	To	Thickness
Sand, water	240	245	5
Sandy shale and gypsum	245	265	20
Brown shale	265	280	15
Tough blue shale	280	295	15
Hard rock shell	295	301	6
Blue shale	301	311	10
Hard shell	311	315	4
White sand	315	320	5
Blue shale	320	350	30
Sandy shale and gypsum	350	365	15
Blue shale, pyrites of iron	365	368	3
Red clay	368	372	4
Sandy shale, pyrites of iron	372	380	8
White sand	380	385	5
Blue shale	385	395	10
Sandy shale	395	398	3
Brown shale	398	420	22
Blue shale	420	423	3
Brown shale	423	512	89
Sandy shale, blue	512	517	5
Brown shale	517	530	13
Hard sandstone	530	535	5
Blue shale	535	550	15
Conglomerate	550	555	5
Brown shale	555	599	4
Blue shale	599	607	8
Brown shale	607	625	18
Hard shell	625	629	4
Blue shale	629	637	8
Brown shell	637	653	16
Hard	653	655	2
Brown shale	655	695	40
Hard dry sand, gas	695	702	7
Dry sand	702	707	5
Brown shale	707	728	21
Hard shell	728	730	2
Brown shale	730	755	25
Sandy, blue shale	755	765	10
Brown shale with little sand	765	780	15
Brown shale, showing of gas	780	785	5
Hard, brown shale, gray sand	785	795	10
Sandy, blue shale	795	808	13
Hard shell	808	812	4
Blue shale	812	818	6

	Depth in Feet		
	From	To	Thickness
Hard sand, showing of gas	818	827	9
Hard shell	827	830	3
Hard, gray sand, Pyrites of iron	830	848	18
Gravel, coarse	848	852	4
Soft, gray sand, oil	852	862	10
Blue shale	862	866	4
Hard, gray sand	866	878	12
Blue shale	878	882	4
Hard, gray sand, Pyrites of iron	882	900	18

HARRIS NO. 1, FANNIN OIL AND DEVELOPMENT COMPANY

Located on Section 170, W. C. R. R. Company. Elevation 1955 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface soil	0	2	2
Conglomerate, lime	2	82	80
Red shale, caving	82	95	13
Slate, hard	95	100	5
Shale, blue	100	118	18
Sand, fresh water	118	123	5
Shale, blue	123	170	47
Joint clay	170	190	20
Sand, salt water	190	202	12
Shale, blue	202	205	3
White shale	205	210	5
Red rock, caving	210	255	45
Dark shale	255	290	35
Lime	290	298	8
Blue shale	298	340	42
Light shale	340	360	20
Shale, blue	360	428	68
White lime	428	446	18
Hard white lime	446	452	6
White slate	452	464	12
Blue shale	464	500	36
Red sandstone, hard	500	620	120
Light lime	620	683	63
Brown lime	683	737	54
Shale, hard, dark	737	746	9
Light lime	746	754	8

	Depth in Feet		
	From	To	Thickness
Brown sand, dry	754	769	15
Blue lime	769	832	63
Slate, hard	832	849	17
Lime shells	849	916	67
Blue lime	916	937	21
Slate, hard	937	946	9
Sandy shale, dry	946	1046	100
Gray lime	1046	1110	64
Light shale	1110	1121	11
Lime, gray	1121	1127	6
Light shale, oil sand	1127	1142	15
Shale and lime, soft	1142	1250	108
White lime	1250	1325	75
Red rock	1325	1345	20
Lime	1345	1440	95
Shale	1440	1513	73
Shale with oil sand	1513	1550	37
Sand and lime	1550	1680	130
Blue shale and slate	1680	1690	10
Lime	1690	1700	10
Lime and shale	1700	1710	10
Hard blue shale	1710	1730	20
Had oil and gas show at 1730.			
Blue shale	1730	1795	65
Lime, sulphur and salt H_2O	1795	1890	95
Shale, strong show gas at 2130	1890	2155	265
Lime	2155	2175	20
Shale	2175	2180	5
Black lime	2180	2185	5
Shale	2185	2195	10
Lime and slate	2195	2210	15
Lime	2210	2215	5
Dark shale	2215	2225	10
Lime and shale	2225	2240	15
Slate and shale	2240	2255	15
Hard slate	2255	2280	25
Lime, soft	2280	2300	20
Soft shale	2300	2330	30
Hard slate	2330	2350	20
Lime, soft	2350	2380	30
Yellow lime, water in gas rock	2380	2449	69
Hard lime	2449	2451	2
Hard lime	2451	2467	16
Porous lime and sand, water at 2525	2467	2525	58

	Depth in Feet		
	From	To	Thickness
Hard and soft lime, show of oil	2525	2581	56
Brown lime	2581	2601	20
Hard, white lime	2601	2616	15
Hard, gray lime	2616	2622	6
Soft, brown lime	2622	2625	3
Sand, water	2625	2640	15
Sandy, gray lime	2640	2700	60
Sand water	2700	2708	8
Sand, gray, oil show	2708	2714	6
Gray lime	2714	2724	10
Brown sandy lime	2724	2734	10
Shale	2734	2740	6
Crystallized lime	2740	2775	35
Shale	2775	2780	5
White lime shells, shale	2780	2785	5
Gray lime	2785	2800	15
Crystallized lime	2800	2830	30
Gray lime	2830	2836	6
Sand	2836	2838	2
Gray lime	2838	2900	62
White lime	2900	2978	78
Brown shale	2978	2987	9
Gray lime	2987	2993	6
Shale	2993	2997	4
Gray lime	2997	3005	8
White chalky lime	3005	3052	47
Gray sandy lime	3052	3055	3
Blue, brown shale	3055	3082	27
Sand, 1200 feet water in hole	3082	3085	3
Blue shale, soft	3085	3087	2
Gray lime	3087	3106	19
Sandy lime, oil show	3106	3108	2
Sandy lime, gray	3108	3126	18
Black shale	3126	3130	4
Brown shale	3130	3140	10
Sandy lime, gray	3140	3154	14
White sand	3154	3165	11
Blue lime	3165	3190	25
Lime, light	3190	3200	10
Lime, gray	3200	3211	11
Lime, white	3211	3257	46
Lime, gray, oil show at 3265	3257	3265	8
White and green shale	3265	3296	31
Sand and shale, blue	3290	3300	10

	Depth in Feet		
	From	To	Thickness
Blue lime	3300	3326	26
Blue shale	3326	3335	9
Lime, yellow	3335	3340	5
Sandy lime, brown	3340	3360	20
Gray lime	3360	3370	10
Sandy lime	3370	3375	5

M. B. PULLIAM NO. 1, WORLD OIL COMPANY

Located in the southwest one-fourth of the southeast one-fourth of Section 18, Block 4, H. & T. C. Railway Survey, eight miles northwest of San Angelo. Elevation 2105 feet (Roxana Petroleum Corporation, plane table level).

