OKLAHOMA GEOLOGICAL SURVEY
Chas. N. Gould, Director

Bulletin No. 40-DD

OIL AND GAS IN OKLAHOMA

GEOLOGY OF COMANCHE COUNTY

By
Frank Gouin

NORMAN
June, 1928

CONTENTS

ILLUSTRATIONS

FOREWORD

In 1917 the Oklahoma Geological Survey issued Bulletin 19 part 2 entitled, "Petroleum and Natural Gas in Oklahoma." This volume was so popular that the supply was soon exhausted, and for several years copies have not been obtainable.

The present director has seen the need of a revision of this bulletin. On account of lack of appropriations he has not been able to employ sufficient help to compile the data, and has called on some twenty representative geologists throughout the state to aid in the preparation of reports on separate counties. These gentlemen, all busy men, have contributed freely of their time and information in the preparation of these reports.

It will be understood that the facts as set forth in the various reports represent the observation and opinion of the different men. The Oklahoma Gological Survey has every confidence in judgment of the various authors, but at the same time the Survey does not stand sponsor for all statements made or for all conclusions drawn. Reports of this kind are, at best, progress reports, representing the best information obtainable as of the date issued and doubtless new data will cause many changes in our present ideas.

Mr. Frank Gouin, the author of this report is also the author of Bulletin 40-E, on Stephens County, Oklahoma. Mr. Gouin has had wide experience in the oil and gas geology of this part of the State and is therefore well qualified to write a report on Comanche County.

June, 1928.

CHAS. N. GOULD,
Director.

IL AND GAS IN OKLAHOMA

COMANCHE COUNTY

INTRODUCTION

In previous reports the writer has stressed the importance of keeping samples of formations encountered when drilling wells and most especially all wildcat wells. A set of samples from a rotary drilled well, if continuous, can be interpreted as successfully as a set from a well drilled with standard tools. A knowledge of paleontology is not essential for a study of the pre-Carboniferous rocks in southwestern Oklahoma. Many conclusions now inferred from the logs of wells drilled in the past would be definite had cuttings been preserved. For those not having facilities for the examination of cuttings, the Department of Geology of the State University is well equipped to perform such work. Also several of the larger oil companies maintain well equipped laboratories for the special study of well cuttings.

The writer hopes that a reading of this report will demonstrate that the information based on well samples is of value and that the lack of such samples is regretable. As stated in previous reports if this results in a little more attention being paid to this phase of the oil business he will feel that his feeble efforts have been rewarded.

Location

Comanche County is located in southwestern Oklahoma. It includes all or parts of the townships included in the area from T. 2 S., to T. 4 N., inclusive and from R. 9 W., to R. 15 W., inclusive. Its area

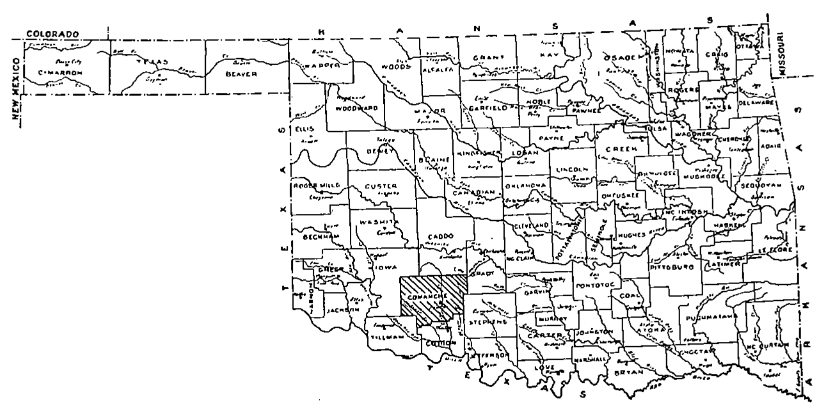


Figure 1. Index map of Oklahoma showing location of Comanche County.

is about 1,083 square miles. It is bounded on the north by Caddo and Kiowa counties, on the east by Grady and Stephens counties, on the south by Cotton and Tillman counties, and on the west by Tillman and Kiowa counties. Lawton, the county seat, with a population of about 9,000, is located just southeast of the center of the county. The old historic army post, Fort Sill, is located some six miles north of Lawton. The post and military reservation is now an army School of Fire for Field Artillery officers training. Both the Chicago, Rock Island, and Pacific, and the St. Louis and San Francisco railroads traverse the county.

Acknowledgments

The writer wishes to acknowledge the following individuals who have assisted greatly in making this report possible: To Sidney Powers and Dollie Radler of the Amerada Petroleum Corporation for furnishing the base maps; to F. A. Bush of the Sinclair Oil and Gas Company; Frank Clarke, and L. K. Foley of the Mid-Kansas Oil & Gas Company for information on well samples; to T. B. Gilbert, superintendent of the Duncan district of the Magnolia Petroleum Company for production statistics used, and to the numerous geologists and operators from whom the writer has secured miscellaneous information and ideas. Finally to Chas. N. Gould and his staff in the office of the Oklahoma Geological Survey for their valuable assistance and suggestions.

Literature

The earliest detailed report on the geology of Comanche County is that of J. A. Taff, assisted by E. O. Ulrich and Chas. N. Gould, in Professional Paper 31 of the United States Geological Survey, published in 1904. This work has lately been republished by the Oklahoma Geological Survey as Bulletin 12, entitled, "Preliminary Report on the Geology of the Arbuckle and Wichita Mountains in Indian Territory and Oklahoma". The field work for this report was done in 1900 and 1901. The facts as set forth in this paper not only form the foundation stone of the geology of Oklahoma, as stated in the foreword to the reprint by the Oklahoma Geological Survey, but the work was so thoroughly handled that to this day there has never been any question as to its accuracy even to the smallest detail. For this reason, much material for this report is copied from Taff's work verbatim.

The only other report that goes into detail on the geology of the county is that by C. H. Wegemann entitled "The Lawton Oil and Gas Field, Oklahoma," published as a part of bulletin 621 by the U. S. Geological Survey in 1915. That part of Bulletin 19, Part 2 of the Oklahoma Geological Survey, "Oil and Gas in Oklahoma," covering this county is largely a reprint of Wegemann's report. There are numerous references in the literature to the geology of the county, an excellent bibliography which can be found in Oklahoma Geological Survey, Bulletin 12, January, 1928.

Topography

Comanche County has both the mountain and red beds plains topography. The Witchita Mountains extend from Fort Sill northwest through the county, occupying the northwest quarter of the county. The rolling country of the red beds plains occupies the remainder of the county. The elevations of the tops of the most prominent peaks is over 2,000 feet, while that of the plains averages from 900 to 1,000 feet. All of the drainage is to the south into Red River, West Cache Creek draining the western part, Cache Creek the central part, and Beaver Creek the eastern part.

GEOLOGY

Stratigraphy

Surface Rocks

The surface rocks exposed in the county belong to the pre-Cambrian, Cambrian, Cambro-Ordovician, and Permian (Plate I). The following descriptions of the pre-Permian surface rocks are quoted from Taff's[1] report.

