SUBSURFACE GEOLOGY OF PRATT COUNTY, KANSAS

by

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INTRODUCTION

Purpose of Investigation

The purpose of the investigation is to study the subsurface structure, stratigraphy, and geological history, and to determine the role of these factors in the accumulation of oil in Pratt County, Kansas.

Location and Physiography

Pratt County is located in South Central Kansas in the High Plains section of the Great Plains Province with the exception of a small area in the southeastern corner which lies in the Red Hills Division. The county occupies the area of the townships 26 to 29 south and ranges 11 to 15 west. It is bordered on the north by Stafford County; on the east by Reno and Kingman Counties; on the south by Barber County; and on the west by Edwards and Kiowa Counties.

The county consists of 20 townships with an area of 720 square miles and is drained by three tributaries of the Arkansas River. The north and central portions of the county are drained by the north and south forks of the Ninnescah River and the southern portion by the tributaries of the Chikaskia and Medicine Lodge Rivers.

The topography of the northern townships is primarily that of rolling sand dunes resting on Pleistocene alluvial deposits. The dunes have an average height of 30 feet. The remainder of the area is covered with Tertiary sand and gravel which form a gentle undulating type of terrain.

Procedure

The writer constructed three structural maps, two thickness maps, and two cross-sections as part of his research. The structural maps were drawn on the Arbuckle, Mississippi, and Lansing-Kansas City groups. All of these are good oil producers in Pratt County. A contour interval of 20 feet was used for the structure and thickness maps. The two isopach maps which were drawn represent the interval between the Arbuckle and Mississippian groups and the Mississippian and Lansing-Kansas City groups. These maps show the structural movements that occurred between the periods of deposition.

The two cross-sections were constructed to show the relationship of oil production to the variation in thicknesses of the formations. The horizons used were the Arbuckle, Simpson, Viola, Mississippian, and Lansing-Kansas City.

The sources for the data used were the Herndon maps, drillers' logs, and in some instances, radioactivity logs were studied to determine the thicknesses of formations described in the stratigraphy section. The mechanical method of contouring was applied to obtain the general configuration of the contoured horizon. The area was then re-contoured using the parallel method.

REVIEW OF LITERATURE

The report by Rutledge and Bryant (1937) and one by Ver Wiebe (1938) described the stratigraphic units present in Pratt County and the development of the oil resources. No reports have been published on the geology of the area investigated since 1938; though, research of the area is in progress by the Kansas Geological Survey, and the findings will be published later.

The structural history of the Central Kansas Uplift was described by Morgan (1932) and by Koester (1935). The Hugoton area was discussed in detail by Merriam (1955). Lee (1943) reported on the Forest City Basin and Nemaha Anticline. The latter structure was also discussed by Ley (1926). Other structural features including the ones previously mentioned were presented very concisely by Jewett (1951). This publication is excellent as it gave the writer a clear understanding of the relationships of the structures in Kansas and familiarized him with the various names used for similar structures.

Moore, et al, (1951) described the stratigraphic units in Kansas. Ver Wiebe and associates have compiled a very complete record of the development of oil in Kansas for each year beginning with 1937.

STRATIGRAPHY

Pre-Cambrian Era

The state of Kansas is underlain by pre-Cambrian rocks composed of granite, porphry, gneiss, schist, quartzite, slate, and marble. The pre-Cambrian does not outcrop anywhere in Kansas (Moore, et al, 1951).

The pre-Cambrian basement complex, which is considered to be part of the Laurentian continental nucleus, has two general trends. The most conspicuous one strikes nearly north-south with some deflections to the north-northeast and to the north-northwest. In Kansas and Oklahoma this trend is very dominant. The other trend, a northwest-southeast direction, is very dominant in Texas and is also present in the Salina Basin of Western Kansas. Ruedemann believes these two trends are a reflection of the old grain of Laurentia and that they played a dominating role throughout the Paleozoic deformation (Ruedemann, 1935).

Cambrian System

Waucoban and Albertan Series. The rocks representing these two series are absent in Pratt County (Moore, et al, 1951).

Croixian Series. The extent of the Reagan sandstone in Pratt County is unknown since only a few wells have been drilled to this horizon. This formation is called the Lamotte in Missouri and the Reagan in Oklahoma. In T. 26 S., R. 13 W., the known thickness is 52 feet, but McClellan (1930) stated the thickness in Kansas ranges from 30 to 100 feet; however, it has a thickness of 1,000 feet further north in Ellsworth County.

The grains of the Reagan sandstone are generally frosted and well-rounded to spherical in shape. They are usually void of pits and etches and are poorly cemented (Koester, 1935). The arkose which lies directly beneath the formation is called "granite wash" that originated from weathering and erosion of pre-Cambrian rock. The "granite wash" is often erroneously included with the Lamotte sandstone by the drillers in Kansas (Lee, 1956).

The Bonneterre dolomite which lies above the Reagan sandstone is conformable with the sandstone and is found throughout the county with the possible exception of the structural highs. It has a thickness of 50 feet in the northwest portion of the county and reaches a thickness of 150 feet in the southwestern part.

The dolomite is gradational with the Reagan sandstone. It is difficult to differentiate between the two formations, but the bottom of the Bonneterre dolomite is placed where the increasing percentage of dolomite becomes greater than the percentage of the underlying sand. Other criteria that are used are the increase of finer sand and the appearance of glauconite (Keroher, 1948).

The Bonneterre dolomite is composed of a high percentage of glauconite, contains no chert, and is coarsely crystalline. The color is buff to white (Moore, et al, 1951).

The Eminence dolomite is not present in Pratt County and was probably removed by post-Bonneterre erosion.

Ordovician System

Lower Ordovician. The Roubidoux formation of the Arbuckle group is present over all of Pratt County, and it has an average thickness of 150 to 200 feet. It is the first stratigraphic unit to extend across Kansas from east to west without interruption except over parts of the Central Kansas and Nemaha Uplift. The formation lies unconformably over the Bonneterre dolomite. It is composed of a sandy dolomite and a sand which is fine and subangular.

The Roubidoux dolomite is differentiated from the underlying Bonneterre dolomite by the absence of glauconite and a definite change from the coarse rounded sand of the lower formation to an angular sand which is fine textured. There is no marked change in the two dolomites (Keroher and Kirby, 1948).

The Cotter and Jefferson City dolomites represent the youngest deposits of the Arbuckle group and are present everywhere in Pratt County. The sequence has a thickness of 300 feet in the northern portion of the county and reaches a thickness of 360 feet at the extreme southern border. It is conformable with the underlying Roubidoux formation. Its composition is dominantly chert which is variable in color. Brown and white, as well as bluish translucent chert, occur very frequently. The chert often contains oölites which are usually white or translucent, although, some are brown.

The Cotter and Jefferson City sequence is differentiated from the Roubidoux formation by the insoluble residue of the latter which is mostly sandy in contrast to the cherts and dolomites of the former sequence. The second significant difference is that the dolomite which is white and coarsly crystalline in the Roubidoux formation becomes varied in color and texture in the overlying formation (Keroher and Kirby, 1948).

The Arbuckle group is known as the "siliceous lime" in Kansas. McClellan (1930) suggests that this name should be abolished since the arbuckle is only siliceous locally and it is dominantly dolomitic.

Middle Ordovician. The Simpson group is represented in Pratt County by the St. Peter sandstone that unconformably overlies the Arbuckle group. The Platteville formation which would overlie the St. Peter sandstone is absent because of post St. Peter erosion.

The lower Simpson beds have an average thickness of 50 feet and are mostly green shales. The upper 40 feet of the St. Peter sandstone contains quartz sand grains which are rounded and frosted (Ver Wiebe, 1938).

The Viola limestone, which is also known by the name "Kimmswick" in Missouri, is present throughout most of the county. Barwick (1928) called it the "Urschel" limestone, but the name was never generally accepted. The Viola limestone has an average thickness of 80 feet. Near its top it is coarsely crystalline and cherty, as compared to the lower 20 feet which is lacking in chert but is more coarsely crystalline (Ver Wiebe, 1938). This formation is very porous, because of weathering that it was subjected to during pre-Mississippian times; and as a result, it is an excellent oil producing zone in Pratt County.

Silurian System

No rocks of Silurian age are recognized in Pratt County; they are prevalant, however, to the east of the county.

Devonian System

The Chattanooga shale lies unconformably over the Viola limestone. The Misener sandstone is the basal member of the shale and has been recognized in only a few wells in the county. Pre-Chattanooga erosion removed most of the sandstone from the area.

The Chattanooga shale is pyritiferous, silty, and is black in the southern part of Kansas, with gradations of gray to the north (Moore, et al, 1951). The shale contains round brownish spots which are the spores Sporangites huronensis (McClellan, 1930). The shale is present in Pratt County only as a thin belt trending southwest-northeast across the area.

Mississippian System

Kinderhookian Series. The Boice shale lies unconformably on the Chattanooga shale. It has a dolomitic layer that separates it from the darker Chattanooga shale in the lower one-third of its section (Ver Wiebe, 1938). Its composition is primarily silty to dolomitic with visible amounts of ferruginous oölite in the strata. The color varies from dark to light greenish gray (Moore, et al, 1951).

Osagian Series. The Keokuk and Burlington limestones represent this series in Pratt County. The sequence is 90 feet thick and is quite cherty at the top. It also consists of a dolomitic limestone that contains white unweathered chert. The base of the dolomitic limestone is crystalline with the percentage of dolomite diminishing (Ver Wiebe, 1938). This series is called the "Mississippi Lime" by the drillers in Kansas.

Meramecian and Chesterian Series. No rocks of either Meramecian or Chesterian series are recognized in Pratt County, but the Chesterian series is present in the deeper portions of the Hugoton Embayment, and the Meramecian series is prevalant in Southern and Northeast Kansas (Moore, et al, 1951).

Pennsylvanian System

Morrowan and Atokan Series. Rocks representing these two series are not present in the county, although they do occur to the southwest of the studied area.

Desmoinesian Series. The Pennsylvanian Basal conglomerate was named the "Sooy conglomerate" by Edson. The name originated from one of the initial wells drilled in Barton County. Generally, the composition of the conglomerate is coarse chert with minor amounts of sand, and is usually interstratified with red shale (Koester, 1935).

The Cherokee group has been reported in a few scattered wells in the western part of the county, and it was recognized in one well in Sec. 5, T. 26 S., R. 11 W. The group is not very prominent west of the Nemaha anticline. It is composed mostly of shales and sandy shales with small amounts of limestone (Moore, et al, 1951).

The Marmaton group is composed of thick shales which are gray at the top, but grade into red and green shales below. The shales contain thin beds of reddish gray limestone. The Marmaton group has been recognized in the north and southcentral portions of the county and has a thickness of 120 feet (Rutledge and Bryant, 1937).

Missourian Series. The lower most group of the Missourian series in Pratt County is the Kansas City group. It is divided into the Zarah, Linn, and Bronson subgroups which are all present in the county. The Lansing and Kansas City Groups are considered to be one lithologic unit because there is no exact horizon where the two groups can be separated. The two groups have a combined thickness of 350 feet, and they have a composition mainly of gray limestones which contain a few cherty and oölitic horizons. Dark gray shales are interbedded with the Lansing-Kansas City which reach a thickness of 5 to 10 feet (Rutledge and Bryant, 1937). These shales are indicated very clearly on the radioactive logs. Koester (1935) called the Lansing the "Oswald limestone" in Western Kansas.

The Pedee group includes the Iatan limestone and underlying Weston shale. The former limestone is called the "Brown Lansing" by many drillers in Kansas. The Iatan limestone is approximately 10 feet thick in the area studied. The limestone is mainly white and has a texture that is very fine and dense (Moore, et al, 1951).

The thickness of the Weston shale is about 10 feet and conformably overlies the Stanton limestone of the Lansing group. The color of the shale is dark blue to bluish gray and is usually unfossiliferous.

Virgilian Series. The three groups representing the series are the Douglas, Shawnee, and Wabaunsee group in ascending order.

The Douglas group unconformably overlies the Lansing group indicating an interruption in sedimentation and a minor period of erosion. This group is mainly shale and sandstone and covers the major portion of the county (Moore, et al, 1951). There are thin hard shelly limestones present in the lower 15 feet of the group which is composed largely of gray shales; but occasionally there is a massive water-bearing sandstone present (Ver Wiebe, 1938).

The Shawnee group has a thickness of 350 feet with the Topeka limestone marking the top and the Oread limestone marking its base. The group is composed of massive limestones with thin interbedded shales (Ver Wiebe, 1937).

The Heebner shale is the most pronounced bed in this group. It has a thickness of 10 feet in the county and is an excellent marker bed. It is easily recognized on radioactivity logs.

The Wabaunsee group is 500 feet thick with shale being the most dominant with interbedded micaceous siltstones and limestones (Ver Wiebe, 1937).

Permian System

The thickness of the Permian strata is estimated to be 1,900 feet.

Wolfcampian Series. This series is composed of the Chase, Council grove, and Admire groups. The sequence of rocks in the Wolfcamp are equivalent to the "Big Blue Series." The strata of the Admire group is dominantly shale, but there are thin limestones present and some coal. This group unconformably overlies the Pennsylvanian system (Moore, et al, 1951).

The Council Grove group is composed of alternating shales and limestones, the latter not being as massive as the Chase group limestones.

The Chase group represents the youngest rocks of the Wolfcampian series. The Herington limestone member is widespread in the county and is a very good marker bed. Its composition is dolomitic with a high percentage of anhydrite. The lithology of the group is primarily shales and limestones which form prominent escarpments throughout Kansas. The shales have various shades of red and green; and as the shales become thicker, the colors of the shales become brighter (Moore, et al, 1951).

Leonardian Series. The Sumner group in Pratt County has a thickness of approximately 1,000 feet. The Ninnescah shale is mainly red, containing some gray shale, calcareous siltstone, and impure limestone. It is 450 feet thick (Moore, et al, 1951). The Ninnescah shale overlies the Wellington formation which has in its lower part 110 feet of gray shale and anhydrite. The middle portion of the Wellington formation contains the Hutchinson salt that is 450 feet thick and is overlain by 200 feet of blue shale (Moore, et al, 1951).

The Nippewalla group is mainly redbuds. It is composed of alternating sandstones and shales with some gypsum beds. These redbeds form a plain and the Blaine formation of the upper part of the Nippewalla group outcrops in the county. Its thickness is approximately 50 feet. The Blaine formation consists mainly of gypsum beds that are separated by red shales and dolomites (Moore, et al, 1951).

Triassic and Jurassic Systems

Rocks of Triassic and Jurassic ages have not been recognized in Pratt County.

Cretaceous System

There are no Cretaceous rocks outcropping in the county. The subsurface Cretaceous rocks cover the extreme western portion of Pratt County (Merriam, 1957).

Commanchean Series. The Cheyenne sandstone was deposited by a transgressing sea, advancing from the south. This formation is indicative of a continental and littoral environment. The sandstone is fine to coarse grained, varicolored, and at its base, it is conglomeritic (Moore, et al, 1951). Quartz grains are the most abundant. Some pyrite and small concretions of limonite are present. The sandstone is easily eroded, because it is loosely cemented (Latta, 1948).

The Kiowa shale was deposited conformably on the Cheyenne sandstone as the waters of the advancing sea grew deeper. The shale is very dark gray to black in its lower portion and becomes varicolored as it becomes thicker. Thin limestone beds are evident in the shale (Latta, 1948).