Driller's Log

	Depth in Feet		
	From	To	Thickness
Soil	0	5	5
Gray lime	5	10	5
Red mud	10	25	15
Lime	25	30	5
Red mud and gypsum	30	50	20
Red mud	50	70	20
Red mud and gyp	70	105	35
Lime, blut, sandy	105	235	130
Sandy lime	235	240	5
Pyrites of iron	240	250	10
Hard, gray lime	250	255	5
Sandy lime, gray	255	330	75
Light shale	330	335	5
Shale and gyp	335	370	35
Red rock	370	460	90
White lime	460	466	6
Red rock	466	484	18
Gray lime	484	486	2
Red rock	486	500	14
Broken lime	500	510	10
Red rock	510	540	30
Blue shale	540	560	20
Green shale	560	590	30
Gray lime	590	595	5
Light shale	595	600	5
Sandy lime	600	610	10

	Depth in Feet		
	From	To	Thickness
Hard sand	610	620	10
Gray lime	620	638	18
Light shale	638	645	7
Gray lime	645	655	10
Light blue shale	655	685	30
Sand, hole full of water	685	695	10
Sandy lime	695	710	15
Blue shale	710	730	20
Gray lime, sandy, show of oil	730	750	20
White lime	750	755	5
Broken lime	755	760	5
Sand, hole full sulphur water	760	770	10
Brown lime	770	785	15
Blue shale	785	790	5
White lime	790	795	5
Gray lime	795	825	30
Blue shale	825	835	10
Gray lime	835	840	5
Brown lime, six bailers water	840	855	15
Gray lime	855	875	20
Blue shale	875	885	10
Gray lime	885	895	10
Brown lime, six bailers water	895	935	40
Dark shale	935	937	2
Broken gray and brown lime	937	945	8
Dark shale	945	950	5
Brown and gray lime	950	958	8
Shaly lime	958	973	15
Gray lime and shale	973	1020	47
Gray lime	1020	1050	30
Blue shale	1050	1060	10
Broken gyp and lime	1060	1070	10
Gray lime and shale	1070	1090	20
Brown lime	1090	1095	5
Gray lime	1095	1100	5
Blue shale	1100	1105	5
Brown lime	1105	1112	7
Brown and gray lime	1112	1120	8
Hard brown lime	1120	1145	25
Hard gray lime	1145	1233	88
Brown lime	1233	1250	17
Blue shale	1250	1253	3
Gray lime	1253	1285	32
Broken shale	1285	1295	10

	Depth in Feet		
	From	To	Thickness
Lime	1295	1315	20
Hard gray lime, water at 1380	1315	1407	92
White lime	1407	1417	10
Broken lime and shale	1417	1492	75
Blue shale	1492	1520	28
Gray lime	1520	1535	15
Broken shale and lime	1535	1550	15
Gray lime	1550	1580	30
Light brown lime	1580	1600	20
Shaly lime	1600	1645	45
Gray lime	1645	1675	30
Blue shale	1675	1705	30
Gray lime, hard	1705	1715	10
Shaly lime	1715	1725	10
Gray lime	1725	1860	35
Light brown lime	1860	1870	10
Gray broken lime	1870	1910	40
Light gray lime	1910	1980	70
Light brown lime	1980	2010	30
Gray lime	2010	2235	25
Blue shale and lime	2235	2245	10
Gray lime	2245	2346	101
Gray lime, sandy	2346	2354	8
Gray lime	2354	2365	11
Dark lime, four bailers water per hour	2365	2380	15
Dark gray lime	2380	2400	20
Gray lime, hole full of water at 2400	2400	2558	158
Gray sandy lime	2558	2570	12
Blue shale	2570	2575	5
Gray lime	2575	2625	50
Broken gray lime and shale	2625	2648	23
Gray lime	2648	2783	135
Light brown lime	2783	2790	7
Gray lime	2790	2936	146
Light brown lime	2936	2960	24
Light gray sandy lime	2960	2970	10
White sand, a hole full of water	2970	3019	49
Gray sand	3019	3025	6
Hard gray sandy lime	3025	3033	8
White sand, water	3033	3067	34
Gray sand, hard	3067	3078	11
Fine sandy lime	3078	3134	56
Hard gray lime	3134	3211	77
Gray sandy lime	3211	3225	14

	Depth in Feet		
	From	To	Thickness
Hard gray lime	3225	3261	36
Gray sandy lime	3261	3271	10
Gray lime	3271	3285	14
Gray sandy lime	3285	3297	12
Gray lime	3297	3320	23
Blue shale	3320	3325	5
Hard lime	3325	3345	20
Gray lime	3345	3347	2
Dark lime	3347	3368	21
Hard white lime	3368	3375	7
Shelly lime and shale	3375	3393	18
Dark broken shale	3393	3405	12
Water sand	2405	3407	2
Dark gray lime	3407	3422	15
Gray lime	3422	3425	3
Blue shale lime	3425	3433	8
Shale lime	3433	3436	3
Blue shaly lime	3436	3440	4
Gray shale lime	3440	3465	25
Gray lime	3465	3472	7
Gray shelly lime	3472	3490	18
Black broken lime	3490	3533	43
Dark broken lime	3533	3587	54
Gray lime	3587	3640	53
Sandy lime, light blue, one bailer water, salt, per hour	3640	3650	10
Shale lime	3650	3676	26
Dark shale	3676	3743	67
Dark sandy shale	3743	3785	42
Hard lime	3785	3790	5
Dark shale	3790	3796	6
Shale	3796	3826	30
Blue shale	3826	3896	70
Dark brown shale	3896	3923	27
Blue shale	3923	4000	76
Gray lime	4000	4007	7
Shale and lime	4007	4025	18
Hard lime	4025	4033	8

SORRELL NO. 1, TEXON, MARLAND OIL COMPANY

Located in center of southwest one-half of Section 265, Christian Mann Survey. Elevation 2105 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Red clay, 55 barrels water	0	55	55
White limestone	55	75	20
Limestone	75	150	75
Yellow clay	150	155	5
Limestone	155	175	20
Yellow clay	175	190	15
Blue shale	190	210	20
Gray limestone	210	215	5
Blue shale	215	275	60
Red rock	275	280	5
Brown shale	280	350	70
Limestone	350	358	8
Sandy limestone	358	395	37
Gyp and limestone	395	405	10
Light sandstone	405	475	70
Red shale	475	600	25
Gray limestone	600	620	20
Blue shale	620	625	5
Red shale	625	640	15
Blue shale	640	645	5
Red shale	645	650	5
Blue shale	650	655	5
Red shale	655	755	100
Gray limestone	755	760	5
Red shale	760	805	45
Blue shale, five barrels water	805	820	15
Red shale	820	825	5
Blue shale	825	915	90
Blue shale, sandy, water	915	945	30
Red shale	945	990	45
Blue shale	990	1075	85
Gray sandy lime, hole full of water	1075	1100	25
Lime and sand	1100	1120	20
Sandstone	1120	1160	40
Blue shale	1160	1170	10
Sandy shale	1170	1175	5
Gray sandstone	1175	1200	25
Blue shale	1200	1220	20
Limestone	1220	1465	245
Broken limestone	1465	2000	535
Hard limestone	2000	2575	575
Limestone	2575	2775	200

	Depth in Feet		
	From	To	Thickness
Hard limestone	2775	3070	295
Soft limestone, hole full sulphur water	3070	3080	10
Limestone	3080	3256	176