IGNEOUS ROCKS

> In the general survey of the Wichita Mountains only sufficient time was available to study the salient features of the igneous rocks. The kinds of igneous rocks which occur abundantly or in large masses were distinguished, classified in respect to age as far as conditions would permit, and mapped. Local variations of the larger masses and various phases of the dike rocks were noted and specimens collected, but a study of their relations in detail was not attempted. The rocks collected were submitted to Mr. Ernest Howe, of the Geological Survey, for study, and the petrographic descriptions are from his report.
>
> The igneous rocks of the Wichita Mountains are separated into four general classes, distinguished by their large mass or abundant occurrence, and also by their age relations. These, in order of apparent age, are, gabbro and related anorthosite, granite and related aplites, granite-porphory and associated aporhyolite, and diabase dike rocks.
>
> * * * *
>
> The prevailing physical aspect of the gabbro is that of a dark-gray to black, rather coarsely crystalline, rock. The gabbro proper consists of labradorite, augite, and magnetite with a little

1. Taff, J. A., Preliminary Report on the Geology of the Arbuckle and Wichita Mountains in Indian Territory and Oklahoma, U. S. Geol. Survey, Prof. Paper 31, 1904; also, Oklahoma Geol. Survey, Bull. 12, 1928.

biotite and accessory titanite. It is a typical gabbro, fairly fresh, or with augite altered to uralitic hornblende.

The rocks which on close study have proved to be anorthosite were collected as phases of the gabbro, and occurred near the contact with the granite or near dikes of granite or aplite. Between the anorthosite and the gabbro a continuous gradation can be made out, even in hand specimens. The specimens of anorthosite collected show a reddish, greenish, or bluish-gray rock, with lath-shaped crystals of labradorite.

* * * *

GRANITE AND ASSOCIATED APLITE

Granite is the principal mountain-making rock in the Wichita region. Its area is greater than that of all the other igneous rocks combined, and is about equal to that of the others and the older Paleozoic sediments. It makes all of the high land of the Wichita, Quana, Devils Canyon, and Headquarters mountains, and a large part of the Raggedy group.

The relations of the granite to the gabbro indicate that the granite is younger and that it intrudes the gabbro. Both occur in large masses, as shown, and the gabbro is cut by a great number of granite or aplite dikes, which in many cases can be traced from the granite mass.

In physical aspect this granite varies from dark red to light pink and from moderately coarse to finely granular. A representative of a large part of the granite mass is found in Mount Scott, which consists of a rather deep-pink, even-textured, and moderately fine-grained (granite).

* * * *

The granite in its various phases is rich in orthoclase and quartz, with relatively subordinate amounts of the dark silicates, hornblende, augite, or biotite. The majority of the specimens studied are from dikes cutting the gabbro or very near the contact of the granite with the gabbro. A specimen from the top of Mount Scott may be taken as typical of the granite as a whole. It is a medium coarse-textured rock, to which the feldspar gives a dominant red color, which is varied by small spots of a dark-greenish mineral and grains of quartz. The microscope shows that orthoclase and quartz in nearly equal amounts and together make up by far the greater part of the rock. A little hornblende also occurs, and accessory magnetite, apatite, and zircon. Although not evident in hand specimens, the rock is seen to have a crude porphyritic structure when examined under the microscope. The feldspar occurs in large phenocrysts, surrounded by quartz and feldspar in micropegmatitic intergrowths. The dark, turbid character of the feldspar is to be attributed to finely divided hematite which fills the crystals as a dust.

GRANITE-PORPHYRY

A class of rocks apparently closely related to the granite composes practically all of the Carlton Mountains, the igneous mass lying between the limestone hills in the vicinity of Blue Canyon, north of Mount Scott, and some hills near the northwest end of the limestone areas east of Rainy Mountain Mission. They vary from brick red to shades of light pink. The porphyritic character is variable, and specimens may be selected which have a near resemblance to certain parts of the granite, but on the whole the masses designated granite-porphypry are different from those described as granite.

Megascopically the rock appears to be a rather coarse-grained and largely feldspathic porphyry. With the exception of the feldspar phenocrysts, there seem to be usually no real crystal grains, the remainder of the rock consisting of a dense felsitic groundmass. Rarely a specimen is found which shows occasional small quartz grains. A microscopic examination shows, with the exception of a very little altered hornblende, the rock is composed almost entirely of spherulitic aggregates of feldspar and micropegmatite, often grouped about small crystals of feldspar. A little quartz also occurs, in grains.

In some instances the feldspars have a faint zonal structure, but these and a small proportion of the others, presumably plagioclase, are undeterminable on account of their decomposition. The greater part of the feldspar is orthoclase. The above description applies to the rock of Carlton Mountain, on Medicine Creek, near the western side of sec. 28, T. 3 N., R. 12 W.

* * * *

DIABASE

The gabbro, granite, and granite-porphyry, the only igneous rocks in the Wichita region which are known to occur in large masses are cut by great numbers of diabase dikes. These dikes range in thickness from several feet to thin stringers. They cross the contact between the granite and the gabbro and intersect the granite dikes at the gabbro.

The diabase dikes extend in various directions, but sufficient time was not given to their study to determine whether they conform to any system of arrangement. Dikes of the same texture and color penetrate one another at various angles, but whether they are of one or more generations was not ascertained.

The diabase ranges from a moderately fine-grained dark-gray to fine-textured bluish-black rock. As a rule, the larger the dikes the coarser the texture. A thick and apparently neck-like dike in the granite-porphyry of Blue Creek Canyon has a texture approaching that of the average gabbro.

Petrographically these dike rocks have the typical structure and mineral composition of diabase. One specimen, from a dike 18 inches wide cutting both gabbro and granite, contains, in addition to labradorite, augite, and magnetite, a considerable amount of a brownish-yellow mineral which is evidently an alteration product, but which possesses the optical characters of serpentine, and was probably derived from olivine, as outlines of olivine crystals are still to be made out. The ophitic structure of the rock is emphasized by this mineral, for it partly surrounds the laths of labradorite after the manner of the augite.

A number of diabase dikes were noted intruding the granite-porphyry of the Blue Creek Canyon area near the Cambrian contact, and pebbles, both of granite-porphyry and of diabase, make conglomerate beds in the Reagan formation, which is in the oldest sedimentary deposit of the region, being middle Cambrian in age. Thus all the evidence of the age of the igneous rocks so far obtainable indicates that they are older than middle Cambrian, and, since granites form only at considerable depths or under great pressure, the inference is that they are much older than middle Cambrian.

* * * *

SEDIMENTARY ROCKS

In the Wichita region and the Arbuckle Mountain region the formations below the "Red Beds" agree in all essentials, both in lithologic characters and in age, in so far as they are exposed, and are of essentially the same thickness. Therefore, the classification and the formation names employed for the Arbuckle region are used also for the Wichita Mountains.