Gulfian Series. The Dakota formation is found in the subsurface in the extreme western part of the county. It represents a continental environment. It is comprised of varicolored clays which are silty or aerenaceous, and usually small concretions of hematite are found in the formation.

Tertiary System

Pliocene Series. The Ogallala formation outcrops in the extreme southeastern corner of the county. Its composition is an arkosic gravel, cemented by silica and calcium carbonate. The formation was laid by stream deposition (Moore, et al, 1951). The Ogallala is referred to as the "Mortar Beds" in Western Kansas where the sediments are loosely cemented with calcium carbonate. The other epochs of the Tertiary are not recognized in Pratt County.

Quaternary System

Pleistocene Series. The Blanco formation of the Nebraskan state constitutes the lowest fill in the valleys of Pratt County. It has a thickness of 40 to 50 feet and contains gravel, sand, silt, and clay.

The Meade formation of the Kansan stage, which covers the entire county, contains Pearlette ash in the east central and southwestern parts. The formation is dominantly gravel, sand, silt, clay, and volcanic ash. The maximum known thickness of the Pearlette ash is 14 feet in S, 1/2, SW 1/4, Sec. 21, T. 27 S., R. 12 W. The estimated reserve is 48,000 tons.

The Grand Island member which is the youngest unit of the Meade formation is found as fillings in abandoned valleys. This member is comprised of sand, gravel, and arkose. The lithology of the member is that of the late Pleistocene alluvium of the Arkansas River (Frye and Leonard, 1952).

Crete gravels outcrop in the central portion of the county and overly the Sappa member that contains the Pearlette ash (Frye and Leonard, 1952).

Recent Series. Eolian deposits forming sand dunes in the northern tier of townships are prevalent. The remainder of the county is characterized by terrace surfaces which are covered with loess 8 to 12 feet thick.

STRUCTURE

Major Pre-Mississippian Structure

Southwest Kansas Basin. The basin received its name from Moore and Jewett and is one of two major basins of pre-Mississippian time; the other is the North Kansas Basin (Appendix, Fig., 2). These two basins were separated by the Ellis-Chautauqua Arch which is now known as the Central Kansas Uplift (Jewett, 1951).

North Kansas Basin. The basin was named by Rich in 1933 and is located in the Northeastern part of Kansas (Appendix, Fig., 2). It was formed by the subsidence of the Nebraska Arch during the Cambrian and Ordovician periods (Lee, 1948).

Ellis Arch. The arch is considered a part of the ancestral Barton Arch, and it was named by Moore and Jewett. It is located in Central and Northwestern Kansas (Appendix, Fig., 2). During pre-Mississippian time the Ellis Arch joined with the Chautauqua Arch to form the Central Kansas Arch which separated the North Kansas and Southwest Kansas Basins (Moore, et al, 1942).

Chautauqua Arch. This arch was named by Barwick (1928). He stated that it was an extension of the Ozark Uplift into Southeastern Kansas (Appendix, Fig., 2). The Ozark Monocline was formed on the north flank of the arch by dipping pre-Mississippian beds (Jewett, 1951). The Ellis and Chautauqua Arches comprised part of the transcontinental arch which extended into Kansas and Missouri (Eardley, 1951).

Major Post-Mississippian Structure

Salina Basin. The basin received its name from Barwick in

1928. It is bordered on the west by the Central Kansas Uplift and the Cambridge Arch, on the east by the Nemaha anticline, and on the south by a broad gentle uplift which is between the Central Kansas Uplift and the Nemaha Anticline (Appendix, Fig., 3). This high area is the division line between the Salina Basin to the north and the Sedgwick Basin to the south.

The structural development of the Salina Basin is divided into five stages of deformation. By the use of thickness maps, Lee determined the degree of folding during the following five stages.

(1) Before the deposition of the St. Peter sandstone there were several minor disturbances in the Cambrian and Ordovician periods, which produced a deep basin named the Ozark Basin in Central Missouri. At this time the Southeast Nebraska Arch was formed in Southeastern Nebraska and Northeastern Kansas. Southwest of the arch a syncline was developed which, during post-Mississippian times, became the Central Kansas Uplift.

(2) The second period of folding extended from the Champlainia epoch to the Kinderhookian epoch. During this interval of time, there was a complete reversal in the structural development as compared to the structural deformation of the Cambrian and early Ordovician. The basin which had formed in Central Missouri gave rise to the Ozark Uplift, and the Southeast Nebraska Arch began slowly subsiding to form the North Kansas Basin.
Two positive areas which were being formed contemporaneously were the Chautauqua Arch and the Central Kansas Uplift. These two areas were located south and west of the North Kansas Basin

respectively.

(3) During the Mississippian period, folding was dominant once again, reaching its peak at the end of Mississippian deposition when the Nemaha Anticline was formed. This structure bisected the North Kansas Basin and formed the Salina Basin on the west, and the Forest City Basin on the east. The Salina Basin had a northwesterly trend and was parallel with the northern flank of the Central Kansas Uplift which was gradually rising.

(4) The next period of deformation was between Permian and Cretaceous times and formed the Anadarko Basin in Southwestern Kansas. This deformation caused the Pennsylvanian and Permian rocks lying in Eastern Kansas to have a southwestwardly dip.

(5) The close of the Cretaceous marked the last period of deformation in the area. The Cretaceous rocks were tilted toward the northeast in Western Kansas and toward the north and northwest in Central Kansas. In the basin proper, the sediments were elevated 1,500 - 2,000 feet above sea level (Lee, 1948).

Nemaha Anticline. The Nemaha Anticline, trending NE-SW, passes through Sumner and Nemaha Counties into Nebraska. Southward it extends into Oklahoma (Appendix, Fig., 3). The structure was named by Moore and Haynes who preferred to call it the "Buried Mountains." It occupies an area 200 miles long and 10 to 25 miles wide (Eardley, 1951). Moore and Haynes, though, were not the first to recognize the structure; for in 1904, Prosser and Beede named a few minor structures in the area which were later considered part of the Nemaha Anticline (Jewett, 1951).

In recent years there has been a great deal of controversial opinion in regard to the correct descriptive name for the Nemaha structure. The name "Nemaha mountains" has generally been discarded by most geologists, but in its place has come the "Nemaha Ridge" and the "Nemaha Anticline."

The writer believes that Eardley is correct in saying that the name "ridge" is incorrect. A ridge has a length of usually no more than five miles and is topographical and not structural. The term range is more appropriate because of the facsimile to the Colorado Range of the Ancestral Rockies (Eardley, 1951). The term anticline, however, has been also widely used, and the author believes this should be the accepted name.

The anticline was formed during late Mississippian or possibly early Pennsylvanian times when the entire region was uplifted 1,000 feet higher than the surrounding region. The Mississippian sediments were eroded away as were the older rocks from its axis, which reduced the height of the anticline to that of the surrounding region (Ley, 1926).

After peneplanation, an eastward facing escarpment was formed when the area west of the Nemaha Anticline was uplifted, accompanied with faulting. The difference in elevation between the western and eastern portion of the anticline was several hundred feet. It has been conceded by most geologists that the escarpment was in places formed by faulting, but the escarpment might have been formed by sharp monoclinal dip (Lee, 1943).

The granite of the anticline is farther below sea level at the southern part of the structure. At the Nebraska and Kansas line, it is 500 feet below sea level as compared to the area near the Oklahoma and Kansas line where the granite is 2,500 feet below sea level (Eardley, 1951).

The Hugoton Embayment. The embayment is a northerly extension of the Anadarko Basin, extending into Southwestern Kansas, Southeastern Colorado, and into the panhandle of Oklahoma and Texas (Appendix, Fig., 3). McClellan (1930) referred to the embayment as the Dodge City Basin which was changed to the more appropriate name of "Hugoton" by Maher and Collins (1948).

The geographic name of "Hugoton" was chosen because the axis of the trough, which has a northwestwardly trend, is 85 miles southwest of Dodge City, but is close to the town of Hugoton. The second reason is that the Pennsylvanian and Mississippian rocks are thicker nearer Hugoton than they are at Dodge City (Maher, 1948).

Jewett (1951) stated that the term "Dodge City" should be used because of its priority through long usage. The writer believes that Jewett's conclusion should not be endorsed. If by further investigation, the name of an area is found incorrect, then it should be changed; priority and long usage should not have precedence.

The Hugoton Embayment is bordered structurally on the southwest by the Amarillo Uplift; on the west by the Sierra Grande Uplift; on the northwest by the Las Animas Arch; on the northeast by the Central Kansas Uplift and the Cambridge Arch; and on the east by the Pratt Anticline. The area of the embayment is approximately 150 miles wide and over 150 miles long.

The embayment was subjected to numerous epeirogenic movements throughout the Paleozoic causing the marginal areas to be uplifted. The uplifted margins supplied sediments to the embayment. The periods of major deformation came at the close of the Arbuckle, Viola, Chesterian, Morrowan, and Permian times. The embayment was separated by the Oakley Anticline which developed during the early Permian into two basins; the Syracuse Basin on the west and the Cimmaron Basin on the east. In the Cretaceous period, a marginal syncline developed on top of the Oakley Anticline which all but destroyed it (Merriam, 1955).

Central Kansas Uplift. The Central Kansas Uplift is located in the Central portion of Kansas and in Southcentral Nebraska (Appendix, Fig., 2). This area was called the Russell Arch by Denison (1926) and was later named the Barton Arch by Barwick (1928). Morgan (1932) was the first person to publish the name "Central Kansas Uplift" and to date it has been the most widely used structural term to describe the structure in the Central part of Kansas.

The uplift is considered to have been a positive area during the greater portion of the Paleozoic. It originated from a series of parallel batholiths which intruded the quartzites and schists during the pre-Cambrian. These batholiths were truncated and were the source of the arkose and red sediments deposited in the depressions. During the Paleozoic and Mesozoic eras, there were six periods of epeirogeny; post-Algonkian, post-Canadian, post-Hunton, early-Pennsylvanian, post-Missouri, and post-Cretaceous. Folding perpendicular to the major trend of northwest to southeast became dominant, mainly in early Pennsylvanian and post-

Cretaceous time, which has resulted in the local accumulation of petroleum (Koester, 1935).

Forest City Basin. The Forest City Basin lies in Northeastern Kansas, Northwestern Missouri, and Southwestern Iowa, and Southwestern Nebraska (Appendix, Fig., 3). It occupies an area of 11,000 square miles.

After Mississippian deposition the entire area occupied by the North Kansas Basin was uplifted, with folding being very dominant. The major orogeny was the development of the Nemaha Anticline that bisected the North Kansas Basin into the Salina Basin on the west and an unnamed basin on the east. When the Nemaha Anticline was re-elevated after being peneplained, faulting formed an escarpment on its east side. East of the escarpment, the post-Mississippian peneplain was downwarped which formed the Forest City Basin. The basin was separated from the Cherokee Basin by the Bourbon Arch which developed complementary to it. By the middle of Cherokee times, the Forest City Basin was filled which caused the arch to be inundated, and the two basins were joined. The Forest City Basin from this time on was only a northern extension of the Cherokee Basin.

The basin has its axis parallel to the axis of the Nemaha Anticline. This position of the axis which is near the Nemaha Anticline gives the basin an asymmetrical profile with a steep west flank and a gentle east flank (Lee, 1943).

Sedgwick Basin. This basin is west of the Nemaha Anticline south of the Salina Basin and east of the Northern Basin Shelf (Appendix, Fig., 3). The basin was named by Moore and Jewett (1942), and may have been an extension of the Anadarko Basin. It is fairly symmetrical and plunges to the south (Merriam and Goebel, 1956).

Northern Basin Shelf. The shelf was named by Wheeler for the area occupied by the northwest flank of the Anadarko Basin that extends from Oklahoma into Clark, Commanche, and Barber Counties of Kansas (Appendix, Fig., 3). Wheeler also observed that the Pennsylvanian strata declined sharply in its rate of thinning which is indicative of a platform present in this area. The oil possibilities are encouraging because the changes in the Pennsylvanian facies are from basinal sands to platform limestones (Jewett, 1951).

Minor Pre-Mississippian Structure

Rush Rib. Koester (1935) named the Rush Rib for the structure which had a northwestwardly trend through Barton and Rush Counties and with a more northerly trend through the counties of Ellis and Trego with its northerly extension into Graham County (Appendix, Fig., 3). The Rush Rib is considered a structural high during the Ordovician, having its major axis paralleling the axis of the Central Kansas Uplift. It is also related to the pre-Ordovician rock in the Barton and Ellis Arch areas (Koester, 1935). The Rush Rib is inferred to have been upfaulted on both sides, forming a horst structure (Farquhar, 1957).

Pratt Anticline. The anticline has a northeast-southwest trend and plunges to the south (Appendix, Fig., 3). It separates the Hugoton Embayment and Sedgwick Basins in Kansas, but it dies out in Oklahoma resulting in no differentiation between the Hugoton

Embayment and Sedgwick Basin on the northeastern flank of the Anadarko Basin (Moore, et al, 1942).

The anticline is present to the north in Stafford County. The writer agrees with Geil (1957) that the anticline is probably an extension of the Ellsworth Anticline. The Viola formation is present in the entire county, but the Mississippian is absent in part of T. 29 S, R. 14 W, R. 15 W., which indicates that the anticline was formed after Viola deposition. Dellweg (1956) stated that the Barber Earthquake affected the anticline to the extent of sending only vibratory waves through the overlying strata.

Minor Post-Mississippian Structure

Cunningham Dome. The Cunningham Dome is located partly in Pratt and Kingman Counties (Appendix, Fig., 3).

The original uplift of the area was during the Wichita orogeny. The Central Kansas Uplift was being re-elevated again during this time, producing folds with a northeast to southwest trend, which is similar to the trend of the Cunningham Dome. Prior to the advancement of the Pennsylvanian seas, the dome which had been elevated to 220 feet, was eroded nearly to its base level. The elevation of 220 feet was inferred by the notable absence of the upper 220 feet of Mississippi sediments.

During post-Lansing and pre-Douglas, the second period of structural movement occurred which was synonymous with the Central Kansas Uplift that caused the post-Lansing unconformity. The upper part of the Missourian series had been eroded, indicated by the detrital material which was found on the flank of the dome above the Lansing.

Throughout the remainder of Pennsylvanian and Permian time, there was no marked structural activity, although there was continuous structural growth. The third period of major structural growth is thought to have taken place after Cretaceous time - the area being affected by the deformation occurring to the northwest of the dome. During this time the dome was tilted to the northwest (Rutledge and Bryant, 1937).

GEOLOGICAL HISTORY

Pre-Cambrian Era

Regional metamorphism occurred in Kansas during the pre-Cambrian which changed the sandstones and shales into quartzites and schists respectively. Farquhar (1951) inferred that an earlier granite was intruded at this time causing the overlying sediments to melt and form a migmatic texture. The metamorphosed sediments and the granitic intrusive have the same foliation. The regional metamorphism is believed to be representative of a period of pre-Cambrian orogeny by the evidence of steep dips and microscopic deformation of the quartzite which was produced by lateral compression and isoclinal folding.

The "later" granite which intruded this metamorphic group was hypidiomorphic, batholithic in area, and was emplaced by a series of phases, rather than by a continuous process.

The pre-Cambrian rocks were peneplained with the exception of a few low hills before the Cambrian sediments were deposited. This inference is made from the uniform thickness of the Cambrian sediments.