TURNER NO. 1, PENN AND WINDSOR

Located in the center of the northwest one-fourth of Section 60, Block 5, H. & T. C. Railway. Elevation 2200 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Lime, soft	0	60	60
Red rock	60	70	10
Lime, soft	70	120	50
Lime, soft, hole full of water	120	140	20
Shale, yellow	140	180	40
Red rock	180	205	25
Sandy lime	205	250	45
Shale, light	250	285	35
Shale, blue	285	310	25
Lime	310	355	45
Shale	355	445	90
Shale, shells	445	515	70
Shale	515	590	75
Shale, gritty	590	605	15
Shale	605	650	45
Red rock	650	715	65
Lime, hard	715	725	10
Shale	725	760	35
Red rock	760	780	20
Shale	780	790	10
Red rock	790	890	100
Shale	890	902	12
Red rock	902	910	8
Lime	910	915	5
Shale, lime shell	915	930	15
Lime, broken	930	940	10
Shale, shells, light	940	960	20
Lime shell	960	985	25
Shale and white lime	985	1025	40
Shale, lime, shells, white	1025	1035	10

Show of oil at 1030.

	Depth in Feet		
	From	To	Thickness
Red rock	1035	1045	10
Shale, blue	1045	1080	35
Shale, caving	1080	1127	47
Lime shells	1127	1130	3
Shale, light	1130	1145	15
Lime, show of oil 1145	1145	1153	8
Shale	1153	1170	17
Shale, light	1170	1185	15
Lime, light, gritty, hole full of water	1185	1195	10
Shale, blue	1195	1205	10
Sand, light, hole full of water	1205	1235	30
Shale	1235	1260	25
Lime, gray	1260	1263	3
Shale, light	1263	1275	12
Lime	1275	1285	10
Shale, blue	1285	1305	20
Lime	1305	1310	5
Shale, blue	1310	1315	5
Lime, gray, show of oil	1315	1320	5
Lime	1320	1330	10
Shale, dark	1330	1350	20
Lime	1350	1360	10
Sand, water	1360	1372	12
Shale, blue	1372	1375	3
Lime, brown	1375	1395	20
Lime, gray	1395	1435	40
Shale, light	1435	1445	10
Shale, blue	1445	1450	5
Lime, brown, hard	1450	1460	10
Shale, blue	1460	1465	5
Lime, white, hard	1465	1470	5
Shale, light	1470	1500	30
Lime, gray	1500	1520	20
Shale, blue	1520	1525	5
Shale, light	1525	1540	15
Lime, brown	1540	1555	15
Lime, gray, hard	1555	1580	25
Shale, dark	1580	1600	20
Lime, brown	1600	1605	5
Shale, light	1605	1610	5
Lime, gray	1610	1615	5
Shale, blue	1615	1620	5
Lime, brown, hard	1620	1635	15
Shale, light	1635	1650	15

Lime, gray	1650	1665	15
Lime, gray, hard	1665	1670	5
Shale, blue	1670	1685	15
Shale, dark	1685	1690	5
Lime, gray	1690	1710	20
Shale, blue	1710	1715	5
Lime, gray, hard	1715	1725	10
Lime, brown	1725	1750	25
Lime, gray, hard	1750	1805	55
Lime, brown, hard	1805	1825	20
Lime, gray, hard	1825	1910	85

Not completed.

Description of Samples by Mrs. Genevieve Beede Henderson; Submitted by R. F. Imbt, Pure Oil Company, San Angelo, Texas

	Depth in Fe
Mainly maroon and greenish shale, some of which is calcareous and sandy. Several subangular small quartz grain from the very fine sandy clay. One or two small pieces of gypsum	800–850
Like the above sample. Several pieces of gypsum	850–870
Same as the sample from 850–870	870–900
Like the above sample. Considerable gypsum	903–910
Light gray limestone. A few pieces contain pyrite. Several pieces of pyrite and fine sandy, calcareous, maroon shale and one or two pieces of greenish shale	910–920
Gray to green fine sandy, calcareous shale and a few pieces of maroon shale. The shale contains an abundance of pyrite. A few small pieces of gypsum	920–930
Like the above sample. Two pieces of sandy limestone with pyrite. Shale has less pyrite	930–940
Same as the sample from 920–930. Less pyrite	940–950
Gray, green, fine sandy shale, one or two pieces of maroon shale. Also three pieces of light gray limestone noted	950–975
Light gray, fine granular limestone. A few pieces of maroon and green sandy shale present. A few pyrite crystals noted in one or two pieces of limestone and green, sandy shale	1000–1010
Light gray, fine granular limestone and maroon sandy shale, fairly evenly distributed. Also several pieces	

	Depth in Feet
of gray, green, sandy, calcareous shale. Several pieces of gypsum and pyrite present	1010–1025
Calcareous sandstone of subangular clear quartz grains. Several pieces of maroon and green sandy shale. Considerable pyrite present. One or two pieces of light gray limestone	1027–1032
Maroon, fine sandy, calcareous shale. A few pieces of fine sandy, calcareous green shale and a few very small pieces of gypsum. A piece of limestone containing calcite crystals and two small fragments of minute fossils	1032–1050
Fine sandy, gray-green, calcareous shale. Some gypsum present and one or two fragments of light gray limestone	1050–1075
Like the above sample. No limestone, a piece or two of pyrite	1075–1095
Same as the sample from 1050–1075. Considerable pyrite in the shale	1095–1120
Gray, somewhat calcareous, pyritic sandstone. A few pieces of green, fine sandy shale	1145–1153
Blue, pyritic clay	1153–1185
Gray, clear and iron-stained, subangular and angular quartz sand. Abundance of pyrite. Considerable pulverized limestone and calcite crystals	1205–1215
Like the above sample	1215–1235
Same as the samples from 1205–1215. One black piece of quartz with a white streak around it	? –1260
Light gray, pyritic, fine granular and very fine sandy limestone. Several pieces of fine sandy, blue-gray shale	1270–1280
Very fine sandy, rather porous, gray limestone. Some pyrite and one or two pieces of blue shale. Part of the limestone is oil-stained. Very slight show of oil in test	1315–1320
Gray, pyritic limestone and calcareous sandstone. A few pieces of mica are seen in the sandstone. Considerable pyrite present. Several pieces of fine sandy, gray shale	1320–1330
Same as the above sample	1330–1350
Apparently oil-saturated limestone. Considerable pyrite. A few fragments of pyritic, green shale. Several pieces of white limestone and gray, fine sandy limestone. One fair sized piece of gypsum. Slight oil test	1350–1365
Same as the sample from 1350–1365. One or two pieces of gray sandstone	1365–1370