CAMBRIAN ROCKS

Reagan Sandstone.—The Reagan sandstone is the lowest Cambrian formation in the Wichita region, and it rests on the eroded uneven surface of the granite-porphyry, from which most of its materials have been derived. The formation is known to outcrop in this region in but four areas. The largest of these lies on the northeastern side of the large mass of porphyry east of Blue Creek Canyon and is beneath the thick section of the Cambro-Ordovician limestone, which follows in regular stratigraphic succession. The other three areas are near the northwestern end of the group of limestone hills, 8 to 12 miles northwest of and in the strike of the large area near Blue Creek Canyon. The same granite-porphyry either is exposed near by or is in contact beneath the Reagan sandstone and the Cambro-Ordovician limestone. Between the smaller outcrops of the Reagan sandstone, as well as in many other places where the succeeding limestone indicates that it should occur, the Reagan sandstone is concealed by the wide-spread "Red Beds" deposits. In all the occurrences cited the Reagan sandstone dips in a northeasterly direction and is so aligned in strike as to show, without doubt, that it is continuous beneath the "Red Beds."

In a part of the larger area east of Blue Creek Canyon the Reagan sandstone is repeated in parallel belts by faulting. The fault approaches the stratified rocks in the porphyry from beneath the "Red Beds" bearing nearly due northwest. The downthrow is toward the southwest, giving sufficient displacement to bring the whole section of the Reagan sandstone against the belt of porphyry which occurs between the duplicate outcrops of the sandstone. The displacement due to faulting decreases toward the northwest and comes to an end near the northwest corner of sec. 1, T. 4 N., R. 13 W. The normal dip of the rocks is toward the northeast, varying from a few degrees to about 25°. Next to the fault on the southwest or downthrown side there is a reverse dip, due to the upward flexing of the strata in the faulting, which is sufficient to produce a narrow synclinal fold a mile or more in length, ending in a spoon-like form, with porphyry upon each side and beneath. The Reagan sandstone is softer than either the porphyry beneath it or the succeeding Arbuckle limestone. In consequence it forms the base and northeast side of valleys, and forms bluffs and steep slopes in which the rocks are admirably exposed.

* * * *

The Reagan sandstone is approximately 300 feet thick and is composed of hard and soft sandstone, grit, conglomerate, shales, and siliceous shell limestones. The section of the formation is essentially the same as in the western end of the Arbuckle Mountains. In each case porphyry is beneath it, and the limestone which overlies the Reagan is of the same nature and contains the same fossil fauna. In both localities the Reagan formation is made up of conglomerate composed of porphyry pebbles and included basic rocks, gritty light-brown to gray and greenish sandstones, greenish clay shales, and siliceous limestones, interstratified. The limy layers contain many species of Cambrian fossils, which were carefully collected, but which have not yet been thoroughly studied. The conglomerate occurs invariably near the base as local beds or lentils, while the calcareous sandstone and limestone beds are without exception in the upper part of the formation.

* * * *

CAMBRO-ORDOVICIAN ROCKS

Arbuckle limestone.—Above the Reagan formation in conformable succession is a great limestone section essentially the same as the Arbuckle formation in the Arbuckle Mountains, where the lower part, practically the lower third, was found to be Cambrian, and the upper two-thirds Ordovician in age. Near the transition zone, between the rocks of the two periods, very few fossils have been found, so that precise distinctions as to age can not be made at the present time. The same conditions of deposition seem to have occurred in the Wichita region as in the Arbuckles, and the rocks must be classified in the same manner. There seems to be no reason to doubt that the formation is continuous from one region to the other beneath "Red Beds" deposits.

With the exception of three small areas near Rainy Mountain Mission (not located in Comanche County), all the limestones found in the area mapped belong to the Arbuckle formation. There are certain thin limy strata in the "Red Beds" which do not resemble the older limestones and have not been mapped. The Arbuckle limestone is composed of practically continuous succession of limestone beds, usually less than 5 feet in thickness and aggregating 4,000 to 6,000 feet. The individual beds vary from dense, fine-grained white limestone to cream-colored dolomitic limestones interstratified with slightly argillaceous and siliceous lime beds, which are usually not so hard. Occasionally cherty limestones, and more rarely thin beds of chert, occur. As a result of the variable hardness of the beds, the more resistant ones have a relief which rarely exceeds 5 or 6 feet. A complete section of the formation is not exposed in the region. The thickest exposure found is northeast of Blue Creek Canyon, where the rocks outcrop in regular succession from the base upward for nearly three miles. The dip is approximately 20° NE., and approximately 4,000 feet of this limestone are exposed. It is estimated that the same thickness is exposed in the long arm of limestone hills outcropping northwestward from Blue Creek Canyon. Neither the top nor the base of the limestone, has been found in the hills west of Blue Creek Canyon. The lowest limestones exposed beneath the "Red Beds" at the southwestern side, however, are near the base and those of the northeastern side are toward the top.

The elongated limestone hills at the northeastern part of T. 5 N., R. 15 W., and in the southwestern portion of T. 6 N., R. 15 W., belong most likely below the middle of the section, as determined by the abundant fossil remains and by the position in the strike of the central part of the section exposed in the large limestone mass toward the southeast. Likewise the limestones occurring at the quarries southeast of Fort Sill, south of Signal Mountain, and farther west at the eastern end of the Quana Mountains, belong below the middle of the Arbuckle formation. The limestone in the hills south of Signal Mountain and farther west yields an abundant fauna of upper Cambrian and lower Ordovician age, closely related to that of the quarries at Fort Sill and of the limestone hills 3 to 6 miles southeast of Rainy Mountain Mission. The Arbuckle limestone north and east of the porphyry in T. 6 N., R. 14 W., is in the lower and middle part of the formation and belongs to the Cambrian and lower Ordovician parts of the section.

PERMIAN ROCKS

The Permian beds in the county belong to the Hennessey, Garber, Wellington, and Enid of the Oklahoma section or to the Wichita-Albany, Clear Fork, and Double Mountain of the Texas section[3]. A fairly close correlation is that the Hennessey and Garber formations are the equivalent of the Wichita-Albany, the Wellington the equivalent of the Clear Fork, while the Double Mountain is thought to be the equivalent of the Enid[4].

Wichita-Albany Formation. Only the upper part of the Wichita-Albany formation is exposed in the county, that area being in the southeastern part. This is the formation shown as the "red sandstone" traversing Stephens County on the areal map of the State[5]. This formation is made up of red clay shales, sandstones, and red mudstone conglomerates and is usually wooded with blackjack oak. This is a tentative correlation by the writer. However, this group of rocks could be basal Clear Fork.

Clear Fork Formation. The Clear Fork formation is exposed over all the remainder of the county not covered by the Wichita Mountains and that part of the northeastern part of the county covered by rocks of the Enid or Double Mountain formation. This is the formation shown as "calcareous shale" across Stephens County on the areal map of Oklahoma. The formation consists of red and gray clay shales, and lenticular red and gray sandstones. It is quite conglomeratic between and around the granite peaks of the Wichita Mountains. The Wichita-Albany—Clear Fork contact extends southwest from this county through Tillman County, crossing Red River in T. 5 S., R. 15 W., south-

3. Gould, Chas. N., The correlation of the Permian of Kansas, Oklahoma, and northern Texas: Bull. Amer. Assoc. Pet. Geol., vol. 10, no. 2, 1926.
Index to stratigraphy of Oklahoma: Oklahoma Geol. Survey, Bull. 35, 1925.
4. Aurin, F. L., Officer, H. G., and Gould, Chas. N., The subdivisions of the Enid formation: Bull. Amer. Assoc. Pet. Geol., vol. 10, p. 786, 1926.
5. Miser, Hugh D., Geologic map of Oklahoma: (Scale, 1:500,000) U. S. Geol. Survey, Geologic Atlas of the United States, State of Oklahoma, 1926.

west of the town of Grandfield. The outcrop of this formation is rarely wooded.