The pre-Cambrian surface was subjected to four major structural periods: (1) During the deposition of the Arbuckle group; (2) Between the Simpson and Mississippian time, when the Chautauqua Arch was uplifted and then subsided before Pennsylvanian time; as part of the Cherokee Basin syncline; (3) During post-Mississippian, when the Central Kansas Uplift was formed as well as the Nemaha Anticline and Cambridge Arch; and (4) During the Cretaceous and post-Cretaceous time when the Central Kansas Uplift was tilted northwardly. Only five wells have been drilled to the pre-Cambrian granite which are located in T. 26 S, R. 13 W, R. 13 W, T. 27 S, R. 13 W, T. 28 S (Farquhar, 1957).

Paleozoic Era

During the Waucoban and Albertan epoch the area of investigation was sub-aerially eroded. In Croixian times, the sea had covered Kansas and the Reagan (LaMotte) sandstone was deposited. The minor source of the sandstone could possibly have been the intruded batholiths which were topographical highs during the advancement of the Cambrian Sea. The major source was probably from the pre-Cambrian rocks of the Sierra Grande Uplift located in Southeastern Colorado and from the Siouxia Uplift in Northeastern Colorado.

The Bonneterre dolomite was deposited as a continuous deposition indicated by the Reagan sandstone grading into the former formation. At the close of the Cambrian, the Central Kansas Uplift was elevated and erosion of the earlier sediments resulted.

The Eminence dolomite and the Van Buren-Gasconade dolomitic sequence may have been deposited and then removed by post-Bonneterre erosion, or their absence might be representative of a non-depositional period.

When the seas advanced again in lower Ordovician times, the Roubidoux dolomite was deposited. The Jefferson City-Cotter dolomite sequence conformably overlies the Roubidoux dolomite. The seas retreated and the latter sequence was subjected to erosion before the sea returned and deposited the St. Peter sandstone. The areal extent of this sandstone indicates the erosion was not too intensive as there is very little topographic relief. The Plattville formation was probably deposited but removed by pre-Viola erosion (Lee, 1956).

In Devonian times, the sea advanced and deposited the Chattanooga shale, after which the area was uplifted. There was a long period of erosion before the Boice shale of the Kinderhookian series was deposited. The Chattanooga shale is often erroneously referred to as "Kinderhook" shale.

At the close of the Mississippian period, tectonic activity was very prevalent in Kansas. The Nemaha Anticline was uplifted and the Salina and Forest City Basin were formed. The Central Kansas Uplift was re-elevated and had regional warping associated with it. The Mississippi strata in Pratt County were deeply eroded.

During Pennsylvanian times, the seas advanced and retreated repeatedly, as evidenced by the presence of alternating limestone and shale deposits.

The Desmoinesian series of rocks covered most of the state, with the exception of a few highs on the Central Kansas Uplift. It was not until Kansas City time during the Missourian Epoch that Kansas was completely blanketed by Pennsylvanian sediments (Moore, et al, 1951).

The seas retreated after the Missourian Epoch with minor erosional activity before the sea readvanced and the rocks of the Virgilian series were deposited.

The Wolfcampian sequence of the Permian represents cyclic deposition is similar to the upper Pennsylvanian rocks. During Leonard time, the sea retreated to the area in Central Texas where it deposited salt beds in the Permian Basin.

In Kansas, this sea left isolated bodies of water which were evaporated and formed the Wellington salt formation.

Mesozoic Era

The area during Triassic and Jurassic periods was positive. During Triassic times, the Hugoton Embayment was destroyed by minor northwestward tilting into the Denver Basin of Eastern Colorado. Then this area was tilted slightly to the south before the early Cretaceous sediments were deposited (Merriam, 1955). In Cretaceous times, the sea advanced and deposited the Cheyenne sandstone which is regarded as a deposit of its strand line. The sandstone is nonmarine in origin, indicated by the presence of fossil land plants and the absence of marine fossils (Merriam, 1957).

As the Cretaceous sea transgressed, the Kiowa shale was deposited. The marine origin is indicated by macro- and micro-marine fossils present in the shale (Merriam, 1957).

The seas retreated after depositing the Kiowa shale, and the area was eroded before the Dakota formation was laid down by the advancement of the Gulfian Sea. The Dakota sandstone was the strand line deposit of this sea, and the Colorado and Montana groups were deposited as the sea advanced further. Erosion removed the Colorado-Montana groups and the Dakota formation, leaving only the Dakota in the extreme western portion of the county.

There was minor tectonic disturbance during the Cretaceous period; the exceptions being the syncline which developed on the Oakley Anticline and minor movements associated with the Cambridge Arch. Before the close of the Cretaceous period, the Hugoton area was tilted northwestward into the Denver Basin again, and the sediments were folded (Merriam, 1957).

Cenozoic Era

During Tertiary times the Permian sediments were partially eroded, as was the Ogallala formation of Tertiary age, which received its sediments from the re-elevated Rocky Mountains. Only in the northeastern part of Pratt County is the Ogallala formation present.

The Pleistocene epoch is characterized by the Pearlette ash which was deposited in parts of Pratt County. The prevailing wind at the time was from the southwest, and in 1928, Landes stated that the origin of the ash was the Mt. Capulin region.

Swineford (1949) is of a different opinion. She says that the cones are too small and the composition of the lavas are basic instead of acidic. An inference was made that acid tuff and pumice were present but became buried by later lava flows. Another source may have been the Columbia Plateau area but the prevailing wind was not from that direction. The source which is considered the most likely is the area of the Valle Grande, in North Central New Mexico. The following four reasons for this conclusion are; (1) The crater is 13 to 17 miles in extent and ejected enormous amounts of acidic lavas, (2) The volcano lies to the southwest of the Pearlette ash beds, (3) The petrographic study is similar to the ash of Kansas, (4) The tuffs are early Pleistocene in age (Swineford, 1949).

HISTORY OF DRILLING IN PRATT COUNTY

The locations of the oil and gas pools are shown in (Fig., 6 of the Appendix). The accumulative production statistics, as well as 1956 production of the oil and gas resources are shown in the Appendix in Tables 1 and 2 respectively.

In July, 1935, the first well in Pratt County was drilled on the Maxedon farm in Sec. 25, T. 27 S., R. 11 W. The discovery well was on the western part of the Cunningham Dome and produced from the Lansing (Oswald) limestone at a depth of 3,460 feet. The porosity does not seem to be very uniform as the production decreases from the depths of 3,441, 3,445, 3,454, and 3,457 feet (Ver Wiebe, 1938).

The Cairo Gas pool was discovered in 1935 by the Skelly

Oil Company which drilled on the Gilchrist farm in Sec. 7., T. 28 S., R. 11 W. The well struck a gas zone in the Viola limestone at a depth of 4,278 feet and was found to have a potential of 14 million cubic feet of gas per day (Ver Wiebe, 1938).

In 1937, the Atlantic Refining Company discovered the second oil pool in Pratt County. The discovery well was drilled on the Runon farm in Se. 11., t. 27 S., R. 13 W. The dolomite at the top of the Simpson formation, at a depth of 4,292 feet, was an excellent producer with a potential of 397 barrels of oil per day and two million cubic feet of gas. This formation yielded 2,921 barrels of oil in 1937 (Ver Wiebe, 1938).

In 1938, there was a fair amount of drilling which resulted in five oil wells, two gas wells, and eight dry holes (Ver Wiebe, 1938).

There were 25 wells completed by 1939, including four oil wells, 19 gas wells, and two dry holes. One of the largest wells in Kansas was drilled in Sec., 25., T.27 S., R. 11 W, which had a potential of 109,000,000 cubic feet per day, after being acidized with 1,000 gallons of acid (Ver Wiebe, 1940).

Twenty-four wells were drilled in 1940, which resulted in 12 oil wells, 8 gas wells, and 24 dry holes. The Arbuckle dolomite of the Iuka pool in Sec. 1., T.27 S., R. 13 W, was reached at a depth of 4,354 feet and has a porous zone of 13 feet. The potential production from this zone was 1,572 barrels of oil. The nine gas wells completed in the Cairo pool, produced 14,000,000 to 70,000,000 cubic feet per day (Ver Wiebe, 1941).

In 1941, there were 27 wells drilled in the Cunningham pool in Pratt and Kingman Counties, 23 of which were oil producers. Of the 27 producers, 20 were drilled in Pratt County, located mainly in sections 24, 25, 35, 36, T. 27 S., R. 11 W. All these wells produced from the Kansas City-Lansing limestone.

Two wells were drilled in the Cairo oil pool and both became producers. This pool is considered to be separate from the Cunningham pool, even through it overlaps the pool since it produces from the Viola. The Iuka pool had four wells drilled to the Simpson formation and all became producers.

A new gas pool was discovered in Sec. 18., T, 26 S., R. 12 W. The discovery well showed zones of oil at the top of the Lansing and in the Simpson formation at a depth of 4,241 to 4,245 feet, but the zones were not potentially good enough to produce, so the well was plugged and the Viola limestone at 4,150 feet was tested for gas. The test was favorable and a production capacity of 12 million cubic feet of gas per day was assigned. This pool was named the Stark Pool. The Ward gas pool was also discovered with an initial flow of 2 1/2 million cubic feet per day. (Ver Wiebe, 1942).

During 1942, there were 18 new wells drilled in the Iuka pool, 12 of which were producers. The Cairo gas pool had three wells drilled, with the result of one producer, the number one Lunt Well Sec. 18., T. 28 S., R. 11 W.

The Carmi pool, situated two miles northeast of the Iuka pool, was discovered. The discovery well had a potential of 3,000 barrels from the Arbuckle dolomite. Production was from the depth of 4,271 and 4,281 feet (Ver Wiebe, 1943).

Pratt County, in the year of 1943, was the site of the most important oil discoveries in the state of Kansas. These discoveries were the extensions of many small pools and the Cairo gas pool had oil discovered on its southern flank. The Ward and Stark pools were joined and the latter name was retained. The Stark pool which was not developed for gas was discovered to contain good oil zones and was developed for oil.

The Chitwood pool was discovered in Sec. 23., T. 28 S., R. 12 W, and produced from the Simpson dolomite between 4,396 and 4,399 feet. This pool was the important discovery in Pratt County and is believed to be an extension of the Cairo gas pool.

The Frisbie pool was discovered in Sec. 5., T. 26 S., R. 13 W, which produced from the Kansas City-Lansing limestone. The test well had a potential of 500 barrels of oil per day. There were only 10 wildcat wells drilled during 1943, which seems rather strange if one considers the important discoveries in the county (Ver Wiebe, 1944).

In 1944, 103 wells were drilled and three new pools were discovered. The discovery well of the Coats pool had a potential capacity of 731 barrels of oil per day; the discovery well of the Ludwick pool produced from the Simpson, is a six foot zone. The discovery well of the Shriver Pool had a potential of 344 barrels of oil per day. In this year the Cunningham and Cairo pools were combined, and now this area is called the Cunningham pool (Ver Wiebe 1945).

Drilling in Pratt County diminished to a great extent in 1945 as compared to the previous year as only 57 wells were drilled.

The Chitwood and Carmi pools produced gas for the first time from the Viola limestone. No new pools were discovered during the year (Ver Wiebe, 1946).

In 1946, three pools were discovered. The Discovery well of the Chance pool produced oil from the Arbuckle dolomite at the rate of 700 barrels a day. The Stoop pool was discovered when well samples were studied from a dry abandoned hole, and heavy oil stains were observed on the Viola limestone. The well was reopened and had a potential of 795 barrels of oil per day. The Stoop Southwest pool was the third pool to be discovered. Its discovery well had a potential of 165 barrels per day, producing from the Viola. Of the 50 wells drilled in the county, 34 became producers (Ver Wiebe, 1947).

The year 1947 showed a marked decrease in drilling as only 20 wells were drilled, six of which produced oil (Ver Wiebe, 1948).

One pool was discovered in 1948, which was the Frisbie Northwest pool. It produced from the Kansas City-Lansing limestone between a depth of 3,788 and 3,800 feet. This zone is 80 feet below the top of the Lansing. The Clara pool, which is in Barber County, was extended into Pratt County (Ver Wiebe, 1949).

In 1949, one oil pool was discovered which was named the Moore pool. The discovery well produced from the Simpson formation at a depth of 4,384 and 4,370 feet. Its initial production amounted to 40 barrels of oil a day with 10 barrels of water (Ver Wiebe, 1950).

The Chitwood Northeast pool was discovered in 1950. The discovery well produced 23 barrels of oil per day and had some water contamination from the top of the Viola. Of the 29 wells drilled, 14 produced oil, 1 gas, and 14 were dry (Ver Wiebe, 1951).

There was a marked increase in drilling in 1951, for 73 new wells were drilled as compared to 29 of the previous year. The Iuka and Carmi pools were joined and was named the Iuka-Carmi pool. The Chance pool was also extended when 30 producers were drilled in the surrounding area (Ver Wiebe, 1952).

In 1952, an increase in drilling of 30% resulted in 300,000 more barrels of oil produced than in 1951. There were four pools discovered: the Barnes, Blowout, Chance East and the Jarbo pools. The discovery wells in the Barnes and Blowout pools had a potential of 8 million cubic feet of gas per day. The former pool produced from the Simpson, and the latter produced from the Lansing. The Chance pool was opened with a well rated at 220 barrels of oil per day and produced from the Viola limestone. The Jarbo pool produced from the Lansing-Kansas City Sequence, with an initial potential of 3 1/2 barrels of oil per day.(Ver Wiebe, 1953).

In 1953, eight pools were discovered which are as follows: Fitzsimmons, Frisbie East, Gereke, Hertlein, Iuka-Carmi Northwest, Iuka-Carmi South Lion, and Moore Southwest. The latter pool is the most important of the new discoveries. Only three dry holes were drilled as compared to eight new producing wells. The discovery well was rated at 28 barrels of oil per day from the producing zone of the Simpson formation, at a depth of 4,364 to 4,366 feet. The Iuka-Carmi pool had the most development, as 46 extension wells were drilled (Ver Wiebe, 1954).

There were 96 wells drilled in 1954 which was 35 less than the previous year, but eight pools were discovered nevertheless. They are as follows: the Cairo North, produced from the Viola limestone; the Chance North; Chance Northwest; Coats North; Earl and Fitzsimmons South, produced from the Simpson groups; and the Lion Northeast and Tatlock, produced from the Lansing-Kansas City sequence. The Iuka-Carmi pool was again the most developed pool with 15 new producers being drilled (Ver Wiebe 1955).

Even though there was a reduction in drilling in 1955, with 79 wells being drilled, eight pools were discovered which were: the Carver-Robbins that produced from the Pennsylvanian basal conglomerate; the Coats West which produced gas from the Lansing-Kansas City sequence; the Earl North that produced from the Simpson group; and the Randle pool which produced oil from the Lansing-Kansas City. The Chitwood Northeast field discovered in 1950 was combined with the Cunningham field (Goebel, et al, 1956).

In 1956, three pools were discovered which were the Carver-Robbins Oil field, Haskins oil field, and the Cullison gas field. The Iuka-Carmi pool, the largest oil and gas field in Pratt County, had the most development with six oil wells being drilled (Goebel, et al, 1957).

THE RELATIONSHIP OF STRUCTURE AND STRATIGRAPHY TO PETROLEUM ACCUMULATION

Arbuckle Production

There is no Arbuckle production in the northwest portion of the county. The major production of oil from the Arbuckle group is in the Iuka-Carmi field, which is located on a structural high on the Pratt Anticline with a closure of 120 feet (Appendix, Fig., 6). The Chitwood pool which lies on the same trend as the Cunningham field also has a closure of 120 feet. The production of the Chance, Chance East, and Coats pools, is associated with anticlinal noses. This production is probably due to variations in porosity and permeability. The Arbuckle group has numerous highs in which oil is not present. Decrease in permeability and porosity may be the cause for the absence of oil.