	Depth in Feet
Like the sample from 1355–1365. No gypsum and no shale. Considerable pyrite	1395–1410
Light brown limestone, apparently oil-stained. Considerable pyrite present and several pieces of gypsum. One or two pieces of anhydrite and green shale	1410–1425
Principally fine granular, gray limestone. Three rather large pieces of white, sharp, angular quartz. Two or three pieces of pyritic, fine sandy, green shale and sandstone. A few flakes of gypsum	1450–1455
Same as the above sample. Only one piece of sharp angular white quartz	1470–1480
Like the above sample	1480–1505
Like the above sample. Several larger pieces of gypsum. One or two fragments of anhydrite and dark blue, fine sandy, pyritic shale	1535–1545
Light brown, fine granular limestone mainly. Several pieces of blue, fine sandy pyritic shale and flakes of gypsum	1545–1565
Same as the sample from 1545–1565. Several pieces of sharp, angular quartz	1565–1575
Like the above sample. More green shale and several pieces of pyrite	1590–1600
Very fine sandy, blue shale mainly. Considerable gypsum and pyrite present. Also some anhydrite	1600–1625
Gray, fine granular, pyritic limestone and blue, pyritic shale. Several pieces of white, granular anhydrite and some gypsum	1625–1635
Like the above sample	1645–1660
Mainly gray limestone, pyritic, and considerable anhydrite. Several pieces of pyritic, blue shale	1660–1665
Blue, very fine sandy clay containing considerable finely divided pyrite. Some small flakes of gypsum	1665–1675
Like the above sample. A few pieces of white and gray limestone also noted. Three or four pieces of sharp, angular quartz grains. Several large pieces of pyrite	1685–1700
Mainly gray, sandy limestone. Considerable pyrite. In the shale and limestone the sand grains are angular. Considerable blue, very fine sandy, pyritic shale. Some small flakes of gypsum	1715–1725
The same as the sample from 1715–1725. Less shale	1725–1730
Like the above sample. One or two pieces of anhydrite	1735–1745
Light gray limestone. A little sand in the limestone. A few pieces of anhydrite and considerable pyrite. Some blue sandy pyritic shale	1765–1770

	Depth in Feet
Same as the sample from 1765–1770. More anhydrite. Some gypsum	1770–1780
Like the above sample. Several pieces of blue shale	1790–1800
Light brown, fine granular limestone mainly. Some anhydrite and gypsum. Several pieces of blue, sandy pyritic shale and some pyrite	1800–1815
Like the above sample. More anhydrite	1815–1825
Like the above sample	1825–1840
Like the above sample. One piece of black shale. Two pieces of coal, probably foreign	1840–1850
Like the above sample. No coal	1850–1885
Same as the sample from 1850–1885	1885–1895
Light gray, fine granular limestone. Several pieces of anhydrite and gypsum. Some pyrite. A few fragments of dark gray shale	1920–1935
Like the above sample	1940–1955
Like the above sample A few pieces of black limestone	1965–1975
Like the above sample	1975–2000
Like the above sample	2000–2025
Like the above sample	2025–2050
Like the above sample	2060–2075
Like the above sample	2075–2090
Like the above sample More dark gray, calcareous shale and less anhydrite and gypsum	2090–2140
Light gray, fine granular limestone. Several pieces of dark gray, calcareous shale. Two or three pieces of anhydrite and gypsum	2140–2150
Like the above sample	2150–2165
Like the above sample	2185–2200
Like the above sample	2200–2240
Like the above sample	2250–2275
Like the above sample Considerable gypsum and anhydrite present, more than in preceding samples	2275–2295
Like the above sample	2295–2335
Like the above sample	2335–2350
Light gray, fine granular limestone, some of which contains a little very fine sand. Several pieces of anhydrite and gypsum. A few pieces of dark gray, calcareous shale	2350–2375
Like the preceding sample	2375–2400
Like the preceding sample Also one or two pieces of dark gray limestone	2400–2420
Like the above sample	2420–2435
Missing from 2435–2610	2435–2610

	Depth in Feet
Gray limestone mainly. Considerable black shale and a few pieces of black limestone. Considerable gypsum and some anhydrite. Thin section shows fragments of *Fusulina*	2610

WESTBROOK NO. 1, SCHUMACHER OIL AND GAS COMPANY

Located 300 feet from the north and 300 feet from the west line of Section 117 Washington Survey, Coke County. Elevation 1853 feet. Casing record: 15½ inches, 171 feet; 12 inches, 730 feet; 10 inches, 1730 feet; 8 inches, 2300 feet; 6 inches, 2950 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Red rock	0	120	20
Lime, hard, water eight barrels per hour	120	135	15
Lime, gray	135	200	65
Red rock and lime shells	200	290	90
Red rock	290	320	30
Lime, gray	320	332	12
Red rock, lime shells	332	410	78
Lime, gray, hard	410	436	26
Slate, blue, and mud	436	500	64
Slate, blue, and shells	500	540	40
Lime, hard and gray	540	595	55
Sand, soft, white (quartz)	595	597	2
Red rock	597	640	43
Shale, blue, soft	640	685	45
Shale, soft, brown	685	735	50
Shale, blue, soft	735	750	15
Lime, hard, white	750	790	40
Shale, soft, white	790	795	5
Lime, hard, white	795	855	60
Lime, hard, black	855	860	5
Shale, white, soft	860	875	15
Lime, white	875	887	12
Shale, blue, soft	887	893	6
Lime, white, hard	893	922	29
Shale, soft, white	922	933	11
Lime, white and gray	933	1022	89
Shale, white	1022	1032	10
Slate, limy	1032	1075	43
Lime, white, hard	1075	1095	20

	Depth in Feet		
	From	To	Thickness
Shale and shell, white	1095	1115	20
Slate, dark	1115	1125	10
Dark, broken lime, sulphur water, sulphur H_2O at 1180–1195 feet (shale white in Bkn. Ls.)	1125	1220	95
Lime, dark	1220	1320	100
Shale and lime, dark	1320	1384	64
Lime, gray	1384	1470	86
Shale, light	1470	1485	15
Shale, brown	1485	1638	153
Lime and shale, gray, gas scent, sulphur water up to 250 feet collar, struck water at 1850, 212, 1638, 1850 feet	1638	1850	212
Lime, gray	1850	1970	120
Lime, dark, water four bailers	1970	1985	15
Lime, hole full water	1985	2025	40
Lime, break at 2145, parafin scum 120, 2025 feet	2025	2145	120
Lime, gray	2145	2330	185
Lime	2330	2375	45
Sandy lime, water two bailers	2375	2385	10
Lime	2385	2420	35
Broken shale and lime shell	2420	2438	18
Lime	2438	2450	12
Shell, blue	2450	2460	10
Shell	2460	2465	5
Blue shell, caving	2465	2500	35
Lime, gray, sandy	2500	2510	10
Shale and shell	2510	2570	60
Shale, brown and light	2570	2600	30
Shell, hard	2600	2602	2
Broken lime and shell	2602	2610	8
Lime, hard	2610	2620	10
Shale, blue	2620	2622	2
Lime	2622	2625	3
Shale, white	2625	2628	3
Shell	2628	2630	2
Shale, white, caving	2630	2645	15
Shell, sandy	2645	2650	5
Red rock	2650	2652	2
Blue shale	2652	2660	8
Lime	2660	2680	20
Shale, blue	2680	2683	3
Lime, hard	2683	2695	12

