SUBSURFACE GEOLOGIC CROSS SECTION FROM TREGO COUNTY, KANSAS, TO CHEYENNE COUNTY, COLORADO

By

JACK B. COLLINS

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INTRODUCTION

A stratigraphic investigation designed to extend the correlation of the subsurface Paleozoic rocks of the oil fields of central Kansas westward into southeastern Colorado was begun by the Geological Survey, U. S. Department of the Interior in the fall of 1943. The results of the investigation are being published by the State Geological Survey of Kansas as a series of cross sections. This cross section, the fifth in the series, extends from the Central Commercial Co. No. 1 Locker well in the SW¼ NE¼ SW¼ sec. 12, T. 14 S., R. 22 W., Trego County, Kansas, westward to the Gulf Oil Corp. No. 1 U.P.-Larsen well in the Cen. SE¼ NW¼ sec. 13, T. 13 S., R. 49 W., Cheyenne County, Colorado. It includes 10 wells numbered from west to east as shown on the index map.

This investigation, conducted under the direct supervision of J. C. Maher, was aided by the generous cooperation of many geologists and oil companies in the mid-continent area. The well cuttings on which the work is based were loaned by the oil companies and the State Geological Survey of Kansas. L. G. Henbest identified suites of fusulinids from several of the wells; J. C. Maher contributed the sample logs and correlations for wells 1, 2, and 3; Jessie C. Kirby drafted the cross section. The writer is indebted to H. D. Miser and N. W. Bass for their careful review of the section and text.

METHODS OF INVESTIGATION

The subsurface stratigraphy of the central Kansas oil fields has been well established through years of work by petroleum geologists who have examined samples from thousands of wells and outcrops. Many of the smaller units of the Permian and Pennsylvanian Systems described on the surface in central and eastern Kansas, and most of the major subdivisions of the Mississippian, Silurian, Devonian, Ordovician, and Cambrian Systems recognized in Missouri, Iowa, and Oklahoma, have been identified in the wells, and their terminology is generally agreed upon by Kansas petroleum geologists. These subsurface units as thus identified and accepted have been used in this investigation as a basis for extending correlations from western Kansas into eastern Colorado. The correlations were carried westward well by well through detailed microscopic examination of cuttings from selected wells located at intervals of 7 to 45 miles.

The microscopic study of the cuttings consisted of describing the kind and character of the rocks by their color, hardness, mineral composition, bond or cementing material, and the type and characteristics of chert, oölites, casts, microfossils, glauconite, pyrite, calcite, siderite, and sphalerite. The crystallinity of the limestones and the size, shape, and degree of sorting and abrasion of the sandstones were also recorded. The characteristics of some of these rocks are distinctive enough so that thin key beds may be traced over great distances. These key beds assisted in the recognition of large sequences of less distinctive or less persistent strata.

Most of the wells in western Kansas and eastern Colorado have been drilled by rotary methods,

which do not permit accurate sampling of the formations penetrated except where cores were procured. Each sample of rotary cuttings contains fragments of many different kinds of rock, most of which have been cut at shallower depth than that at which the sample was collected. Usually only a small part of the sample represents the rock actually drilled at the depth marked on the sample container. Therefore the logging of such samples consists of describing for a given interval only that type of rock that has not appeared in the samples at shallower depth and that the geologist believes belongs in that interval. Because this involves interpretation, the logs prepared from rotary cuttings are subject to the personal equation of the geologist, and complete agreement by different geologists regarding details cannot be expected.

In the preparation of this cross section the sample logs were drawn on a vertical scale of 1 inch equals 100 feet and were reduced to 1 inch equals 200 feet on the published chart. The logs are alined on sea-level datum and the horizontal scale between wells is 1 inch equals 6 miles. The vertical exaggeration of the section is 158.4 times. This exaggeration permitted the representation of most stratigraphic units, but not all the finer details serving to differentiate those units could be shown. The electric logs of wells 2, 5, and 9 were plotted on the section to show the relation between the distinctive markers on the electric logs and the geologic formations identified in the samples. The electric logs were not available when the sample logs were prepared and no adjustments were made.