Pre-Simpson erosion produced the characteristic Karst topography of the Arbuckle. Deep basins were produced in T. 27 S, R. 13 W, T. 29 S, R. 13 W, as well as the one paralleling the north side of the Cunningham structure. This period of erosion caused an increase in the porosity and permeability of the Arbuckle which offered favorable conditions for the accumulation of oil.

Simpson Production

The St. Peter's sandstone of the Simpson group is an excellent oil reservoir where the sandstone is clean. Production from the Simpson group is wide-spread throughout the county. The Iuka-Carmi field which is the largest oil field in Pratt County, produces principally from the Simpson group.

Viola Production

Viola production is present through most of Pratt County with the exception of the southeastern portion. Pre-Mississippian weathering has caused this formation to become very porous and consequently it is a very good oil producer. The thickness of the oil producing zone varies from 2 to 16 feet. The fields that produce from the Viola limestone are the Carver-Robbins Northeast, Chance, Chance East, Chitwood, Cunningham, Haskins, Iuka-Carmi, Iuka-Carmi Northwest, Lion, Stark, Stoops, and Stoops Southwest.

Mississippian Production

There are four pools producing oil from the Mississippian lime. They are the Chance, Chance East, Cullison, and the Iuka-Carmi pools. The oil has accumulated in a structural high having 80 feet of closure in the Iuka-Carmi field, and the other pools are located in structural noses (Appendix, Fig., 7). The producing zones vary from 13 feet to 24 feet in thickness.

The oil occurs in the cavities of the limestone or in the weathered chert. The limestone openings are quite large and are connected by devious solution channels. These openings are often sealed by cementation, but when they are acidized, they are opened. The Mississippi-lime contains oil in its coarse and interconnected cavities. It produces a large initial yield, followed by sharp decline in production.

The rocks of the Mississippi System are missing in the southeastern part of T. 29 S, R. 14 W, and the southeastern portion of T. 29 S, R. 15 W. There is no oil accumulation associated with the pinchout of the Mississippian sediments onto the Lansing group.

Lansing and Kansas City Production

The producing zone of the Lansing-Kansas City averages approximately five feet, with the exception of the Iuka-Carmi field that produces from a zone 31 feet thick. The Lansing-Kansas City production in Pratt County is distributed over small nosing structures and structural highs with no more than twenty feet of closure (Appendix, Fig., 8).

The production is mainly from an oölitic zone of four to five feet in the Cunningham field. The porosity in this zone was caused by solution which removed numerous oölites. Production is also obtained from the fractured cherty limestone which has a thickness of two to three feet. The fractures are more numerous toward the top of the structure as is indicated by the increased production of oil and gas.

A cross-section of this formation shows that there is some thinning over areas of production (Appendix, Fig., 5). Closures of 20 feet or less are characteristic of the Blowout, Moore Southwest, Stark, Haskins. The Chitwood field has 30 feet of closure, and the Cunningham field has 160 feet of closure. The fields that produce from structural noses are Chance East, Hertlein, Iuka-Carmi, Lion Northeast, Randle, Tatlock, and Fitzsimmons. The Jarboe is also located on a structural nose but is now abandoned.

CONCLUSIONS

The major portion of oil production, with the exception of the Cunningham Dome, is located on the Pratt Anticline and along its flanks. There is minor accumulation of oil on the southern part of the anticline. The cross-sections show there is a thinning of the formations where oil is localized. The trend of oil fields is mainly southwest and southeast, although the trend changes to north-south in the extreme northern portion of the county where it is dominated by the southern flank of the Central Kansas Uplift.

The latest statistics available, through 1956, show that Pratt County ranked thirteenth in production, with a total of 39,201,314 barrels of oil. The oil was taken from an accumulative area of 22,140 acres. The Iuka-Carmi field is the largest pool, followed by the Chitwood, Cunningham, and Chance pools. These four fields have produced 85% of all the known oil in Pratt County.

The future possibilities for oil discoveries in Pratt County are not very encouraging as the crest and flanks of the Pratt Anticline have been fairly well developed. Future pools will undoubtedly be discovered, but they will probably be small structural or stratigraphic traps.

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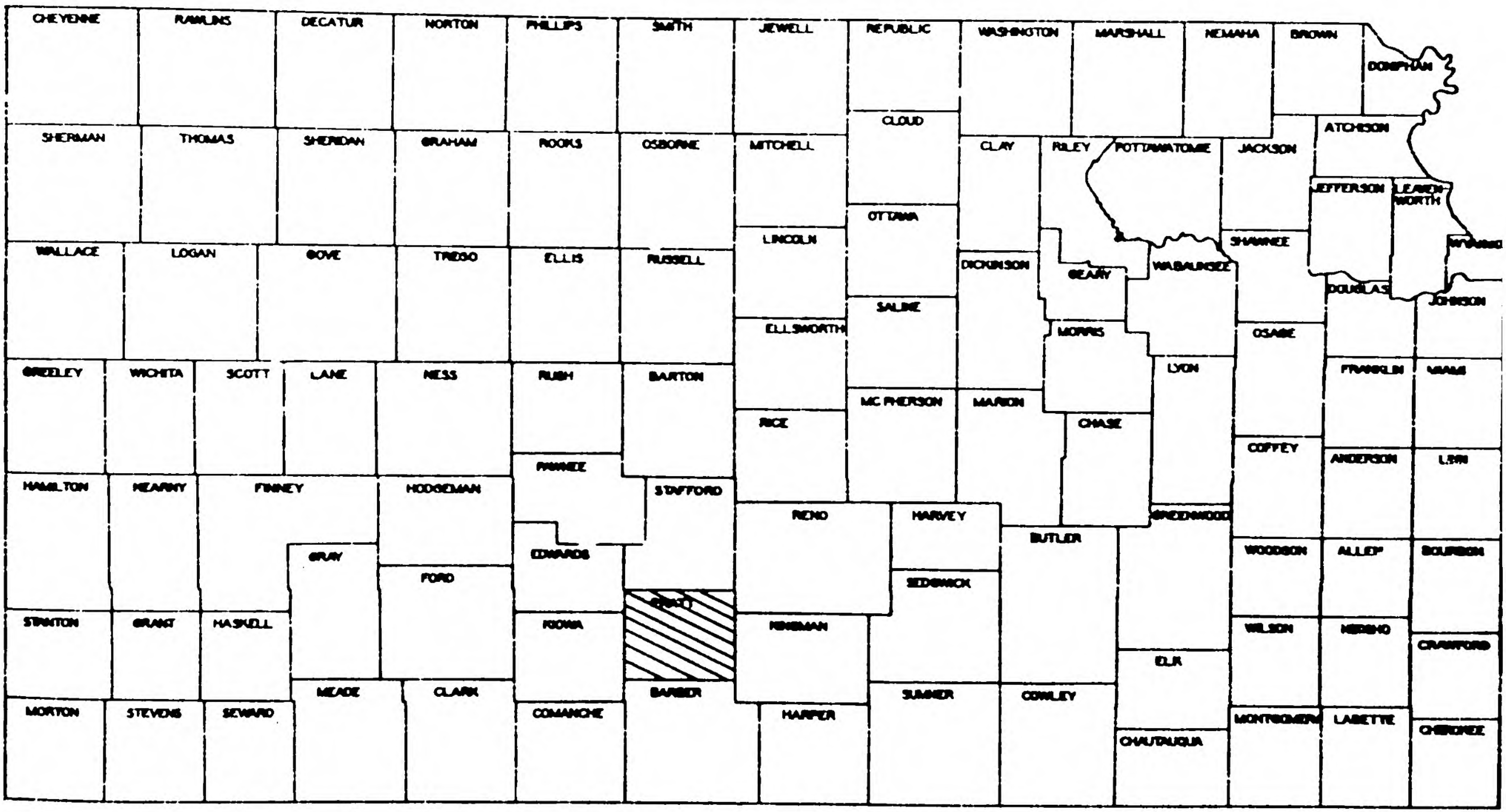
APPENDIX



Area covered by this thesis

Fig. 1. Map of Kansas showing the location of Pratt County

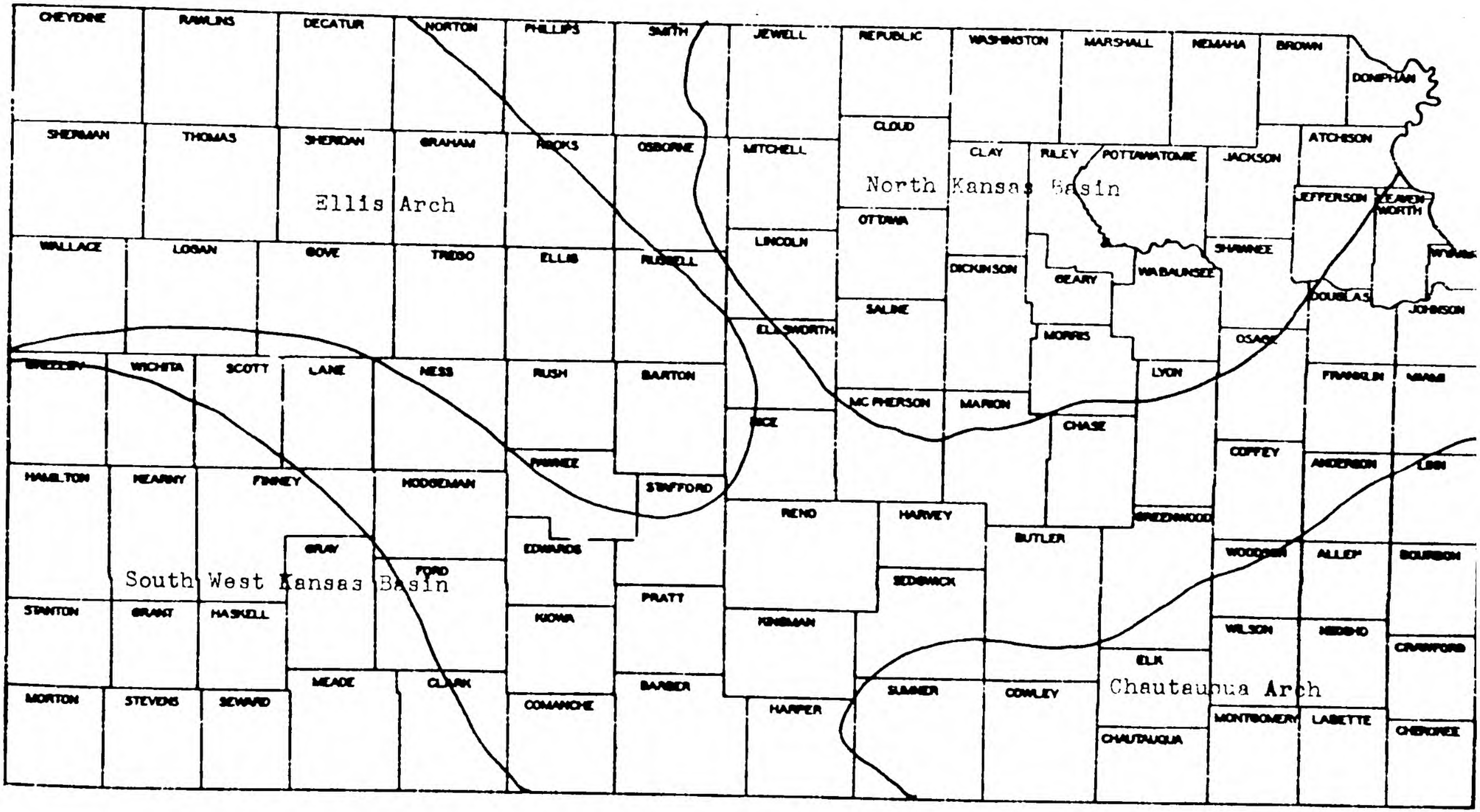
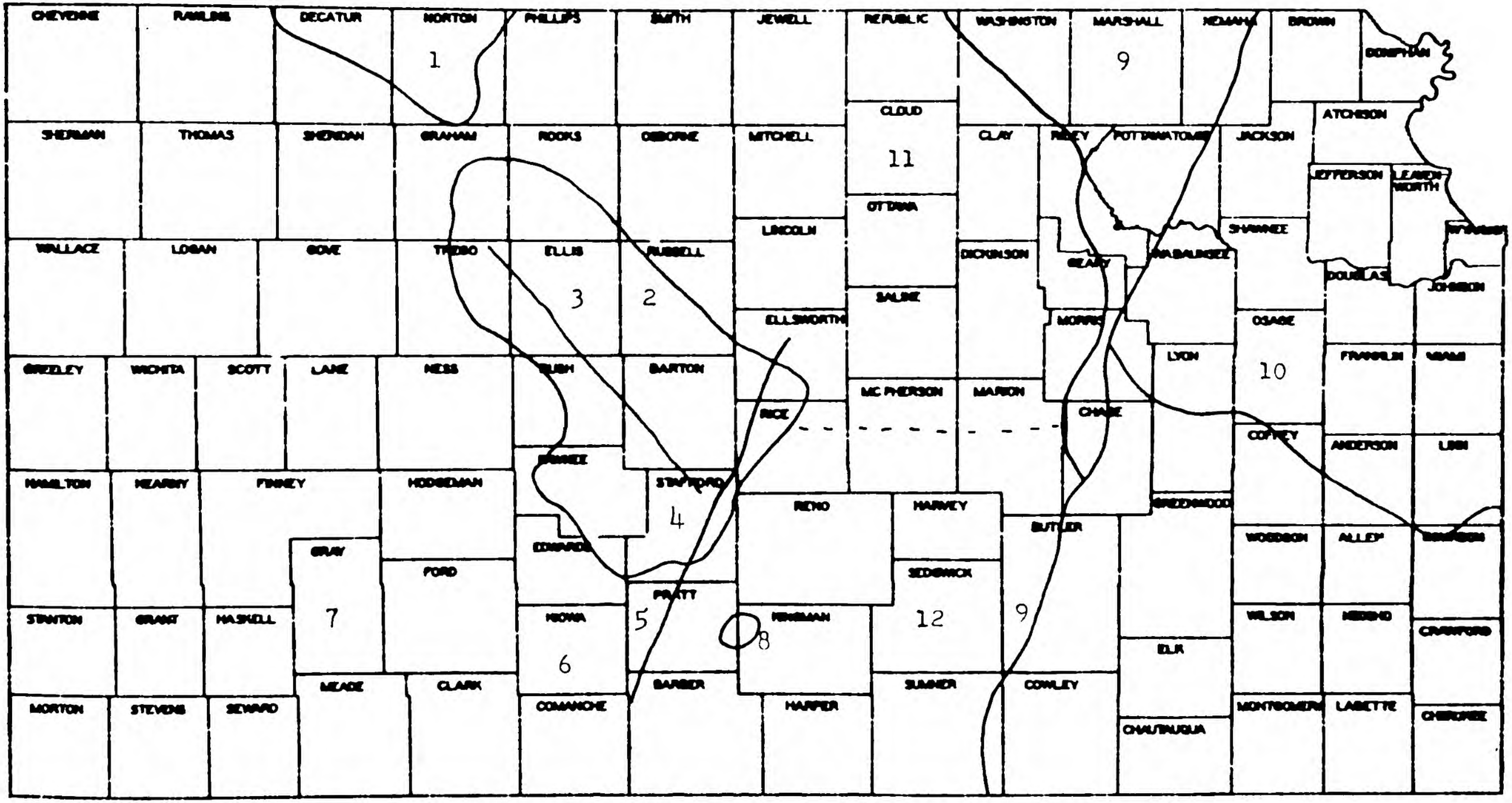