	Depth in Feet		
	From	To	Thickness
Lime, broken	2695	2705	10
Shale, blue	2705	2710	5
Shale, white	2710	2715	5
Lime, hard, black	2715	2720	5
Lime, gray	2720	2730	10
Lime, white	2730	2745	15
Shale, blue	2745	2800	55
Slate, blue, and shell	2800	2815	15
Lime and slate	2815	2850	35
Shale, blue	2850	2860	10
Lime, shells, shale, black, blue, caving, small coal seam, caving at 2930–2950 feet	2860	2930	70
Slate, white, blue, and shells	2930	3005	75

WILLIAMS NO. 1, McCULLOCK, CHURCH-FIELDS

Located southwest of Christoval school land No. 2, 1125 feet from south line and 811 feet from the east line. Elevation 2242 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Lime	0	228	228
White shale	228	270	42
Sand, two bailers of water	270	273	3
White sand	273	285	12
Lime	285	290	5
White shale	290	320	30
Lime	320	416	96
Brown lime, sulphur water	416	424	8
Lime	424	545	21
Green shale	545	549	4
Lime shell	549	550	1
Gray shale	550	555	5
Brown lime	555	565	10
White shale	565	595	30
White lime shell	595	596	1
Blue gumbo	596	600	4
Lime	600	605	5
White shale	605	695	90
White lime	695	1145	450
Sand, hole full of water	1145	1155	10
Hard slate	1155	1660	505
Shale	1660	1670	10

	Depth in Feet		
	From	To	Thickness
Lime	1670	1700	30
Shale	1700	1765	65
Lime *	1765	1810	45
Shale	1810	1835	25
Lime	1835	1850	15
Brown shale	1850	1860	10
Lime	1860	1865	5
Brown shale	1865	1870	5
Lime	1870	1873	3
Brown shale	1873	1910	37
Lime	1910	1930	20
Shale	1930	1945	15
Lime	1945	1960	15
Shale	1960	1975	15
Lime	1975	2100	125
Sandy shale	2100	2140	40
Lime	2140	2160	20
Shale	2160	2215	55
Sand	2215	2225	10

WILLEKE NO. 1. H. D. CAMP

Located in Blind Asylum Lands, 200 feet from the north line, 310 feet from the west line of Section 4. Elevation 2095 (Sun). Casing record: 10-inch at 246 feet, 8¼-inch at 548 feet, 6⅝-inch at 747 feet, 5 3/16-inch at 890 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Soil	0	3	3
Sand rock	3	25	22
Red bed	25	45	20
Rock, sand	45	55	10
Red bed	55	80	25
Red shale	80	95	15
Blue shale	95	100	5
Red shale	100	115	15
Sand	115	123	8
Sandy limestone	123	129	6
Gray shale	129	144	15
Gray, sandy shale	144	155	11
Blue, sandy shale	155	180	25

	Depth in Feet		
	From	To	Thickness
Sandy shale	180	195	15
Hard, sandy shale	195	215	20
Sandy shale	215	228	13
Hard, sandy shale	228	234	6
White, sand, 1½ BPHSW	234	241	7
Blue shale	241	256	7
Blue shale	241	256	15
Gray shale	256	266	10
Broken limestone	266	271	5
Red bed	271	335	64
Brown shale	335	340	5
Gray limestone	340	350	10
Red bed	350	394	44
Blue shale	394	444	50
Gray limestone	444	448	4
Water sand, HFSW	448	451	3
Limestone	451	460	9
Sand	460	470	10
Blue shale	470	524	54
Sandy shale	524	528	4
Sand, HFSW	528	537	9
Limestone	537	545	8
Broken limestone	545	546	1
Limestone, HFW	546	549	3
Water sand, 2½ BSWPH	549	552	3
Blue shale	552	555	3
Blue, sandy shale	555	570	15
Gray, sandy limestone	570	574	4
Gray shale	574	587	13
Gray limestone	587	596	9
Blue shale	596	611	15
Sandy shale, dark	611	621	10
Water sand, 2 BPHSW	621	628	7
Gray limestone	628	642	14
Blue shale	642	645	3
Gray limestone	645	652	7
Gray shale	652	658	6
Blue shale	658	662	4
Gray limestone	662	667	5
Limestone, broken	667	674	7
Limestone, brown, salt, WHF	674	684	10
Gray limestone, water	684	700	16
Limestone	700	704	4
Gray limestone	704	747	43

	Depth in Feet		
	From	To	Thickness
Brown limestone	747	763	6
Gray limestone	763	775	12
Brown shale	775	782	7
Gray limestone	782	797	15
Brown limestone	797	803	6
Blue shale	803	821	18
Gray sand	821	850	29
Water sand	850	853	3
Gray limestone, 2 BPHSW	853	914	61
Brown limestone	914	925	11
Brown shale	925	935	10
Gray limestone	935	972	37
Dark, sandy limestone	972	987	15
Gray limestone	987	996	9
Light, gray limestone	996	1003	7

HECKET NO. 1, BORED BY J. C. SNOW

Located on 25-acre tract, Hecket estate. Well begun about October 18 in middle of tract, northwest side of City of San Angelo. Submitted by Dr. J. W. Beede. Water well.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Yellow, soft soil	0	56	56
Concrete rock	56	58	2
Yellow clay, cave	61	67	6
Concrete rock, little water	61	67	6
Yellow sand, water	67	70	3
Porous sand, rock, water	70	76	6
Conglomerate with sand poskets and probably water pockets	76	90	14
Blue sand rock	90	92.5	2.5
Blue shale bottom	92.5	92	.5

Water stands 50 feet from top, but pulls down easily to 54 feet, then holds.

Well under test 5⅝ working barrel placed on bottom. About 6-inch pipe showed from 15 to 20 gallons per minute of water.

WELL NO. 2
(Name?)

Located north of San Angelo, near city limits. Submitted by Dr. J. W. Beede. Well begun November 12, 1919; completed November 19, 1919. Tested November 20, 1919; yielded water full capacity of pump—125 gallons per minute.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Yellow adobe	0	35	35
Soft lime rock (caliche?)	35	38	3
Clay, adobe	38	53	15
Concrete rock	53	56	3
Crevice in rock	56	56.5	.5
Concrete in rock	56.5	58	1.5
Gravel	58	61	3
("Snow believes portions water bearing." Conglomerate.)			
Chocolate rock	61	68	7
Yellow doby	68	74	6
Yellow lime rock	74	76	2
Yellow sand rock	76	79	3
Blue shale	79	80	1

HECKET NO. 3, J. C. SNOW

Located on the Hecket estate, just north of the city limits of San Angelo. Started November 24, completed December 8, 1919. On test with 5⅝, working on 6-inch water pipe for one hour and twenty minutes. Well pumped at a rate of 25 to 30 gallons water per minute. Submitted by Dr. J. W. Beede.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Chocolate soil	0	12	12
White chalk	12	17	5
Yellow doby	17	23	6
White	23	28	5
Yellow doby	28	37	9
Gray doby	37	49.75	12.75
Gray lime rock	49.75	50	.25

	Depth in Feet		
	From	To	Thickness
White doby	50	58	8
Concrete rock, soft in places	58	59.5	1.5
Concrete rock	59.5	67	7.5
Yellow rock	67	69.5	2.5
Yellow sand	69.5	70	.5
Yellow rock	70	70.5	.5
Yellow doby	70.5	77	6.5
Red shale	77	79	2
Yellow doby	79	81	2
Blue sand rock	81	88	7