STRATIGRAPHY

In the area traversed by this section, Tertiary rocks are present at the surface except along the principal drainages where rocks of Upper Cretaceous age are exposed. Beneath the Upper Cretaceous rocks are Lower Cretaceous, Jurassic, Triassic (?), Permian, Pennsylvanian, Mississippian, Ordovician, and Cambrian sedimentary rocks resting on pre-Cambrian and metamorphic rocks. The total thickness of the sedimentary rocks ranges from about 5,000 feet in Trego County, Kansas, to more than 6,300 feet in Cheyenne County, Colorado. Only the Paleozoic rocks, 3,443 to 4,420 feet thick, were studied in this investigation; they are described herein beginning with the youngest.

PERMIAN SYSTEM

The Permian rocks along the line of this section range in thickness from 2,212 feet in well 10 to 1,308 feet in well 1; they are buried beneath the younger sediments to depths ranging from 1,000 feet at the east end of the section to 2,900 feet at the west end. The Permian rocks consist of an upper continental facies of red shale, sandstone, anhydrite, and salt underlain by a marine facies of limestone, dolomite, and gray shale. The continental facies is progressively thicker westward and, in well 1, represents about 80 percent of the Permian section.

GUADALUPIAN SERIES

The Guadalupian Series is represented in wells 1 to 7 by the Whitehorse sandstone. The two younger formations of the series, the Taloga formation and the Day Creek dolomite, are absent. In these wells, the Whitehorse is 19 to 179 feet thick and consists principally of red fine-grained silty sandstone and shale containing some thin beds of anhydrite.

LEONARDIAN SERIES

Nippewalla group. The Nippewalla group, 454 to 752 feet thick, includes the Dog Creek shale, Blaine formation, Flowerpot shale, Cedar Hills sandstone, Salt Plain formation, and Harper sandstone. Of these several formations, only the Dog Creek shale and the Blaine formation could be identified satisfactorily in the wells of this section. The other formations are represented by an irregular sequence of thick beds of red shale and fine silty sandstone containing lenses of salt, anhydrite, and a few beds of orange coarse sandstone. The Dog Creek shale, 11 to 43 feet thick, was tentatively identified in wells 2 to 7 where it is composed of red anhydritic shale and red sandy shale. The Blaine formation was identified in wells 1 to 7 where it consists mainly of thick beds of white, pink, and red crystalline anhydrite, and thin beds of maroon shale. In well 5, the

lower half of the Blaine consists of red oölicastic anhydritic dolomite. The thickness of the Blaine ranges from 8 to 61 feet.

Sumner group. The Sumner group, which may be separated from the Nippewalla group by a minor unconformity, includes the Stone Corral dolomite, Ninnescah shale, and Wellington formation. The thickness of the group ranges from about 700 feet in well 9 at the east end of the section to 325 feet in well 1 at the west end. Although the Stone Corral dolomite consists mainly of dolomite on the outcrop, it is mostly white to tan crystalline dolomitic anhydrite in the subsurface and is commonly termed the "Cimarron anhydrite." It was readily identified in wells 2 to 10, where it is 41 to 53 feet thick, and was identified tentatively in well 1, where it seems to be represented by a bed of anhydrite about 10 feet thick.

The Ninnescah shale, 122 to 238 feet thick, consists of thick beds of red and brown shale and thin beds of sandstone and anhydrite in wells 4 to 10. In wells 1 to 3, it is chiefly red-brown fine-grained sandstone. At the outcrop, the beds of shale of the Ninnescah are predominantly red and those of the underlying Wellington formation are gray. Unfortunately this convenient distinction does not persist in the subsurface, and the identification of the unconformable contact between the Ninnescah shale and the Wellington formation is very difficult.

In wells 4 to 10, the upper part of the Wellington formation contains red shale, gray shale, and thin beds of sandstone and anhydrite, and the lower part consists predominantly of anhydrite interbedded with dolomite, salt, and gray shale. The lower evaporite facies wedges out westward from well 4 and the whole formation, except for a thin anhydrite bed which may mark the top, is composed principally of red fine-grained sandstone and sandy shale. The thickness of the formation ranges from 485 feet in well 10 to 115 feet in well 1.