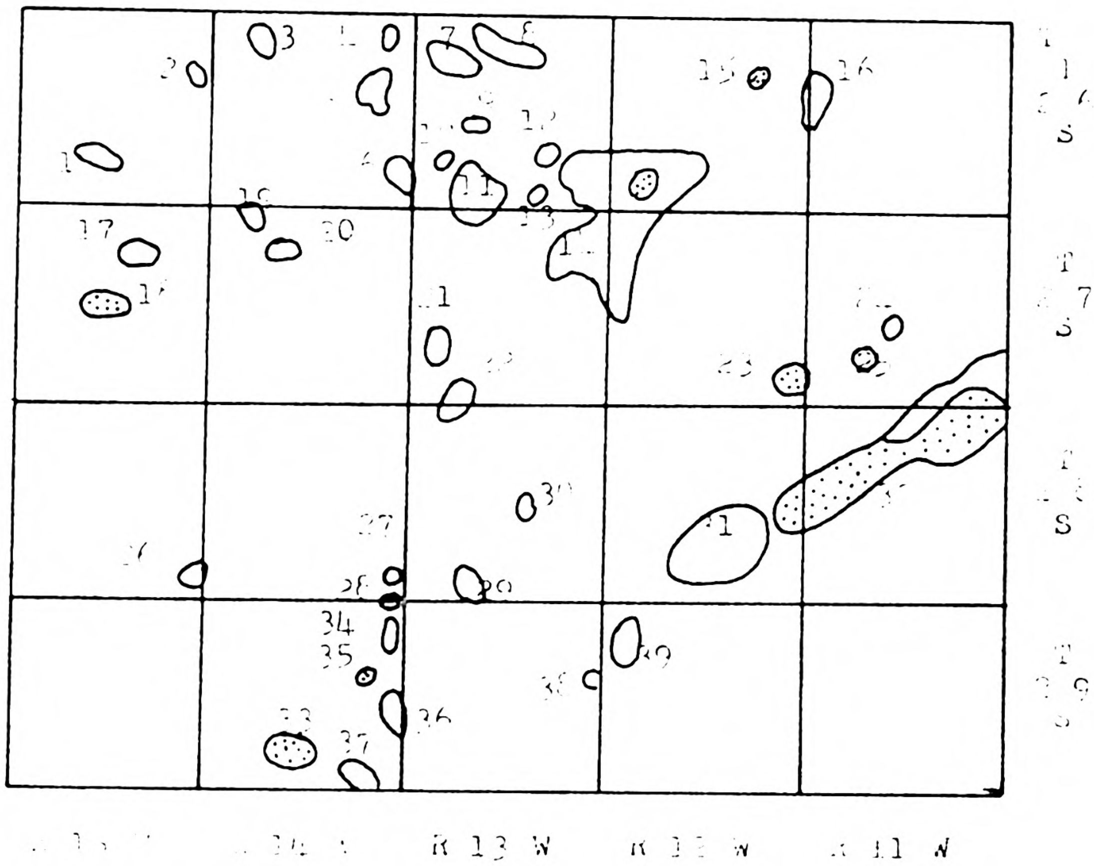
Fig. 2. Geographical distribution of major pre-Mississippian structures in Kansas.



Explanation: 1. Cambridge Arch 2. Central Kansas Uplift 3. Rush Rib 4. Ellsworth anticline 5. Pratt Anticline 6. Northern Basin Shelf 7. Hugoton Embayment 8. Cunningham Dome 9. Nemaha Anticline 10. Forest City Basin 11. Salina Basin 12. Sedgwick Basin.

Fig. 3

Geographical distribution of major and minor structures in Kansas.



Explanation: Oil field   Gas field

INDEX

1. Tatlock	14. Iuka-Carmi	27. Earl N
2. Hereke	15. Ward	28. Earl
3. Randle	16. Stark	29. Ludwick
4. Coole	17. Carver-Robbins N	30. Wertlein
5. Moore Sw	18. Carver-Robbins	31. Chitwood
6. Jarboe	19. Haskins	32. Cunningham
7. Frisbie	20. Blowout	33. Shriver
8. Frisbie Nw	21. Fitzsimmons	34. Coats N
9. Chance N	22. Fitzsimmons S	35. Coats W
10. Chance Nw	23. Barnes	36. Coats
11. Chance	24. Lion Nw	37. Clara
12. Iuka-Carmi Nw	25. Lion	38. Stoops Sw
13. Chance E	26. Collison	39. Stoops

Fig. 4. Map of Pratt County showing the location of oil and gas pools.

Table 1. Producing oil fields in Pratt County, Kansas

Field and Year of Discovery	Discovery Well Location	Area Acres	Oil production, bbls. 1956	Oil production, bbls. Cumulative	Producing Wells	Producing Zone
Blowout ('52)	8-27-14W	40	1,708	9,761	1	Lans.-K.C.
Cairo North ('54)	6-28-11W	80	10,779	39,526	2	Viola
Carver-Robbins Northeast ('56)	10-27-15W	160	1,118	1,118	2	Penn. Congl.
Chance ('46)	4-27-13W	1,600	255,027	3,219,555	72	Marmaton Mississippian Viola Simpson Arbuckle
Chance East ('52)	34-26-13W	320	8,730 53,286 15,195 13,480	261,982	1 7 2 2	Lans.-K.C. Mississippian Viola Simpson Arbuckle
Chance North ('54)	21-26-13W	80	1,962	11,839	2	Simpson
Chance Northwest ('54)	29-26-13W	120	13,026	67,754	3	Simpson
Chitwood ('43)	23-28-12W	2,000	419,060	8,481,898	69	Lans.-K.C. Viola Simpson Arbuckle
Clara* ('48)	36-29-14W	140	8,111	194,297	5	Simpson
Coats ('44)	24-29-14W	200	9,935	433,806	8	Arbuckle
Coats North ('54	12-29-14W	80	18,216	89,483	2	Marmaton

Table 1. (Cont'd.)

Field and Year of Discovery	Discovery Well Location	Area Acres	Oil production, bbls. 1956	Oil production, bbls. Cumulative	Producing Wells	Producing Zone
Cullison ('56)	25-28-15W	40	2,788	2,788	1	Simpson Mississippian
Cunningham* ('31)	7-28-11W	4,800	84,017	4,898,646	67	Lans.-K.C. Viola
Earl ('54)	36-28-14W	200	17,934	84,477	4	Lans.-K.C. Simpson
Earl North ('55)	36-28-14W	40	7,756	9,329	1	Simpson
Fitzsimmons ('53)	30-27-13W	160	35,792	116,800	5	Lans.-K.C.
Fitzsimmons South ('54)	31-27-13W	300	52,431	89,617	8	Lans.-K.C. Simpson
Frisbie ('43)	5-26-13W	400	54,091	460,904	9	Lans.-K.C.
Frisbie Northeast ('48)	4-26-13W	400	30,774	308,692	12	Lans.-K.C. Viola Simpson
Gereke ('53)	12-26-15W		no report	28,021		Viola
Haskins ('56)	5-27-14W	80	4,598	4,598	2	Lans.-K.C. Viola
Hertlein ('53)	22-28-13W		no report	307		Lans.-K.C.
Iuka-Carmi ('37)	11-27-13W	8,780	84,852 1,219 68,477 1,085,771 231,971	18,091,318	17 1 13 164 43	Lans.-K.C. Mississippian Viola Simpson Arbuckle

Table 1. (Concl.)

Field and Year Of Discovery	Discovery Well Location	Area Acres	Oil production, bbls. 1956	Oil production, bbls. Cumulative	Producing Wells	Producing Zone
Iuka-Carmi Northwest ('53)	26-26-13W	400	19,537	95,914	6	Viola Simpson Arbuckle
Jarboe ('52)	25-26-14W		no report	1,267		Lans.-K.C.
Lion ('53)	29-27-11W		no report	none		Viola
Lion Northeast ('54)	21-27-11W	40	8,552	25,132	1	Lans.-K.C.
Ludwick ('44)	4-29-13W	40	1,258	36,156	1	Simpson
Moore ('49)	1-26-14W	400	18,115	220,038	2	Viola Simpson
Moore Southwest ('53)	11-26-14W	640	21,071	121,227	10	Lans.-K.C. Kinderhookian Simpson
Randle ('55)	5-26-14W	100	13,961	19,813	2	Lans.-K.C.
Shriver ('44)	33-29-14W	300	25,475	768,223	6	Simpson
Stark ('41)	18-26-11W	40	240	859,316	1	Lans.-K.C. Viola
Stoops ('46)	7-29-12W	80	1,910	93,910	2	Viola
Stoops Southwest ('46)	24-29-13W	40	852	18,305	1	Viola
Tatlock ('54)	28-26-15W	40	18,200	35,497	2	Lans.-K.C.
Total Pratt County		22,140	2,762,605	39,201,314		

* Field extends into adjacent county or counties.

Table 2. Gas fields and gas production in Pratt County, Kansas

Field and Year of Discovery	Discovery Well Location	Area Acres	Gas Production, M cu.Ft.** 1956	Cumulative	No. Wells	Producing Zone
Barnes ('52)	25-27-12W		no report	none		Simpson
Carver-Robbins ('55)	21-27-15W		no report	none		Penn. Congl.
Chance ('46)	4-27-13W	40	3,000		1	
Chitwood ('43)	23-28-12W		no report	10,089,598		Viola
Coats West ('55)	24-29-14W		no report	none		Lans.-K.C.
Cullison ('56)	25-28-15W		no report	none		Mississippian
Cunningham* ('31)	7-28-11W	8,000	509,095		31	Lans.-K.C.
			371,429		5	Viola
			45,661		1	Arbuckle
Iuka-Carmi ('42)	29-26-12W	600	429,051	3,648,793	5	Viola
Lion ('53)	29-27-11W		no report	none		Viola
Shriver ('49)	27-29-14W		no report	104,191		
Stark ('41)	13-26-12W		no report			Viola
Ward ('41)	11-26-12W		no report			Viola
Total Pratt County		8,640	1,358,236	17,339,802	43	

* Field extends into adjacent county or counties.

** All figures at base of 14.65 psia.

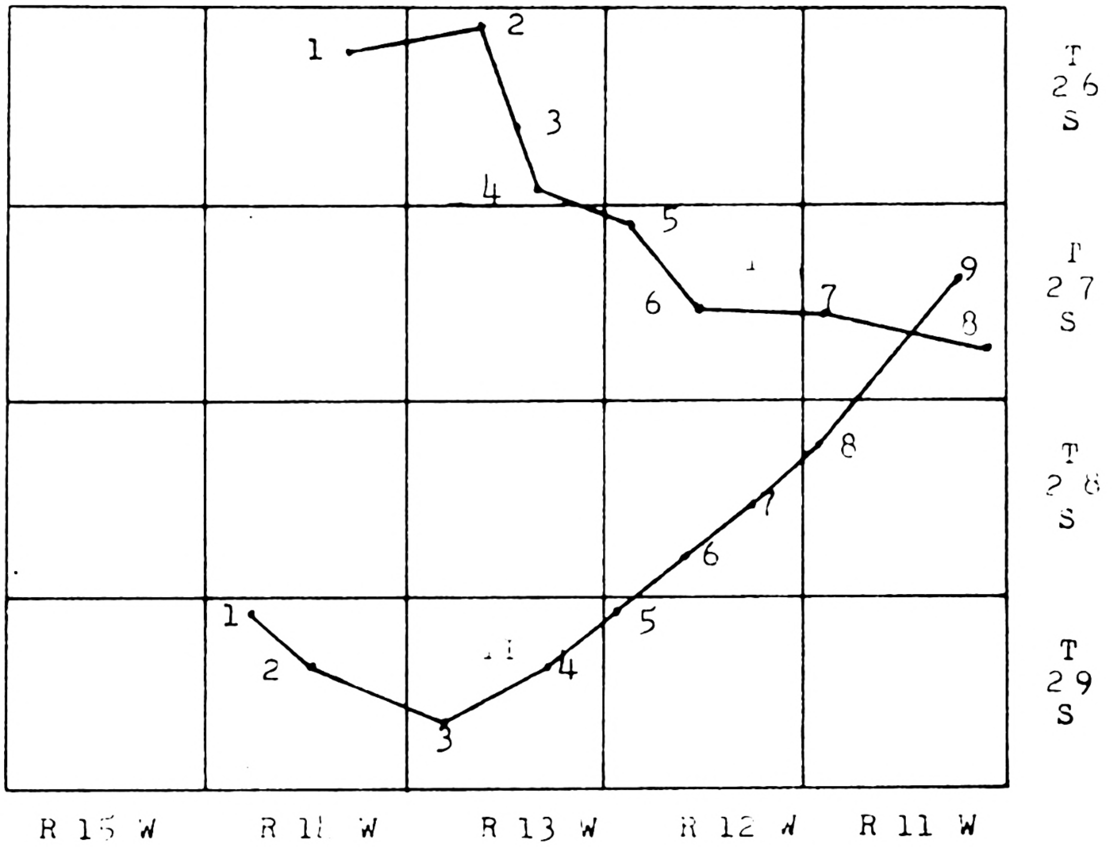
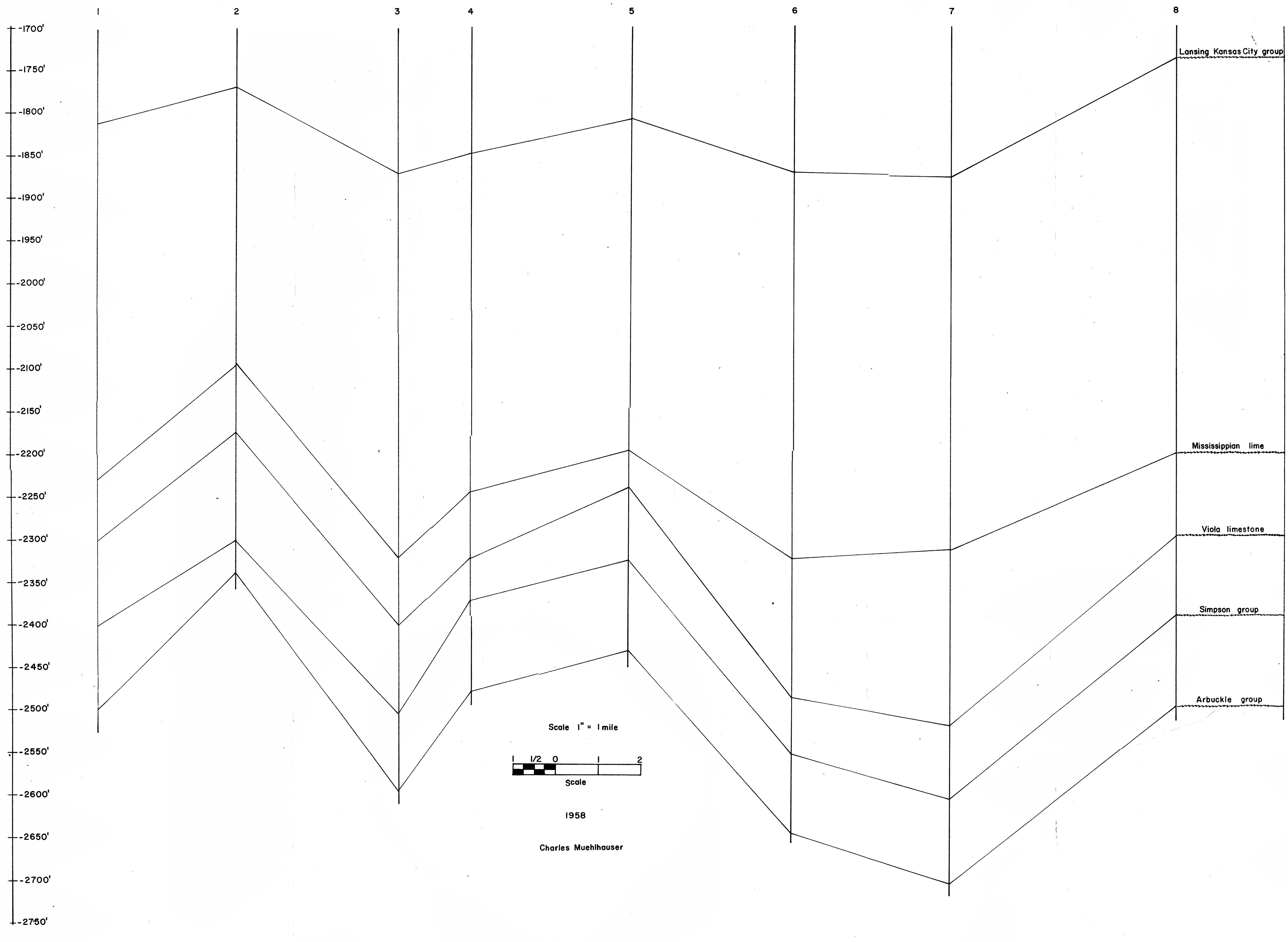


Fig. 5. Map of Pratt County showing general locations of cross sections.