LLANO NO. 1, MARLAND OIL COMPANY

Located on Llano County School Land, H. L. Fannin Survey, 330 feet from the south line and 2,310 feet from the west line of Section 11. Tom Green County. Elevation 2,070. Casing record: 15-inch at 250 fee, 12½-inch at 610 feet. Cable tools. 8/13/27.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Lime	0	30	30
Sand, light medium	30	35	5
Lime, grey, hard	35	40	5
Lime, white	40	70	30
White shale	70	115	45
Sandy, lime	115	130	15
Red shale, 3 BW fresh WPH	130	140	10
Red shale	140	168	28
Gray lime	168	178	10
Brown shale	178	200	22
Gray shale	200	218	18
Sandy shale and lime shells	218	235	17
Gray shale, 3 B fresh WPH at 280	235	315	80
Red shale	315	386	71
Blue shale	386	390	4
Red shale	390	500	10
Blue shale	500	515	15
Sand	515	525	10
Gray shale	525	530	5
Water sand, white, HFW	530	550	20
Gray shale	550	570	20
Gray shale and lime shells, 4 B Salt WHP	570	595	25

	Depth in Feet		
Gray water sand	595	606	11
Lime and shale	606	620	14
Gray shale	620	630	10
Brown shale	630	670	40
Gray shale	670	675	5
Lime and shale	675	720	45
Brown shale	720	735	15
Gray lime	735	745	10
Blue shale and lime shells	745	760	15
Gray lime	760	812	52
Shells	812	828	16
Brown shale	828	842	14
Grey lime	842	880	38
Blue shale and shells	880	890	10
Red shale	890	905	15
Gray lime	905	915	10
Gray shale	915	917	2
Gray lime	917	940	23
Brown shale	940	970	30
Gray lime, hard	970	989	19
Gray lime and shale	989	993	4
Brown shale	993	1042	49
Gray lime, hard	1042	1075	33
Lime shells and shale	1075	1090	15
Gray lime, hard	1090	1127	37
Lime shells, grey shale	1127	1142	15
Gray lime, hard	1142	1152	10
Hard gray lime, thin shale	1152	1250	98
Gary lime, hard	1250	1362	12
Gray shale	1362	1368	6
Shale and lime	1368	1378	10
Gray lime, hard	1378	1410	32
Lime and shale	1410	1460	50
Shale and lime shells, cavy	1460	1490	30
Gray lime, hard	1490	1498	8
Shale	1498	1500	2
Lime	1500	1510	10
Hard, gray lime	1510	1548	38
Gray lime, medium	1548	1665	117
Blue slate and lime shells	1665	1685	20
Gray lime, hard	1685	1712	27
Shale and lime shells	1712	1725	13
Lime, hard	1725	1750	25
Black shale	1750	1755	5

Lime	1755	1820	65
Broken lime and shells	1820	1844	24
Lime and shale	1844	1850	6
Lime, some water about 1900 feet	1850	1910	60
Lime	1910	1930	20
Lime shells	1930	1950	20
Lime, more water at 2015	1950	2055	105
Lime, hard	2055	2060	5
Lime, dark gray	2060	2080	20
Broken lime shells	2080	2160	80
Lime shells	2160	2180	20
Lime, dark, hard	2180	2230	50
Sand	2230	2244	14
Dark lime and shale	2244	2258	14
Dark lime, hard	2258	2267	9
Gray lime, soft	2267	2290	23
Broken lime	2290	2311	21
Gray lime, hard	2311	2340	29
Gray lime	2340	2380	40
Sandy lime, dark	2380	2395	15
Dark gray lime, hard	2395	2422	27
Gray lime	2422	2435	13
Broken lime	2435	2445	10
Lime shells	2445	2468	23
Lime and shale	2468	2475	7
Lime, dark, and gypsum	2475	2485	10
Lime and shale	2485	2500	15
Shells, broken	2500	2510	10
Broken lime, light	2510	2520	10
Lime shells	2520	2530	10
Gray lime	2530	2538	8
Broken lime	2538	2560	22
Lime, gray	2560	2585	25
Broken lime	2585	2615	30
Lime	2615	2620	5
Gray lime, some water 2660–2670	2620	2652	32
Dark lime	2652	2668	16
Dark gray lime, hard at 2745	2668	2775	107
Light sandy lime	2775	2785	10
Gray lime, dark	2785	2793	8
Light gray lime	2793	2825	32
Sandy lime, white	2825	2830	5
Lime	2830	2835	5
Soft gray lime, water at 2865–2885	2835	2880	45

Hard gray lime	2880	2925	45
Sandy lime	2925	2990	75
Gray and light lime	2990	3006	16
Water sand	3006	3010	4
Hard, dark, gray lime	3010	3074	64
Gray lime, hard; water sand 2995	3074	3080	6
Water sand	3080	3105	25
Shale	3105	3110	5
Slate	3110	3115	5
Lime, gray, hard at 3129	3115	3134	19
Dark gray lime	3134	3143	9
Gray sandy lime	3143	3159	16
Shale	3159	3163	4
Shale and lime shells	3163	3174	11
Shale caving	3174	3179	5
Broken lime	3179	3187	8
Gray lime, water at 3191	3187	3206	19
Black gumbo	3206	3208	2
Gray lime, soft at 3242	3208	3242	34
Sand, HFW	3242	3245	3
Sand	3245	3265	20
Hard gray lime	3265	3270	5
Water sand, sulphur	3270	3282	12
Shale	3282	3300	18
Lime	3300	3304	4
Sand, water, sulphur	3304	3315	11
Sand	3315	3327	12
Hard lime	3327	3334	7
Loose sand	3334	3342	8
Hard gray lime	3342	3346	4
Shale	3346	3362	16
Brown lime	3362	3385	23
Lime	3385	3390	5
Gray lime	3390	3395	5
Shale	3395	(?)	(?)
Soft lime	(?)	3420	(?)
Lime and shale	3420	3475	55
Lime, water, sulphur	3475	3505	30

PLATES I–V

Plate I

Fig. 1. Blaine sandstone resting on San Angelo sandstones, contact near the base of the fence posts.

Fig. 2. Fossiliferous dolomites of the upper San Angelo formation. Blaine sandstone at the top. About one-half mile east of the Twin Buttes.

Fig. 3. Exposure of cream-colored Blaine sandstones. About one mile southwest of the Twin Buttes.