Enid (Double Mountain) Formation. Members of the Enid formation are exposed across the northeast corner of the county, all having a northwest-southeast line of outcrop. Named in ascending order, they are; Duncan sandstone, Chickasha formation, Blaine formation, Whitehorse sandstone, and Cloud Chief gypsum. A description of these formations is so well given in other publications that this will not be discussed here. However, it might be of interest to state here that aside from the great lithological difference in these formations they are alternately favorable or unfavorable to the growth of blackjack oak so that they can be traced by means of vegetation alone. Blackjack does not grow on the Duncan sandstone except where the Chickasha formation has eroded down over it in stream re-entrants. However, blackjack grows luxuriantly on the Chickasha formation, is not present on the Blaine, but again appears on the Whitehorse. From Comanche County to the east end of the Anadarko basin the Dog Creek shale is non-existent, the Whitehorse sandstone resting directly upon the topmost gypsum member of the Blaine. This has been verified by core drilling to the east in Stephens County.

SUBSURFACE ROCKS

The only clue to the nature of the subsurface rocks in the county is from the information obtained from wells drilled in and close to its limits. Many of these wells were drilled before it was the custom to save samples so it is necessary to interpret the logs of these wells by keeping in mind the anticlinal structure of the Wichita Mountain folding with the subsequent truncation that has taken place.

ORDOVICIAN

Simpson formation and Viola limestone. Since the Viola limestone and Simpson formation are exposed near Rainy Mountain Mission just north of the northwest corner of the county, and since the Simpson has been encountered in wells just to the north of this Viola outcrop it is assumed that both the Simpson formation and Viola limestone are present in the northeast corner of the county. The writer has no knowledge of any well having encountered these formations in this county as they are absent over most of this area; while, if they are present in the northeast corner of the county, they are at depths greater than wells have been drilled in that area.

There are probably no post-Ordovician—pre-Pennsylvanian rocks present in the county for this area is thought to be south of the deposition of such sediments.

PENNSYLVANIAN

Pre-Pontotoc. That section of rocks which is the equivalent of the Glenn formation is represented in the county only in the northeast corner, the east edge, and the southeast corner. Its maximum thickness is unknown for it has not been drilled through in places where it should be the thickest. It overlaps the older formations around the east edge of the Wichita Mountain uplift. In places where it is present it is a formation made up of blue shales, thin limestones, and a few thin sandstones. On the south side of the uplift the section between the base of the Pontotoc and the top of the Arbuckle is probably represented by the lower part of the Pennsylvanian section. On the north side of the uplift the upper part of this section immediately below the Pontotoc may be represented by pre-Pontotoc rocks slightly younger in age.

Pontotoc. The Pontotoc formation is present in the eastern part of the county where it encircles the Wichita Mountain uplift, thickening outward from the uplift. As in northern Stephens County[6] its chief characteristic is the large percentage of brown shale in the section, in direct contrast to the brick red shales of the overlying Permian and to the blue shales of the underlying lower Pennsylvanian. Due to the proximity to the source of the material there is a large quantity of coarse, arkosic sands and gravels. In fact much of the brown shale is quite gravelly. From a formation less than a hundred feet in thickness where it abuts the pre-Pennsylvanian rocks in the western part of T. 3 N., R. 11 W., it attains a thickness of about 2,400 feet in sec. 10, T. 3 N., R. 10 W., or in less than ten miles; and a thickness exceeding 3,200 feet in sec. 26, T. 2 N., R. 9 W. In the northeastern corner of Comanche County this formation probably attains a thickness as great, if not greater, than any other place. To the northeast, on the opposite side of the Anadarko basin, a well in sec. 28, T. 11 N., R. 5 W., had 2,250 feet of Pontotoc beneath 1,950 feet of Permian, the combined thickness of the two formations being almost as great as the combined thickness of the two formations in the well mentioned above as having the greatest amount of Pontotoc. The Pontotoc is correlative with upper Cisco of the Texas section and the upper part of the Missouri group of the northern Oklahoma and southern Kansas section.

PERMIAN

Wichita-Albany. The entire Wichita-Albany group including that part exposed on the surface in the southeast corner of the county probably nowhere exceeds 1,000 feet in thickness. In many places, where resting on the lower Paleozoics, it has a thickness of less than half of that amount. The unexposed portion has characteristics in common with those given earlier in this paper in the description of the surface rocks.

6. Gouin, Frank, Geology of Stephens County, Oklahoma: Oklahoma Geol. Survey, Bull. 40-E, 1926.

Structure

STRUCTURE OF THE WICHITA MOUNTAINS

After an interval of over 25 years the words of Taff[7] leave nothing more to be said about the structure of the Wichita Mountains so the writer is quoting them here.

> The Wichita Mountain range, except the group of outlying ridges on the northeastern side and some low detached hills on the southern side, near the eastern end, is composed entirely of igneous rocks. These igneous rocks are separated into more than 250 detached areas, and form mountains and hills which range from closely connected groups of 150 square miles in area to isolated, sharp knobs which rise above the plains like islands. The numerous small igneous mountains and hills in the western half of the range are especially broken and disconnected. All these groups and mountains are surrounded by the nearly horizontal "Red Beds" deposits which extend on all sides of the range for long distances. They conceal the rocks of the Wichita Mountains to such a degree that no adequate conception can be had of the extent of the Wichita uplift. The archipelago-like arrangement of the granite mountains and peaks in the plain leaves one to assume that only a small part of the igneous core of the Wichita uplift is now exposed.
>
> EVIDENCE OF DISTURBANCE IN THE IGNEOUS ROCKS
>
> These igneous masses of the Wichita Mountains possess certain general, yet pronounced structural features. The granite has been intruded through the gabbro, in part at least, and spread out in a broad way upon it. Where the erosion of Permian and more recent times has uncovered the gabbro in what is now the generally level plain, the gabbro areas are found to be oriented in a direction approximately N. 60° to 70° W., as would be the case if the gabbro had been arched in the axial part of an uplift. The larger areas of granite, especially in the Wichita and Quana mountain groups, and also a great number of the smaller ones, are found to be oriented in the same general northwest-southeast direction.
>
> In the strike of the principal ridges and lines of peaks and hills there are marked zones of fracture or of major jointing. These lines of jointing are especially pronounced in the western part of the Wichita group, south of Mount Baker. The same structures were also noted near the eastern end of this group, east of Mount Cummins, and in the porphyry of Carlton Mountains. In the western part of the range the major joints are generally nearly vertical, while in the eastern part they are inclined toward the south at an angle of 30° to 40°. This inclined jointing is so marked in the eastern end of the Carlton Mountains, and in the granite east of Mount Cummins, that at a distance it resembles pronounced stratification. Such structures, causing variable weaknesses in the igneous rocks, were emphasized to a marked degree by agents of degradation before the present drainage system was established. Especially pronounced instances are found in the large resurrected Permian valley leading southeastward from Military Pass between the Wichita and