CROSS SECTION NUMBER I

PRATT COUNTY, KANSAS

Fig 5



CROSS SECTION NUMBER II

PRATT COUNTY, KANSAS

Fig 5

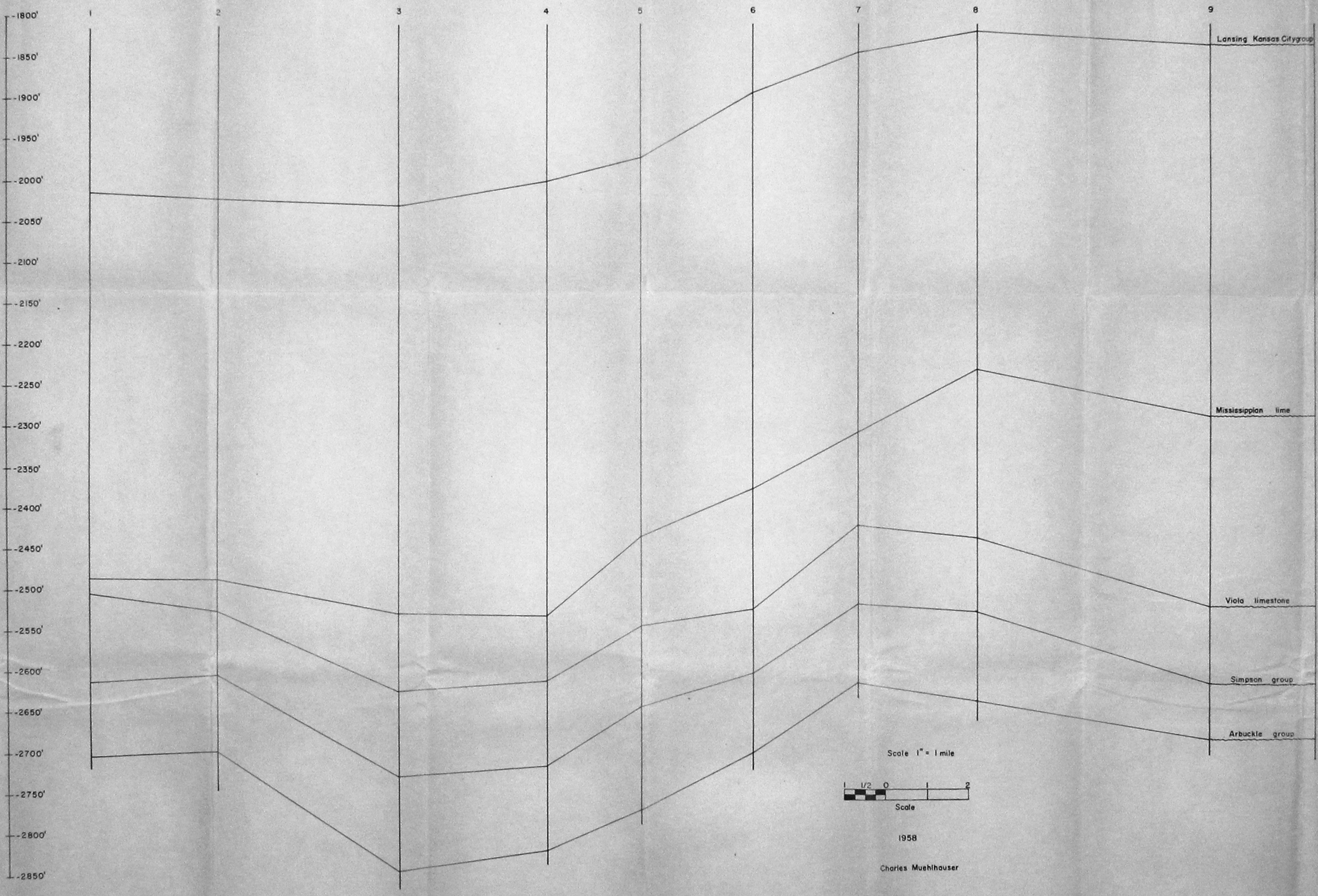


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Table 3. The exact location of wells used on Cross-Section I.

Well No.	Well Location	Source	Elevation	Lansing-K.C.	Mississippian	Viola	Simpson	Arbuckle
1	11 26S 14W SENENE	Herndon Map	1983	-1813	-2230	-2301	-2402	-2500
2	4 26S 13W NWNWNE	Driller's Log	1936	-1766	-2092	-2169	-2297	-2334
3	21 26S 13W SWSWSE	Driller's Log	1943	-1869	-2320	-2394	-2505	-2588
4	33 26S 13W NENESW	Driller's Log	1956	-1842	-2237	-2320	-2372	-2477
5	6 27S 12W SWSWNE	Driller's Log	1877	-1801	-2186	-2228	-2313	-2419
6	21 27S 12W NWNWSE	Herndon Map	1842	-1861	-2318	-2477	-2549	-2641
7	19 27S 11W NESWSW	Herndon Map	1797	-1863	-2310	-2520	-2605	-2643
8	25 27S 11W NWSENE	Herndon Map	?	-1727	-2190	-2288	-2379	-2483

Table 4. The exact location of wells used on Cross-Section II.

Well No.	Well Location	Source	Elevation	Lansing-K.C.	Mississippian	Viola	Simpson	Arbuckle
1	5 29S 14W NENESW	Herndon Map	2031	-2014	-2482	-2506	-2616	-2704
2	15 29S 14W SESESW	Herndon Map	1988	-2027	-2486	-2528	-2596	-2694
3	29 29S 13W SWSWNE	Herndon Map	1933	-2030	-2553	-2634	-2747	-2840
4	14 29S 13W NESENW	Herndon Map	1913	-2006	-2529	-2605	-2722	-2822
5	6 29S 12W SENESW	Herndon Map	1886	-1969	-2427	-2553	-2650	-2770
6	28 28S 12W SESESW	Herndon Map	1906	-1890	-2324	-2498	-2590	-2680
7	23 28S 12W NESENW	Herndon Map		-1839	-2403	-2416	-2525	-2618
8	7 28S 11W NESESE	Herndon Map	1793	-1802	-2227	-2434	-2528	-2637
9	14 27S 11W NWSESW	Herndon Map	1808	-1812	-2274	-2505	-2590	-2670

Fig. 6. Structure contours drawn on the Arbuckle group, Pratt County, Kansas.

(In accompanying plate box)

Fig 6

STRUCTURAL CONTOUR MAP
ON THE TOP OF THE ARBUCKLE
PRATT COUNTY, KANSAS

County line

Township line

Contour line

Contour interval = 20 feet

Scale 1" = 1 mile

1 1/2 0 1 2
Scale

N

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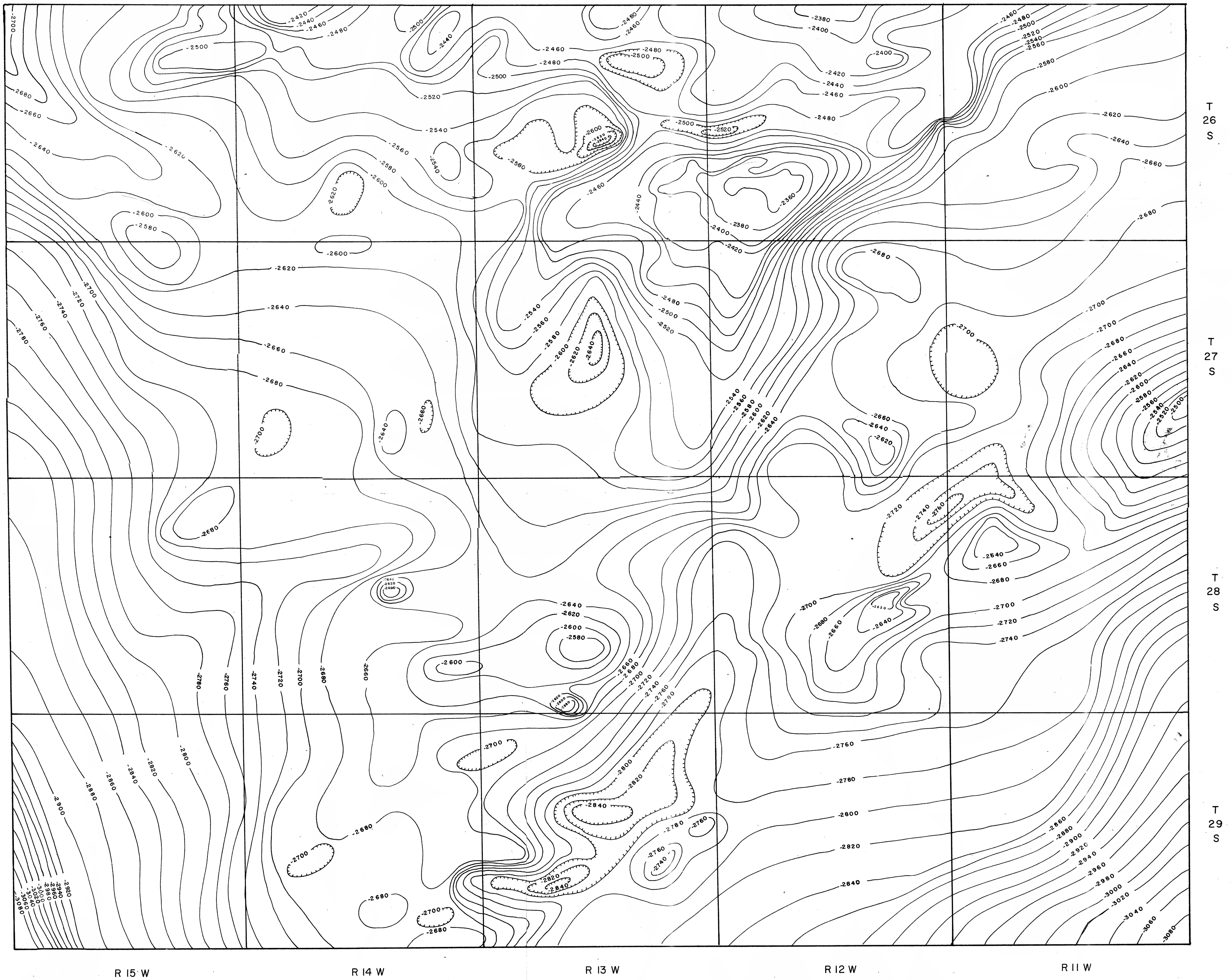

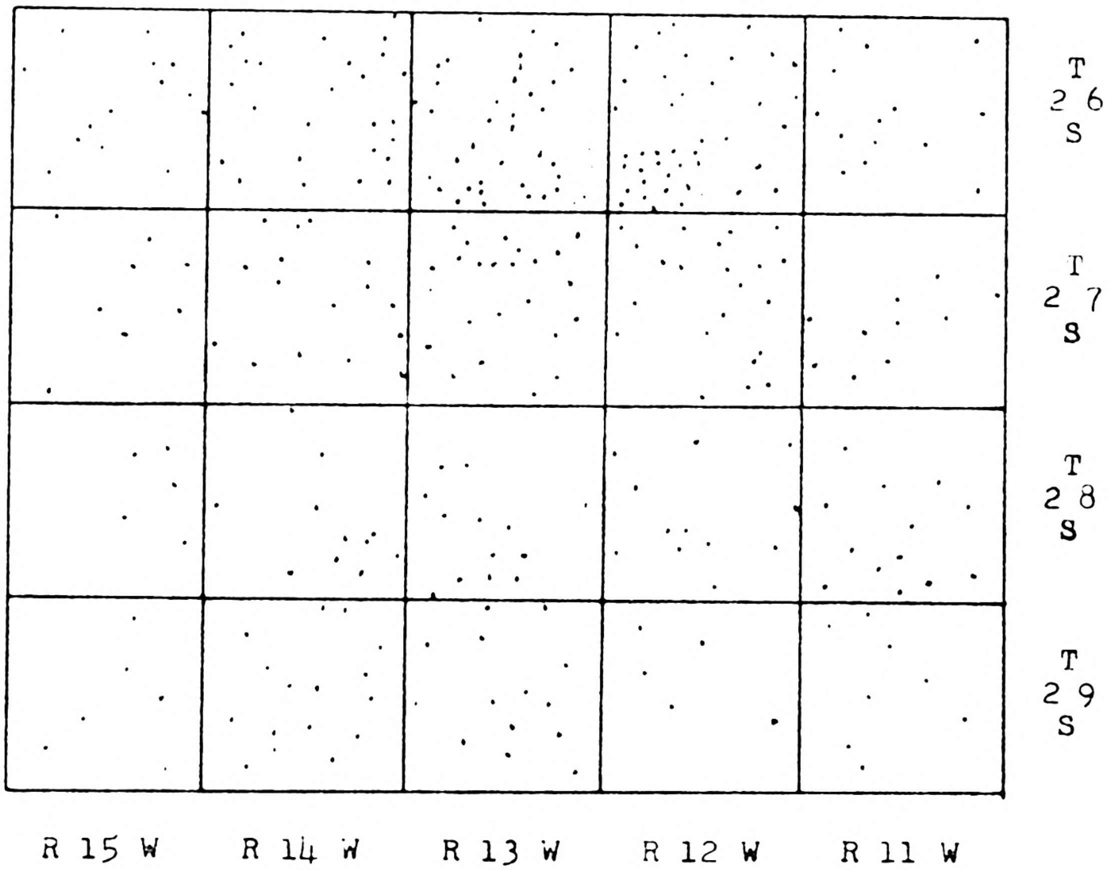

Fig. 6A. Map of Pratt County, showing the locations of control points used for drawing the structural contours on the Arbuckle group.

Fig. 7. Structure contours drawn on the Mississippian lime, Pratt County, Kansas.