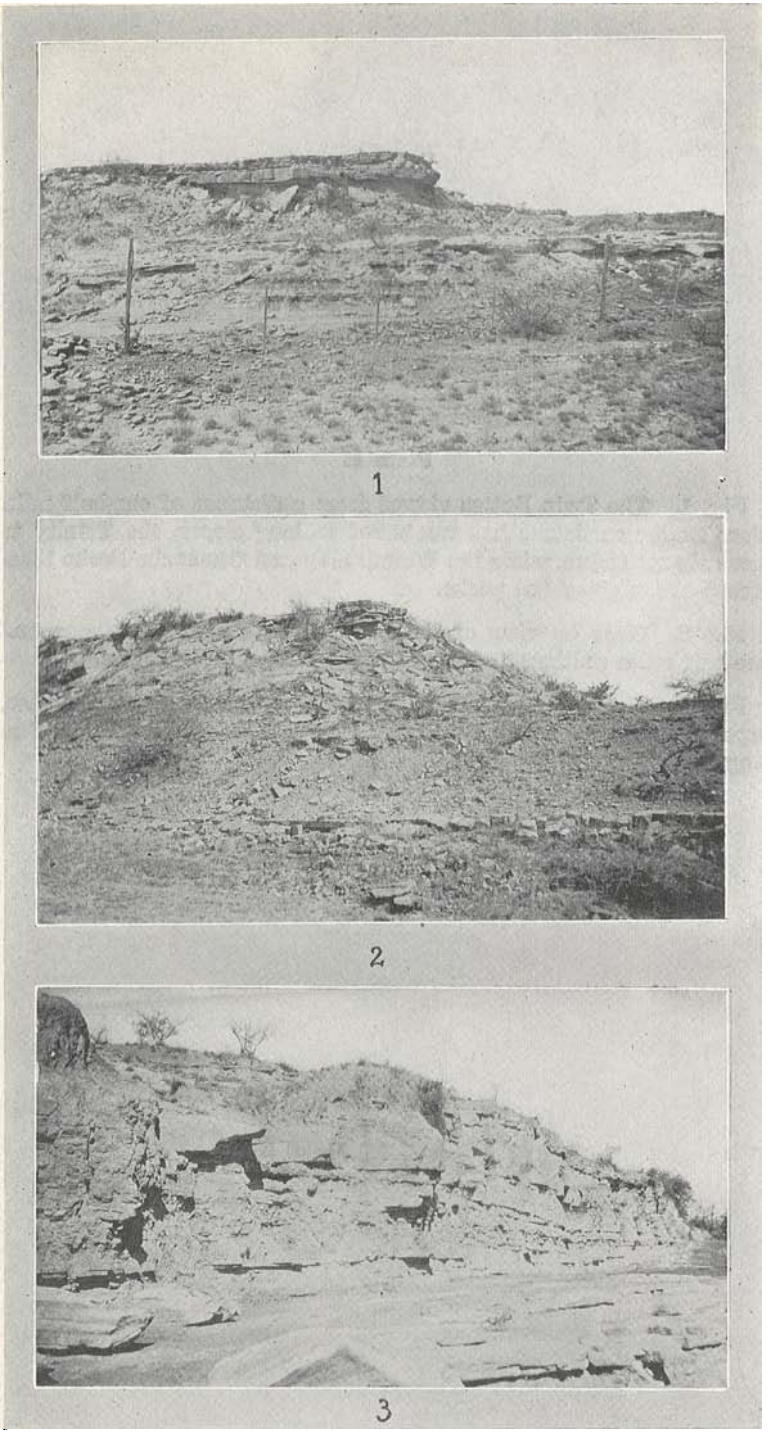

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Plate II

Fig. 1. The Twin Buttes viewed from a dictance of one-half mile. Here Blaine sandstone has weathered to long slopes, the Trinity to more abrupt slopes, while the Walnut clay and Comanche Peake limestones are capping the peaks.

Fig. 2. Close up view of the San Angelo conglomerate, one and one-half miles southeast of the Devil's Courthouse Mountain.

Fig. 3. The San Angelo sandstone with conglomerate at the base, exposed one mile below the Seven-Mile Bridge southwest of San Angelo.

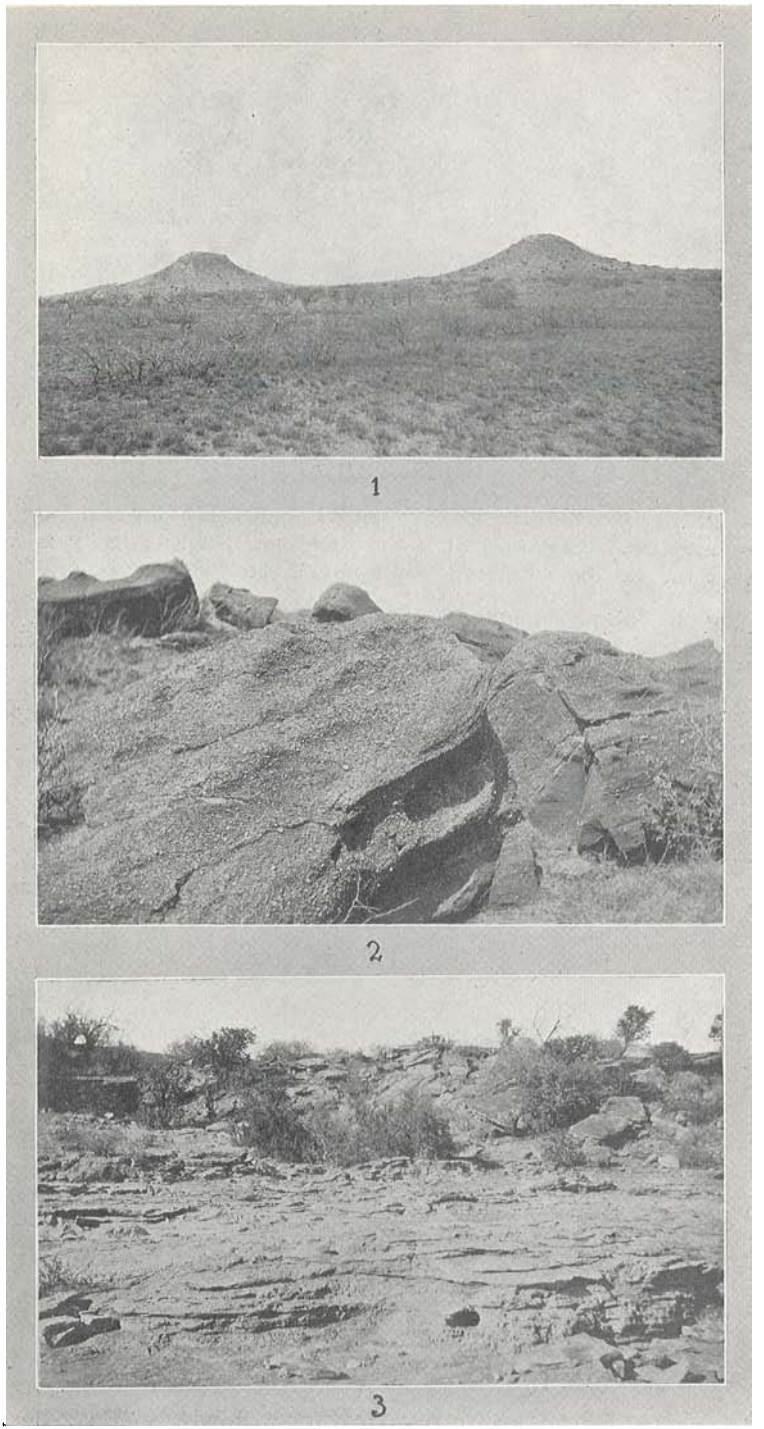

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Plate III

Fig. 1. Contact of the red clay and thin dolomites of the San Angelo formation and cream-colored Blaine sandstones, unconformity is at top of the red clay. One mile southwest of the Twin Buttes.