7. Taff, J. A., op. cit, pp. 85-88.

Quana mountain groups. Other instances of less pronounced character occur in the southern part of the Wichitas south of Mount Baker, where the ridges and valleys are oriented in the general strike of the range. These major structural lines would naturally be concealed to a greater extent in the large area of isolated mountains and hills making the western half of the range. Many of these mountains, however, and even some of the smaller ones, show pronounced major joints in zones of crushed rocks bearing in northwesterly directions. Such occur in Elk Mountain and are especially marked in Twin Mountains. Aside from the major jointing, it will be observed by reference to the map that with a few exceptions these igneous mountains and even small hills have their long axes arranged in directions generally northeast and southwest. This is doubtless due to the survival of the more resistant zones of the igneous mass parallel with the lines of weakness. Conspicuous jointing occurs in other directions than northwest and southeast, the most pronounced being north and south, across the trend of range.

FOLDING AND FAULTING OF THE STRATIFIED ROCKS

In the stratified rocks on the northeastern side and near the eastern end of the range the structures are more pronounced and easily interpreted. These rocks occur in a small part of the Wichita Range, and, as explained above, are probably but a small part of the uplift. The Ordovician limestone, which forms part of the thick Arbuckle formation, occurs upon the northern and southern sides of the Wichita Mountains near the eastern end, showing that this part of the range is anticlinal. On the southern side of the range, south and southwest of Signal Mountain, the remnants of the Arbuckle limestone occur in low hills dipping south and southwest. One-half mile southeast of Fort Sill the same limestones dip toward the southeast. Beginning north of Fort Sill and extending northwestward to Rainy Mountain Mission the whole Cambrian section and a large part of the Ordovician are exposed in a group of straggling, low mountains and hills. Local foldings occur in these limestone hills and there are repetitions in the section due to faulting, but throughout the exposed section of 4,000 to 6,000 feet the general directions of the dip is toward the northeast. This shows, without doubt, that these separated limestone hills are parts of the northern limb of a great anticlinal fold which encompassed at least the eastern part of the Wichita Range. The diverging strikes of the rocks on each side of the eastern end of the range indicate that the uplift became broader and probably more elevated toward the northwest.

The Reagan sandstone, the lowest Cambrian formation in the region, lies upon the porphyry east of Blue Creek Canyon and dips northeast. In the strike of these rocks toward the northwest the same formation occurs in three small areas near the northwestern end of the group of hills, dipping in the same northeastern direction. Below it is the same kind of porphyry as at Blue Creek Canyon, and above it the limestone occurs, dipping in order toward the northeast. Between these small areas, and separating them from the larger limestone mass east of Blue Creek Canyon, the "Red Beds" conceal all the older strata. The regularity of the dip and strike of the Reagan sandstone and succeeding limestones indicates, without much doubt, that they occur and continue without break beneath the "Red Beds" deposits.

Blue Creek faults.—In the vicinity of Blue Creek Canyon, about 7 miles north of Mount Scott, there are two lines of pronounced faulting. One of these faults follows the canyon and bears nearly N. 20° W., while the other is a mile east of the canyon and strikes N. 40° W. In each case the throw is downward and toward the southwest, and the displacement of the canyon fault is greater than the other. As a result of the displacements due to these faults the prophyry mass has been elevated with respect to the stratified rocks on the northeastern and southwestern sides. The Blue Creek fault extends toward the northwest and separates the limestone and porphyry areas upon the northeast from limestones of the same character and age upon the southwest. Excepting along Blue Creek Canyon the extensive deposits of "Red Beds" conceal the fault contact. The limestones southwest of the prophyry belong to the same formations as those upon the northeast, and in each area the dips are in the same general northeastward direction, exposing the limestone section to a thickness of 4,000 to 5,000 feet.

The lowest rocks exposed on the southwestern side of this group of limestone hills are below the middle of the Arbuckle formation and belong to the upper part of the Cambrian or the lower part of the Ordovician, the Reagan sandstones being here concealed by the "Red Beds," so that there is no positive connection, except as indicated by the structure, between the igneous mass of the Wichitas and the limestones. The structure section accompanying the map of the Wichita Mountains shows the succession of stratified rocks and their relations to the igneous masses.

A glance at Plate II will show how thoroughly Taff's work was done, for subsequent drilling has borne out his conclusions to a remarkable degree especially his estimate of the size of the uplift.

STRUCTURE OF THE PENNSYLVANIAN

The structure of the pre-Pontotoc Pennsylvanian is probably quite similar to that of the lower Paleozoics. This is inferred from conditions to the south and east of the county, which should be similar. On the other hand the structure of the Pontotoc formation is known to be quite similar to that of the Permian, except that the Pontotoc folds are more pronounced.

It might be well to call attention here to the fact that the area of the Anadarko basin as shown on the areal map of Oklahoma does not coincide with the true subsurface Anadarko basin in so far as its eastern portion is concerned. The true Anadarko basin in the Pennsylvanian rocks has an axis which roughly includes western McClain northern Grady, southern Canadian, northern Caddo, and southern Blaine counties, and thence northwest through Custer County.

STRUCTURE OF THE PERMIAN

The surface Permian rocks dip at low angles with the major component toward the north. Below the Duncan sandstone the dip is interrupted in many places by low folds. Over that part of the county covered by the Enid or Double Mountain rocks the dip increases from 50 to 80 feet to the mile in a northeasterly direction without interruption to the Cyril syncline. Strange to say it has not been possible to get any unanimity of opinion as to the direction of dip of the Wichita-Albany and Clear Fork rocks in southern Oklahoma until the last few years. This has been due to two reasons: first, the assumption that all rocks should dip away from the mountain uplifts for a great many miles regardless of the age of the uplift; and second, the fact that the dips are extremely low and are interrupted everywhere by folds. Much of the field work in the past has been done in patches in connection with surface structural mapping. Extensive mapping of units within these formations has revealed the true conditions. In these days of intense competition in the oil business we are prone to go over things too hurriedly. It is refreshing, to say the least, to go back to Taff when he states "*In and near* the Wichita Mountains the 'Red Beds' have local variable but low dips away from the mountains, which were the old Permian land areas. These local structures are considered to be due to deposition of the sediments upon the sloping near-shore sea bottom rather than to post-Permian orogenic movements." (The italics are the writer's).