(In accompanying plate box)

Fig 7

STRUCTURAL CONTOUR MAP ON THE TOP OF THE MISSISSIPPIAN PRATT COUNTY, KANSAS

County line

Township line

Contour line

Contour Interval = 20 feet

Scale 1" = 1 mile

1 1/2 0 1 2

Scale

N

1958

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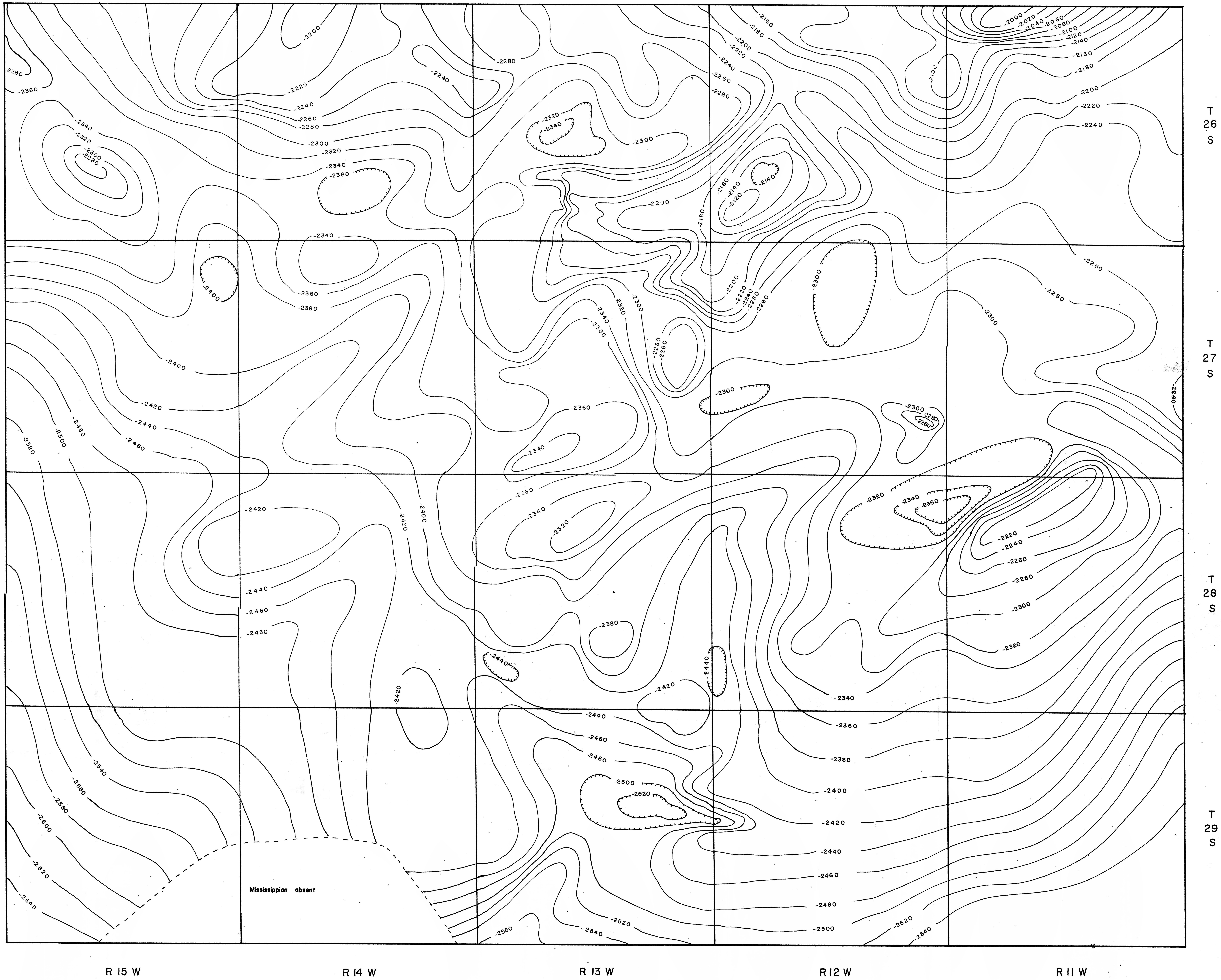

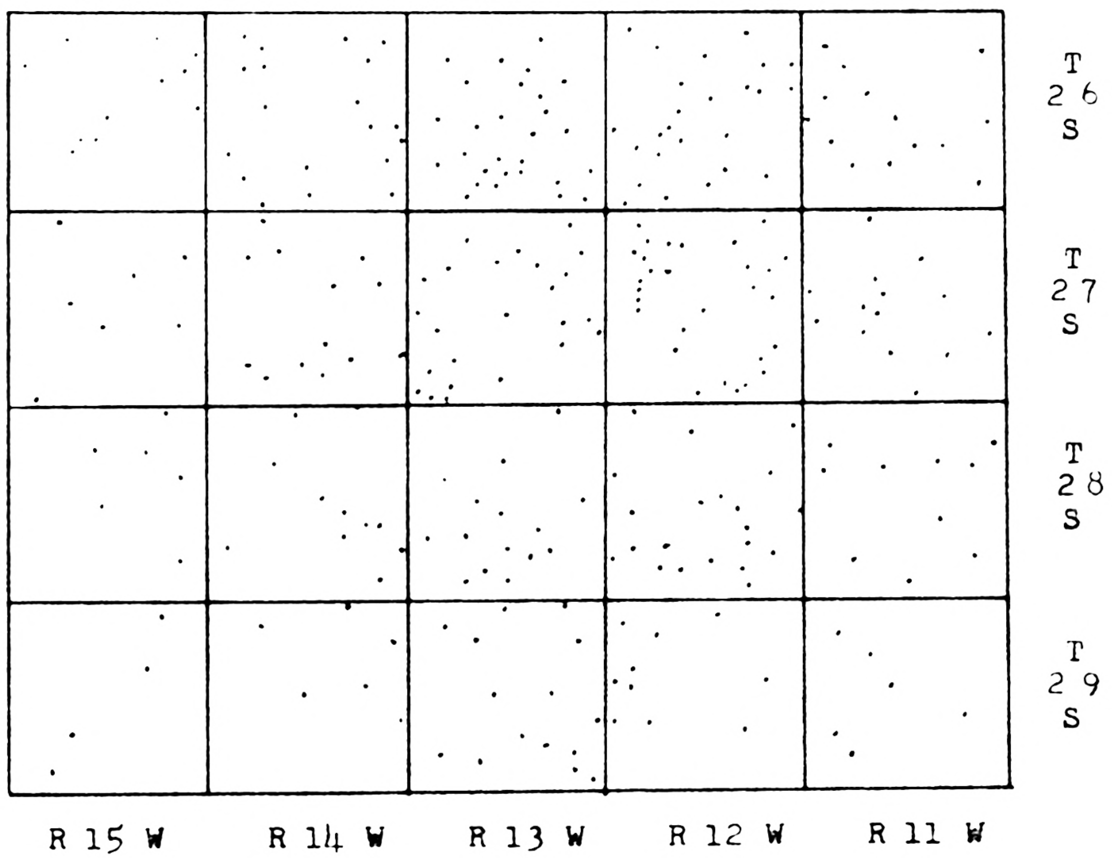

Fig. 7A. Map of Pratt County showing the locations of control points used for drawing the structural contours on the Mississippi lime.

Fig. 8. Structure contours drawn on the Lansing group, Pratt County, Kansas.

(In accompanying plate box)

Fig 8

STRUCTURAL CONTOUR MAP ON THE TOP OF THE LANSING PRATT COUNTY, KANSAS

County line

Township line

Contour line

Contour interval = 20 feet

Scale 1" = 1 mile

1 1/2 0 1 2

Scale

N

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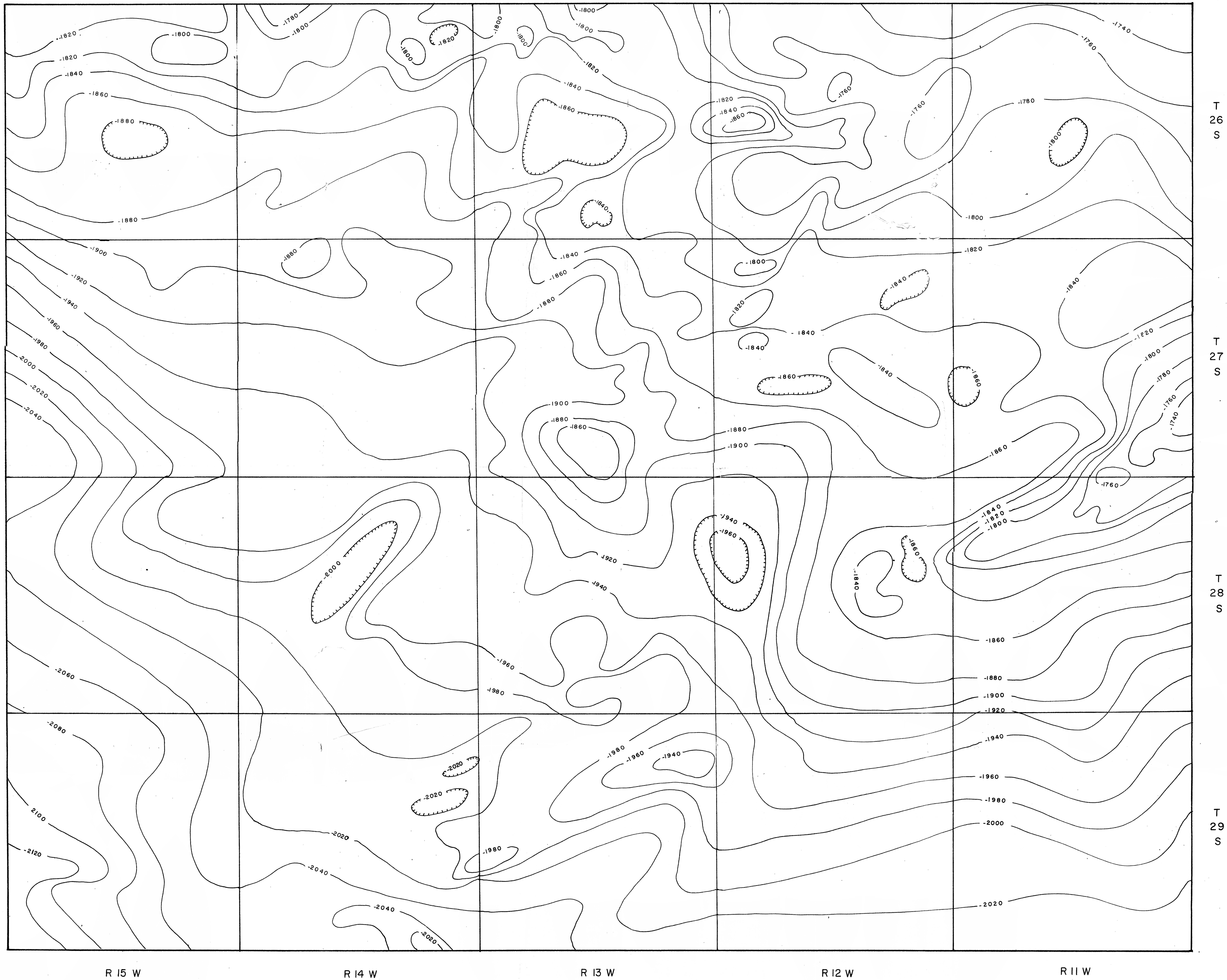

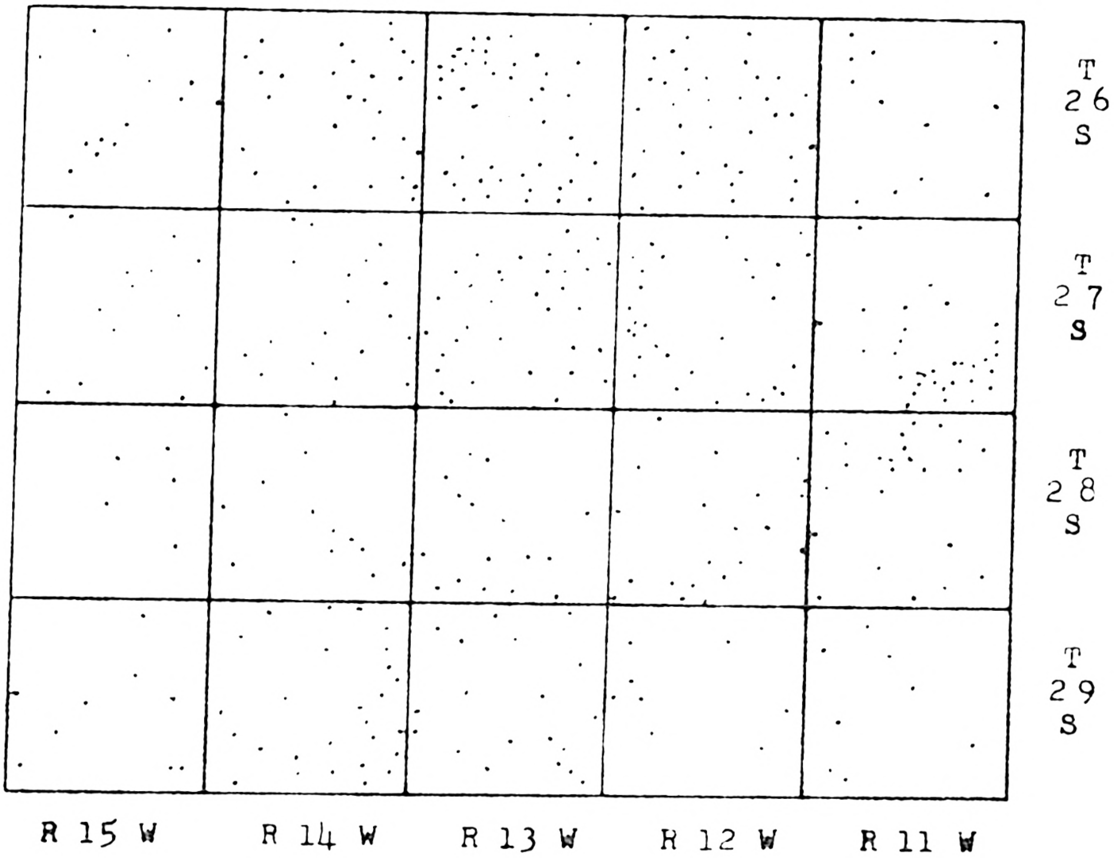

Fig. 8A. Map of Pratt County, showing the locations of control points used for drawing the Lansing group.

Fig. 9. Isopachous lines drawn representing the interval between the top of the Lansing group and the top of the Mississippian lime.