Fig. 2. Steeply dipping beds in Blaine sandstones on Abe Mayer Ranch, just across the line in Irion County, along Middle Concho River.

Fig. 3. Local unconformity in the Blaine sandstones along Grape Creek on the March Ranch, north central part of Tom Green County. Asphaltic sandstone is exposed just above this.

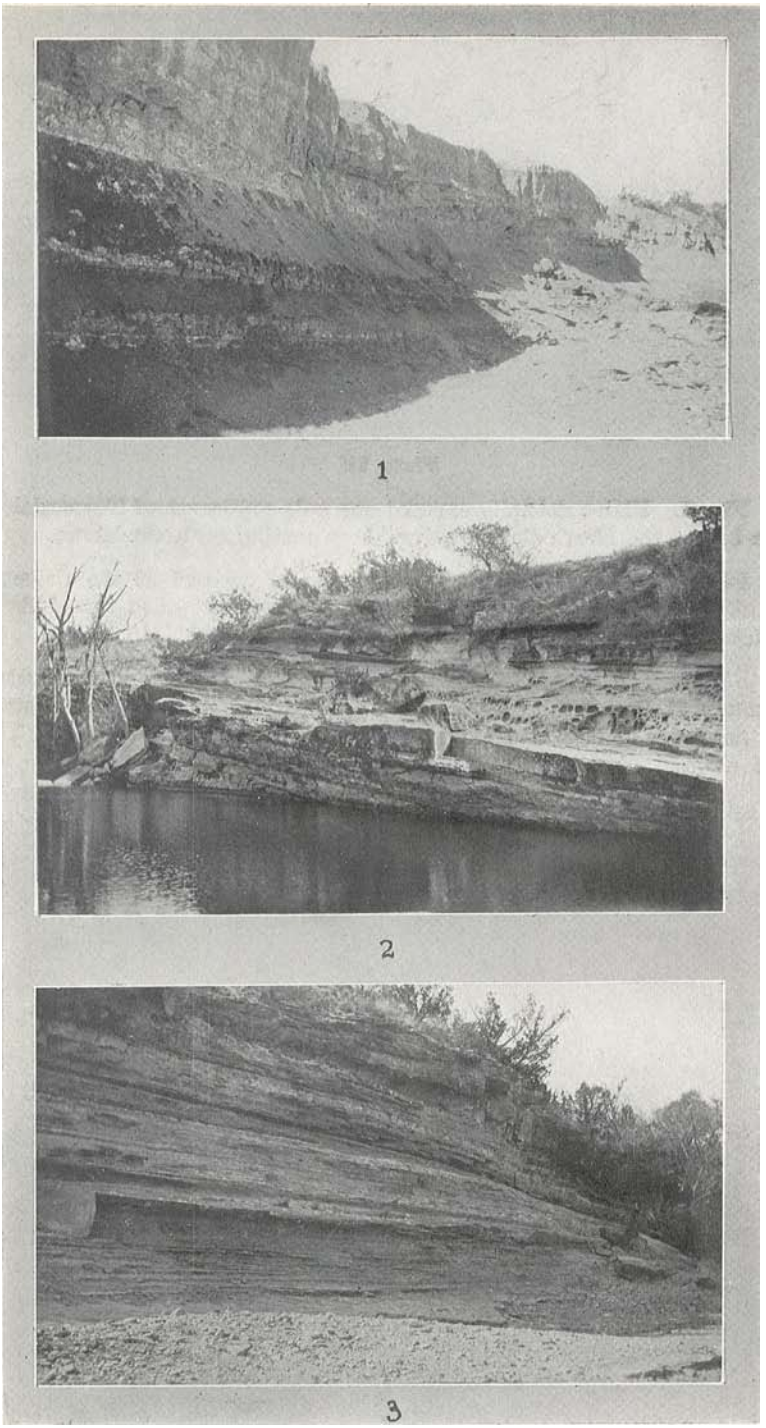

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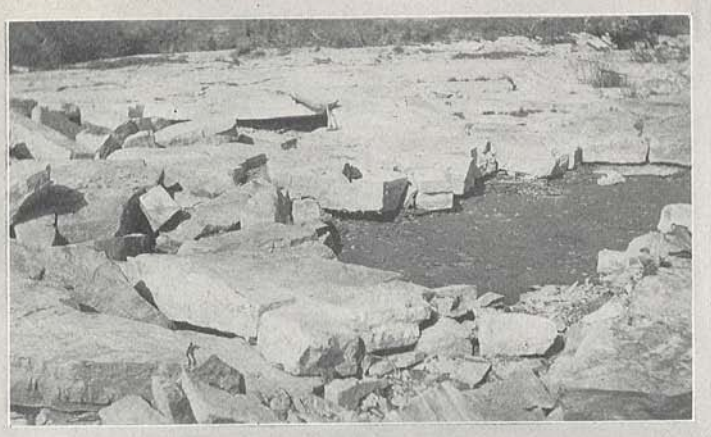
Plate IV

Fig. 1. Blaine dolomite exposed one mile southwest of Turnerdale in bed of the North Concho River, here resting on a sandstone.

Fig. 2. Bluff of Pleistocene conglomerate exposed at the Orient Railroad bridge at San Angelo, shown as heavy ledges at top of the picture, Choza dolomites at lower left corner.

Fig. 3. Limestones of the Choza formation, exposed in the rock quarry at Ben Ficklin, three miles southeast of San Angelo. Note general dip of beds and pinching out of layers.



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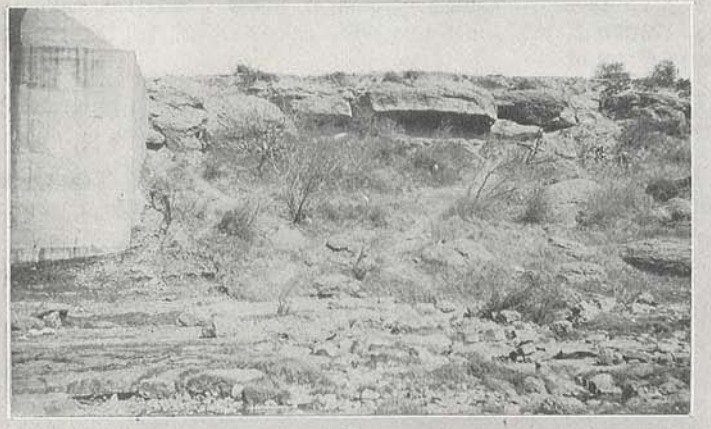

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Plate V

Fig. 1. Merkel dolomite horizon of Choza formation, exposed on the Johnson Ranch about two miles southeast of the Devil's Courthouse Mountain.

Fig. 2. Basal Trinity conglomerate, exposed eleven miles north of San Angelo to the east of the Robert Lee road.

Fig. 3. Close up view of botryoidal, cross-bedded Trinity sandstone. Found in many different localities in the county.

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