Geologic History

The age of the original folding of the Wichita uplift is not definite at this time. We can only state here that it occurred between Ordovician and early Pennsylvanian times. Some argue that it was certainly not later than Ordovician time for there is apparent structural conformity in the Cambrian and Ordovician rocks exposed on the northeast flanks of the Wichita Mountains, yet there have been found no rocks of an age younger than the Arbuckle and older than the Pennsylvanian to date south of this uplift. Pennsylvanian rocks are resting directly upon the Arbuckle limestone in and around the Walters field in T. 1 S., R. 10 W., the Empire field in T. 1 S., R. 8 W., and the Comanche pool in T. 2 S., R. 7 W. Indeed, it is entirely possible that from the Wichita-Criner Hills uplift southwest into Texas there was no deposition of post-Arbuckle—pre-Pennsylvanian sediments. The majority of writers to date favor an early Pennsylvanian age for the original folding[8]. The writer has favored an early

8. Howell, J. V., Some structural factors in the accumulation of oil in southwestern Oklahoma: Econ. Geology, vol. 17, no. 1, pp. 15-33, 1922.
Powers, Sidney, Reflected buried hills and their importance in petroleum geology: Econ. Geology, vol. 17, no. 4, pp. 233-259, 1922.
Powers, Sidney, Crinerville oil field, Carter County, Oklahoma: Bull. Amer. Assoc. Pet. Geol. vol. 11, p. 1072, 1927.
Powers, Sidney, The Seminole uplift, Oklahoma: Bull. Amer. Assoc. Pet. Geol., vol. 11, p. 1105, 1927.
Powers, Sidney, Age of folding of the Wichita, Arbuckle, Ouachita mountains of Oklahoma and Llano Burnet and Marathon uplifts of Texas: Bull., Geol. Soc. of America, vol. 38, 1927.

Mississippian age in previous publications but is inclined now to place it earlier[9]. However, all such views are merely theories at this time.

The next regional uplift occurred in late Pennsylvanian time being part of the general uplift which raised the main Arbuckle Mountains[10]. During most of the intervening period a very small part of the county was low enough for the deposition of sediments which attained such a great thickness in the Ardmore basin. Subsequent to this folding occurred the deposition of the Pontotoc, a formation deposited as the result of rapid erosion. Again only the eastern part of the county was low enough to receive any of these materials. The opening of Permian time was not marked by any movement, the only difference being in the source of the materials deposited. The Permian sea finally covered the southern part of the county and between the scattered peaks of the Wichita Mountains leaving the present exposed mountains as islands. There have been several periods of very gentle uplift since Wichita-Albany time but only enough to fold the more unconsolidated younger beds into gentle flexures. If any of these later uplifts could be called the more intense perhaps the post-Cretaceous can be classed as such but it had little or no effect upon the rocks in this county.

OIL AND GAS DEVELOPMENT

According to Wegemann[11] the first oil found in Comanche County was in a well dug for water in 1901 to a depth of 60 or 70 feet near what is now the Midland Hotel in Lawton. The water was so tainted with oil that the well was finally abandoned. In 1904 a well dug to a depth of about 90 feet in the southern part of the city produced 3 or 4 barrels of oil a day for several years. The product was sold locally. During the same year the first well was completed in the Lawton field in sec. 6, T. 1 N., R. 10 W. This well had an initial production of about one-half million cubic feet of gas with a pressure of 125 pounds from a sand found at 400 feet in depth. Later in the year a small amount of heavy oil was found in another well drilled in section 1, T. 1 N., R. 11 W. No more wells were drilled until 1906 when several small oil and gas wells were completed in the sands found at 300 to 400 feet. Since that time a small amount of drilling has been done at irregular intervals in the same area resulting in the completion of small wells at depths of 300 to 800 feet.

9. Gouin, Frank, op. cit.
Gouin, Frank, Geology of Beckham County, Oklahoma: Oklahoma Geol. Survey, Bull. 40-M, 1927.
Schuchert, Chas., and Pirsson, L. V., Text-book of geology, Pt. 2, p. 343. 1924.
Plummer, F. B., and Moore, R. C., Stratigraphy of the Pennsylvanian formations of north-central Texas: Univ. of Texas Bull. No. 2132, 1921.

10. Powers, Sidney, op. cit.

11. Wegemann, C. H., and Howell, R. W., The Lawton oil and gas field, Oklahoma: U. S. Geol. Survey, Bull. 621, 1915.

Tabulation of Deep Tests in and Adjoining Comanche County.

LOCATION	COMPANY	Total Depth	Top Arbuckle	REMARKS
32-1S-10W	Garvin Drg.	4,335	3,976	Determined from samples.
9-1S-12W	Humble	2,560	1,341	Artesian sulphur water—fresh.
30-1S-13W	Mid-Kansas	1,920	1,373	Into granite at 1,860—samples.
15-1S-15W	Cosden	1,960	603?	Possibly igneous at bottom.
5-2S-12W	Magnolia	2,475	2,150	Fresh artesian water in Arbuckle limestone.
23-2S-12W	Mt. State	3,066	3,027?	Base Pontotoc about 1,860—No samples.
5-1N-9W	Sykes, et al	2,501	1,555	From samples.
10-1N-9W	Graham	2,765	?	Had sulphur water. Top of Arbuckle uncertain.
20-1N-9W	Ramsey	2,572	?	Top of Arbuckle uncertain.
26-1N-9W	Magnolia	3,250	2,880	No samples—based on log and nearby control.
11-1N-10W	Porter	2,170	1,700?	No samples.
20-1N-10W	Magnolia	2,500	1,614?	Artesian water. Top of Arbuckle—uncertain.
27-1N-10W	Consolidated	2,112	1,757?	No samples.
35-1N-10W	Page, et al	2,501	2,180?	No samples.
3-1N-11W	Homa-Okla.	1,340	831	Samples.
32-1N-14W	Booth, et al	2,000	640	Samples.
26-2N-9W	Magnolia	4,555	None	Base Pontotoc about 4,555. No Arbuckle—sample.
29-2N-10W	Franklin	2,570	985	Into granite at 2,050—samples reported.
33-2N-10W	J. C. Keys	1,249	890	Samples—reported by others.
21-2N-11W	Comanche Oil	2,348	650	Reported by Wegemann.
10-3N-10W	Magnolia	4,310	4,160?	Samples of Arbuckle but exact top uncertain.
33-3N-10W	Mid-Kansas	2,003	None?	Samples suggest granite from about 1,920.
34-4N-11W	Emerald Oil	1,152	850	Samples reported by others.

Note: Rocks older than the Arbuckle limestone and younger than the Pennsylvanian have not been identified in the above wells. Several scattered wells between the exposed portion of the Wichita Mountain uplift and the wells listed above have encountered the Arbuckle limestone at depths consistent with the contours on the regional map.

The first oil production of consequence was discovered in the summer of 1920 by the Gladys-Belle Oil Company in sec. 32, T. 2 N., R. 9 W. This well had an initial production of about 100 barrels of 40 gravity oil at a depth of 1,530 feet. The decline in this well and in the three offsets that were drilled was so rapid that further drilling was discouraged, but not before several scattered wells had been drilled in the general area without results. Nothing further in the way of deeper development took place in the county until Harry Hanbury completed a well in sec. 30, T. 2 N., R. 9 W. in August, 1925 which had an initial production of about 400 barrels of 42 gravity oil from a depth of 2,010 feet. The development caused by this producer was northwest of the discovery well. A month or so later a well was completed with an initial production of 20 barrels of 34 gravity oil from a depth of 1,120 feet in sec. 3, T. 3 N., R. 10 W. by the White Eagle Oil Company and the Becker-Reed Oil Company. Aside from later discoveries around the wells previously mentioned there are no other areas producing in the county.