(In accompanying plate box)

Fig 9

ISOPACHOUS MAP SHOWING THE THICKNESS FROM THE TOP OF THE LANSING GROUP TO THE TOP OF THE MISSISSIPPIAN LIMESTONES
PRATT COUNTY, KANSAS

County line

Township line

Contour line

Contour interval = 20 feet

Scale 1" = 1 mile

1 1/2 0 1 2
Scale

N

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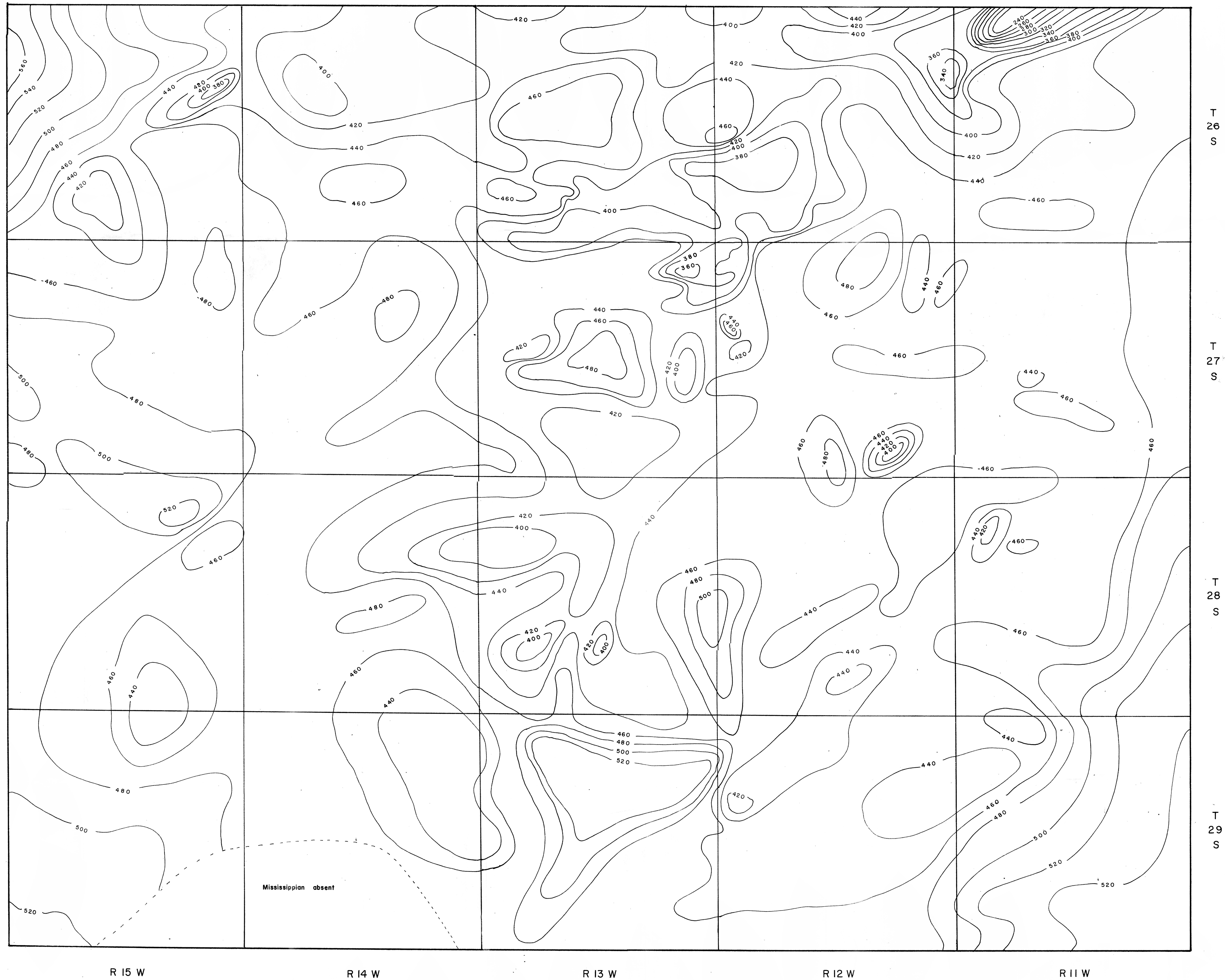

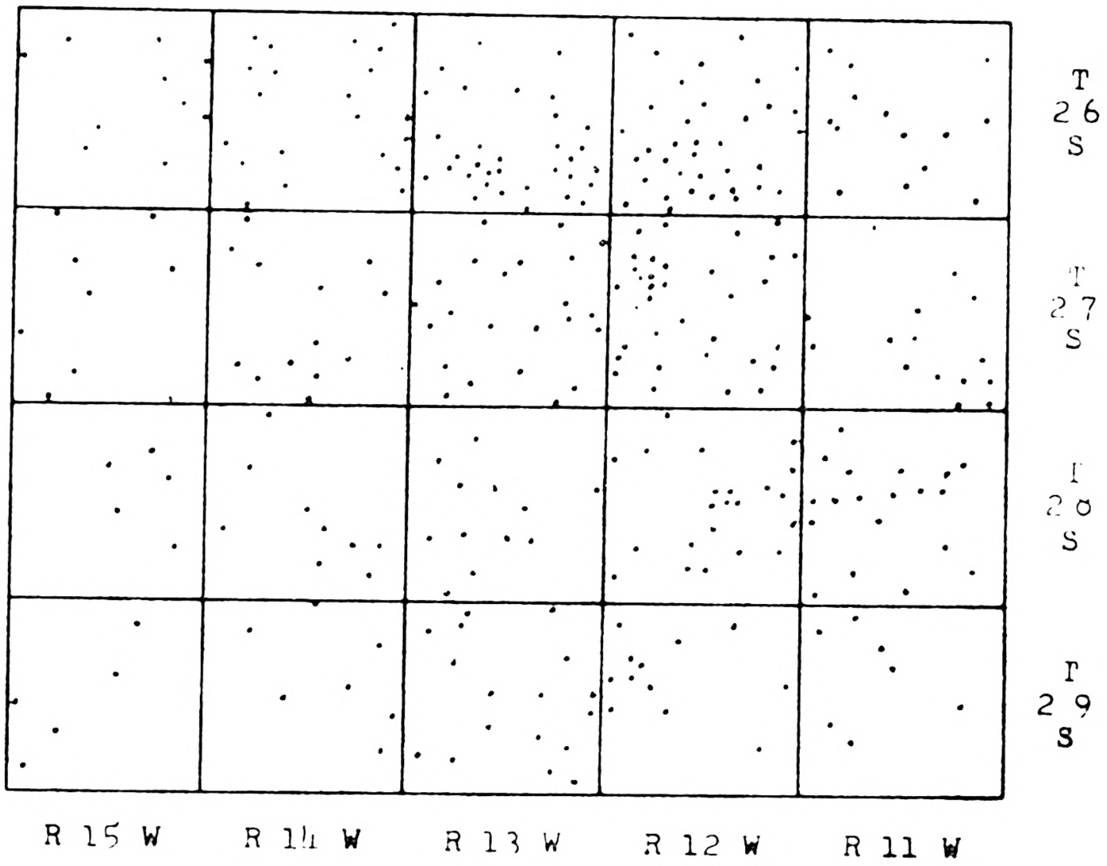

Fig. 9A. Map of Pratt County, showing the locations of control points used for drawing the isopachus lines between the top of the Lansing group and the top of the Mississippian lime.

Fig. 10. Isopachous lines drawn, representing the interval between the top of the Mississippian lime and the top of the Arbuckle group.

(In accompanying plate box)

Fig 10

ISOPACHOUS MAP SHOWING THE THICKNESS FROM THE TOP OF THE MISSISSIPPIAN LIMESTONES TO THE TOP OF THE ARBUCKLE GROUP

PRATT COUNTY, KANSAS

County line

Township line

Contour line

Contour Interval = 20 feet

Scale 1" = 1 mile

1 1/2 0 1 2

Scale

N

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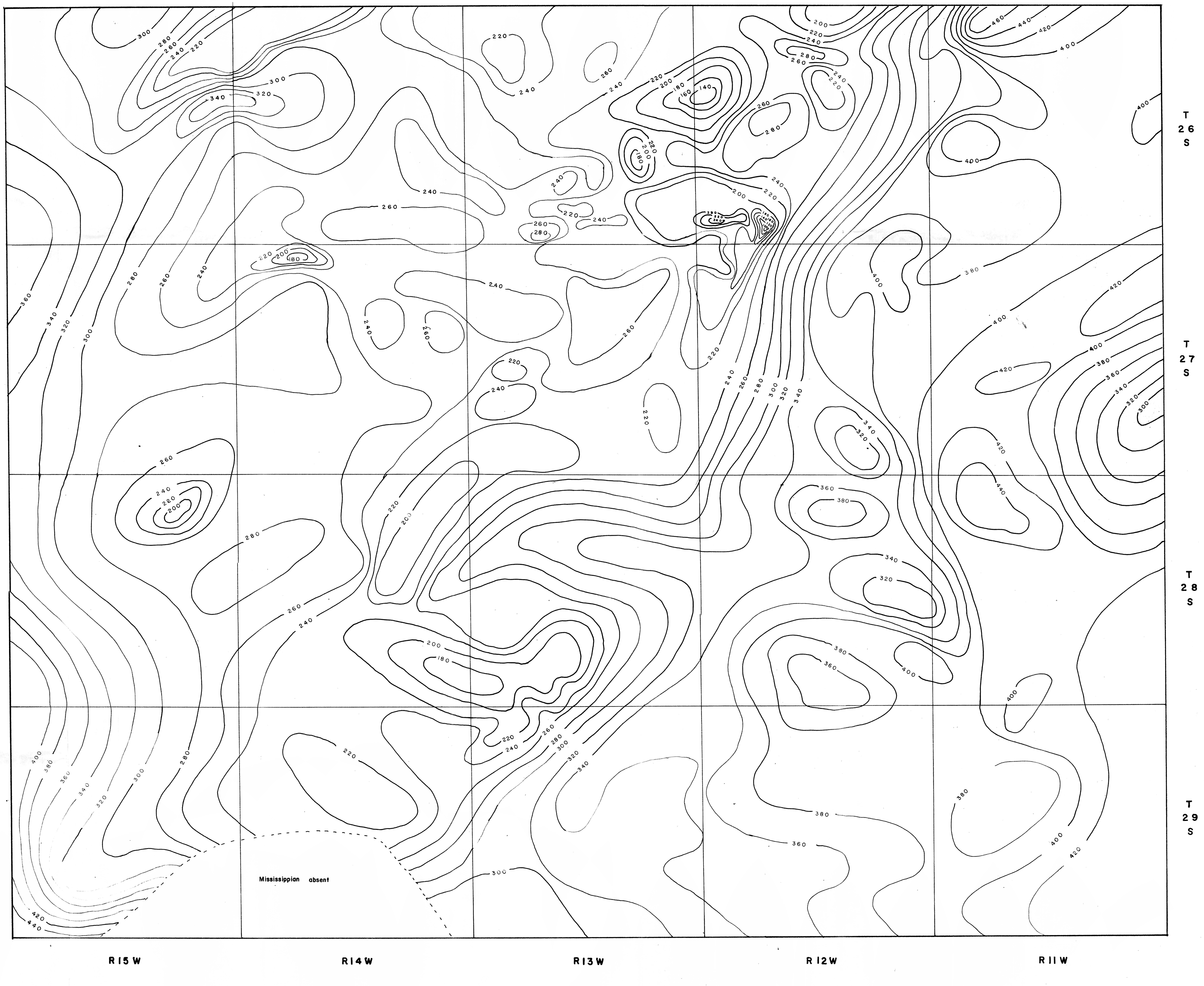

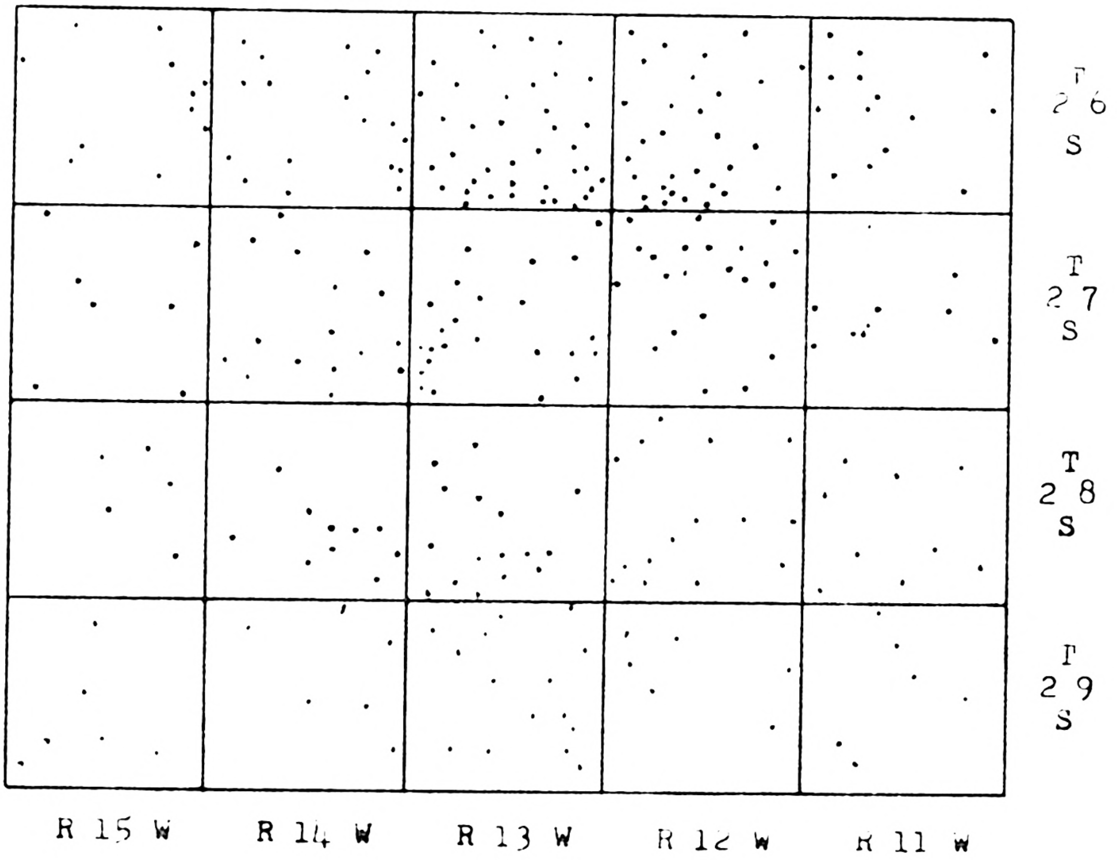

Fig. 10A. Map of Pratt County, showing the locations of control points used for drawing the isopachus lines between the top of Mississippian lime and the top of the Arbuckle group.

SUBSURFACE GEOLOGY OF PRATT COUNTY, KANSAS

by

Helmut Charles Muehlhauser

B. S., Lawrence College, 1955

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Geology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1958

Pratt County is located in South-Central Kansas in the High Plains section of the Great Plains Province. A small area in the Southeastern corner lies in the Red Hill division. The county consists of 20 townships with an area of 720 square miles.

Three structural maps, two thickness maps, and two cross-sections were constructed. These show that major production is related to anticlinal noses and structural highs. The thickness maps and cross-sections indicate a thinning of the sediments over producing fields.

Two minor structures in Pratt County are the Cunningham Dome and the Pratt Anticline. The Cunningham Dome is partly in Pratt and partly in Kingman Counties where the third best oil producing field in the county is located. The Pratt Anticline has a northeast-southwest trend across and is believed to be an extension of the Ellsworth Anticline in Stafford County. Oil has accumulated on the closed localized highs of the anticline and along its flanks.

The geologic history of the county indicates the following periods of erosion: Post-Arbuckle, post-Viola, post-Osage, and post-Missouri. All produced favorable oil zones. Weathering and solution produced excellent porosity in the Arbuckle group, Mississippian limestone, and Lansing group. The Simpson sandstone is a favorable reservoir and has very good effective porosity.

Production in the county has been at a very high level since the early 1950's. The possibilities for future discoveries of major pools are very slim; although, continued exploration will undoubtedly find localized pools in small structural or stratigraphic traps.