THE LAWTON OIL AND GAS FIELD

This field has been very well written up by Wegemann[12]. Drilling since the time of his report has been mainly within the limits of the area which was producing at that time. This pool centers around the southwest corner of T. 2 N., R. 10 W., and includes portions of the three adjoining townships. As mapped by Wegemann the producing area appears to be on a terrace of the Clear Fork group.

Production is from sands in the Wichita-Albany group, this group resting directly upon the Arbuckle limestone in this field. A well drilled in the NW.¼ sec. 29, T. 2 N., R. 10 W., to a total depth of 2,570 feet found Arbuckle limestone from a depth of 985 to 2,050 feet and is reported to have had granite from 2,050 feet to 2,570 feet. Another well drilled in the NW.¼ section 33 had Arbuckle limestone from 890 feet to its total depth of 1,249 feet. Incidentally both of these wells were drilled on the dome of the northeast of the terrace as mapped by Wegemann so that it is quite possible that the Arbuckle was found somewhat higher in these two wells than it would be in the area immediately adjacent.

THE LAWTON-HANBURY POOL

This pool was mentioned by the writer in his report on Stephens County[13]. As previously stated the discovery well was located in sec. 30, T. 2 N., R. 9 W., but since that time production has extended into section 19 of the same township and in secs. 24 and 36, T. 2 N., R. 10 W.

12. Wegemann, C. H., and Howell, R. W., op. cit.
13. Gouin, Frank, op. cit.

The surface rocks in this area belong to the Clear Fork group. There is a section of 1,200 to 1,400 feet of Permian rocks below which is found the Pontotoc group in which the producing sands of this field occur. The Pontotoc rests unconformably upon the Arbuckle limestone probably throughout the extent of the field. The underlying Arbuckle evidently has considerable relief and its topography is quite irregular. A well, in section 24 drilled to a depth of 1,723 feet, encountered what was thought to be Arbuckle at about 1,546 feet. This could have been a coarse conglomerate made up of boulders from the Arbuckle as has been found in some wells drilled on the flanks of the Wichita uplift, but since the coarse material has been found to rest directly upon the Arbuckle, this point is of minor importance only.

The structure of the surface rocks is that of a flat-lying dome with the apex about west of the center of section 19. Production is so scattered that control is not sufficient to map the structure of the producing sands with any degree of satisfaction. It is the belief of many that accumulation is controlled altogether by the pinching out of the sands against the Arbuckle topography. While this may be true in section 24 it is not the case in section 30 where there is enough control to map a structural condition of the sand that governs the accumulation.

Sands in this field are found between 1,800 and 2,100 feet with initial production as high as 400 barrels per day. All the oil is over 40 gravity. The decline, however, has been extremely rapid in most cases. The producing sands in the majority of the wells are very coarse. In two wells where the sands were of finer texture the decline has been much slower.

There are large gaps between production in this field but one can almost figure beforehand, that, if successful in getting a producing well by drilling in these gaps, it is doubtful if the well would pay for itself. Then the chances are more than even that a dry hole will result. An example of this can be seen on the map. The well in the northeast corner of section 36 flowed through ten inch casing from a sand at 1,800 feet. Both the east and northeast offsets to this well were dry. Practically the same thing happened in the NW.¼ of section 19 and the NE.¼ of section 24 only that two more dry holes were drilled than in the first example.

ELGIN AREA

The well in sec. 3, T. 3 N., R. 10 W., mentioned under "History of Development", after producing a small quantity of oil for a short time at a depth of 1,120 feet was later deepened to a sand found from 1,430 to 1,448 feet, in which it had an initial production of about 20 barrels of oil and a little gas. The sand was an arkose but much finer than the gravels of the Lawton-Hanbury field. Subsequent drilling

Production Data, Hanbury-Lawton Pool, Eastern Comanche County, Oklahoma.

Average Daily Production per month (in bbls.)

COMPANY	FARM		LOCATION	1925 Sept.	Oct.	Nov.	Dec.	1926 Jan.	Feb.	Mch.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
Magnolia	W. T. Price	1	30-2N.-9W.	35	25	20	20	17	15	15		15	12	10	10	8	7	7	7
Magnolia	W. T. Price	2	30-2N.-9W.		50	50	20	20	15	10		10	8	8	8	7	5	5	4
Magnolia	W. T. Price	4	30-2N.-9W.						45	12		10	10	8	8	7	6	6	6
Magnolia	W. T. Price	5	30-2N.-9W.					15	10	7		5	5	4	4	3	4	4	3
Magnolia	G. E. Hardy	1	30-2N.-9W.						30	30		10	7	5	5	4	4	3	3
Magnolia	School Land		36-2N.-10W.							21		14	14	12	10	9	9	7	7

COMPANY	FARM		LOCATION	1927 Jan.	Feb.	Mch.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	1928 Jan.
Magnolia	W. T. Price	1	30-2N.-9W.	7	6	6	6	6	6	6	6	6	6	6	6	5
Magnolia	W. T. Price	2	30-2N.-9W.	4	4	3	3	3	3	3	3	3	3	3	3	2
Magnolia	W. T. Price	4	30-2N.-9W.	6	5	4	4	4	4	4	4	4	4	4	4	3
Magnolia	W. T. Price	5	30-2N.-9W.	3	2	2	2	2	2	2	2	2	2	2	2	2
Magnolia	G. E. Hardy	1	30-2N.-9W.	2	2	2	2	2	2	1	2	2	2	1½	2	1½
Magnolia	School Land		36-2N.-10W.	7	7	7	7	7	7	6	6	6	6	6	6	5

NOTE: Price No. 1 above completed in August, 1925, had an initial production of 400 bbls. the first 24 hours. Compare its average in September.

around the 40 acre tract upon which the well was located resulted in failures. The horizon is probably the upper part of the Pontotoc.

SCATTERED SHOWINGS

There has hardly been a well drilled in the county to any considerable depth that has not encountered showings of oil or gas, or both. These showings occur in both the shallow sands of the Permian and in the deeper sands of the Pontotoc. In wells drilled with cable tools these showings have amounted to as much as five barrels of oil a day or up to one million cubic feet of gas. The showings encountered by the rotary drilled wells of course have not been measurable. It is also remarkable that many of the sands carrying these showings have been free from water.

OIL SEEPS

Wegemann[14] mentions the presence of oil seeps and occurrences of asphalt in localities scattered all over that part of the county covered by sedimentary rocks. Some of those he noted are as follows:

T. 1 S., R. 10 W. A light yellow asphaltic sandstone outcrops in the NE.¼ of section 27. This section is now part of the Walters oil and gas field of Cotton County.

T. 2 N., R. 11 W. In section 21 there is a seep of asphalt in broken sand in the SW.¼ NE.¼ of the section. In the NE.¼ of section 24 there is an asphaltic sandstone. There is also an oil seep in the northeast corner of this section.

T. 2 N., R. 12 W. There is an occurrence of asphaltic sandstone in the southeast corner of section 17. In the SW.¼ NW.¼ section 21 and in the NW.¼ NE.¼ of section 34 there are occurrences of asphalt bearing sandstone.

T. 2 N., R. 13 W. Asphalt noted in a sandstone bed that outcrops along a creek in the SE.¼ of section 36.

T. 3 N., R. 11 W. In the SE.¼ of section 9 in three small southward-opening draws that drain the S.½ of section 10 seepages of asphalt or asphaltic oil occur at about the same elevation, as if derived from one bed.

T. 3 N., R. 12 W. In the NE.¼ of section 29 there is an oil seep from an arkosic conglomerate which is close to the igneous mass of the mountains.

T. 4 N., R. 11 W. In the NW.¼ SW.¼ of section 26 there is an outcrop of asphaltic sandstone. Another occurs in SE.¼ NE.¼ of section 32. A water well dug to a depth of 72 feet in the SE.¼ SW.¼ of section 30 is reported to have struck a sand carrying dark oil that yielded four or five barrels per day.

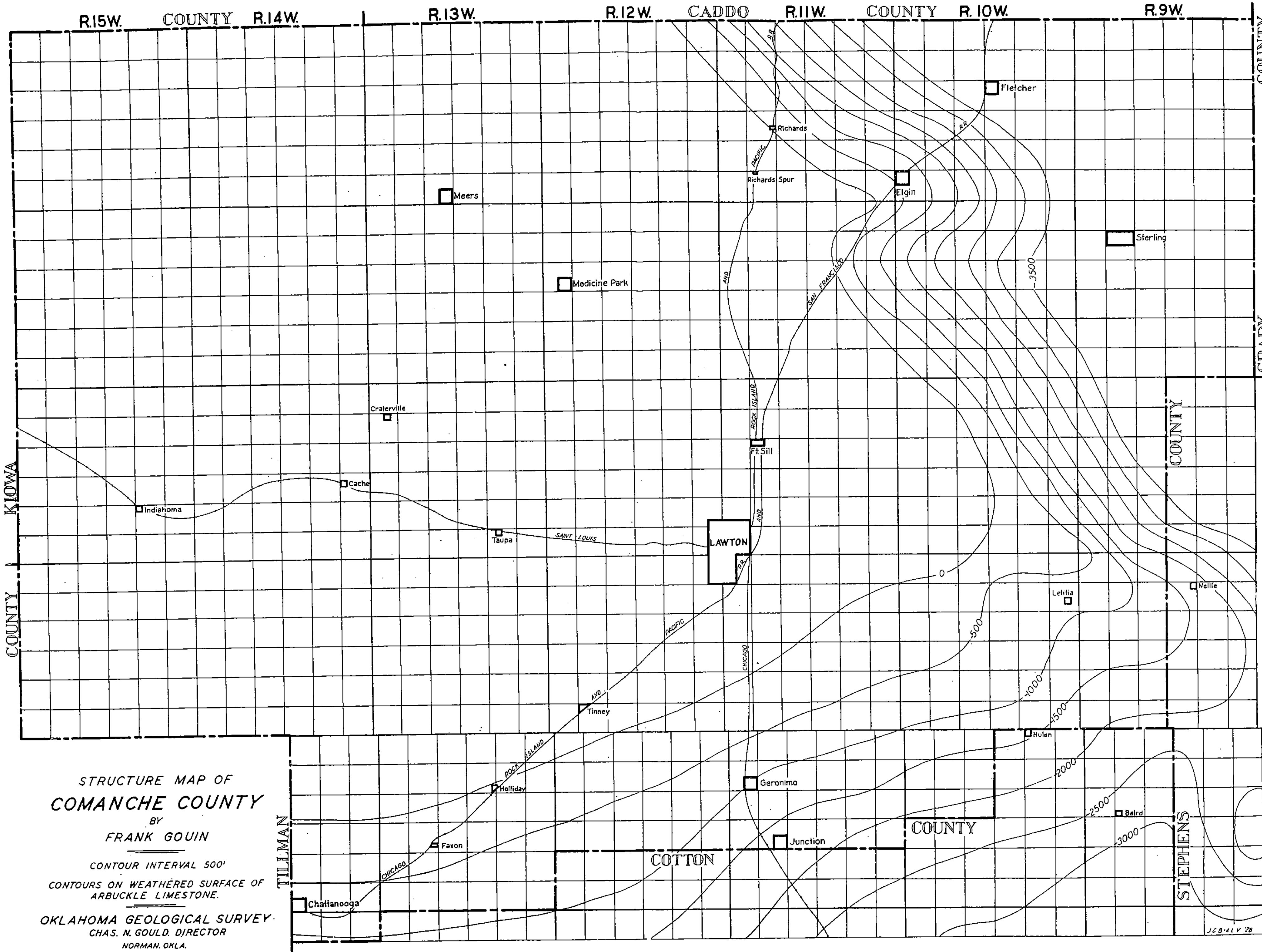
Wegemann also reports many showings in wells drilled for water.

14. Wegemann, C. H., and Howell, R. W., op. cit.

FUTURE POSSIBILITIES

There are possibilities for finding small wells in the shallow Permian sands in all of the county where the Permian outcrops. Judging from the structure of the Lawton field it would probably be necessary to have some sort of structural conditions favorable for accumulation. The area of the county in which the Pontotoc beds are present is quite limited, while the area covered by beds older than the Pontotoc in which producing sands are found in other counties of the state is even more limited. In this connection it will be remembered that the northeastern corner of the county is very low structurally. There is thus left a strip roughly paralleling the outcrop of the Duncan sandstone having the escarpment of that sandstone as its eastern limit with a width of about six miles at the north edge of the county and enlarging to a width of not over eight miles at the east edge of the county. The length of this strip would be about 20 miles. West of this strip there is no Pennsylvanian while east of it the Pennsylvanian is low structurally. Future production within the confines of this strip is dependent upon conditions favorable for accumulation.

While the present production and the future possibilities of Comanche County are anything but favorable when compared to other oil producing counties of the state, yet the writer feels that there is an immense amount of reserve oil that can be obtained by artificial means other than in present day drilling when the day comes that this oil will be needed. It is a known fact that a sand can be saturated with oil and yet will not produce in commercial quantities if the dissolved gas that was once in solution in the oil in that sand has been dissipated. This is true of many sands in Comanche County, so if the day comes that there is a shortage of oil obtained from production methods now used, this county can be depended upon for a reserve supply.



STRUCTURE MAP OF

COMANCHE COUNTY

BY

FRANK GOUIN

CONTOUR INTERVAL 500'

CONTOURS ON WEATHERED SURFACE OF ARBUCKLE LIMESTONE.

OKLAHOMA GEOLOGICAL SURVEY

CHAS. N. GOULD. DIRECTOR

NORMAN. OKLA.

1928