WOLFCAMPIAN SERIES

Chase group. The Chase group, 210 to 340 feet thick, consists of thick beds of limestone and sandy dolomite and thin beds of shale in the eastern part of the area traversed by the section. These rocks lose their identity near the Kansas-Colorado state line as they grade westward into red shale, sandstone, and thin beds of dolomite and limestone. The principal formations of the Chase group that can be traced for some distance in the subsurface are the Nolans, Winfield, Barneston, and Wreford limestones.

The Nolans limestone, which includes the Herington limestone member, consists of gray-buff to cream-colored slightly sandy dolomite in wells 4 to 10. West of well 4, it grades into red shale which includes a thin bed of dolomite at the top.

The Winfield limestone is a tan to cream-colored granular slightly sandy dolomite. It is very sandy in wells 8, 7, and 6, and loses its identity west of well 6, where it grades into red shale and anhydrite.

The Barneston limestone is composed of two thick limestone members—the Fort Riley and the Florence—separated by a thin shale. The Fort Riley limestone member consists of buff to cream-colored, calcareous dolomite with minor amounts of light-gray to tan, slightly oölicastic limestone near the base. The underlying Florence limestone member is a gray-buff to cream-colored, finely crystalline limestone containing some gray fossiliferous chert and fusulinids. The Florence and Fort Riley limestone members grade westward from well 8 into sandy dolomite and red shale and cannot be identified with certainty.

The Wreford limestone consists of light-gray to cream-colored finely crystalline limestone containing a little gray to tan dense chert. It grades progressively westward into tan to buff slightly sandy dolomite and limestone, which in turn grades into red dolomitic and gypsiferous sandstone and shale.

Council Grove group. The Council Grove group, despite its unconformable relations with the overlying Chase group, is fairly uniform in thickness in the wells of this section. It ranges in thickness from 305 feet in well 2 to 357 feet in well 9. This group includes many thin beds of limestone separated by relatively thick beds of shale. Only the Beattie, Grenola, and Foraker limestones are distinctive enough to be correlated from well to well, and only the Foraker limestone can be identified with certainty west of well 2 where most of the group is composed of red silty fine-grained sandstone.

The Beattie limestone was identified in wells 5 to 10 by its cream to gray color and the presence of spines and weathered fusulinids in its basal member, the Cottonwood limestone. The unconformity present below the Cottonwood limestone member in some areas of Kansas does not seem to be clearly defined in the wells of this section.

The Grenola limestone, which was traced from well 10 to well 5, consists of two beds of limestone, the upper one of which is the Neva limestone member. The Neva is cream-colored, oölicastic, and cherty; the lower limestone is gray-buff and slightly cherty.

The Foraker limestone comprises thick beds of gray-buff to tan fossiliferous limestone and thin beds of gray shale. Gray to black dense chert and fusulinids are common in the lower part. In well 1, the upper part contains white finely granular anhydrite and cream-colored finely oölicastic limestone.

Admire group. The Admire group, which rests unconformably on Pennsylvanian rocks, is 100 to 160 feet thick in all wells on this section, except in well 2 where it may be less than 10 feet thick or is absent. In the eastern wells, the Admire group consists mostly of beds of black, gray, and tan shale, gray fine sand, and a few beds of gray to buff and tan finely crystalline limestone. More limestone beds are present in the western wells than in the eastern wells.

PENNSYLVANIAN SYSTEM

The Pennsylvanian System, a marine sequence composed principally of interbedded limestone and shale, ranges in thickness from about 1,000 feet in well 10 to 1,500 feet in well 1. Beds assigned to the Virgilian, Missourian, and Desmoinesian Series are present in all wells; beds older than Desmoinesian, herein termed pre-Cherokee rocks, are present in wells 1 to 4.

VIRGILIAN SERIES

Wabaunsee group. The Wabaunsee group, defined by pronounced unconformities at the top and base, consists mostly of marine beds of gray-buff, finely crystalline, fossiliferous, and algal limestone, cream-colored finely crystalline fossiliferous limestone, gray, red, and green shale, and gray fine-grained sandstone. Fusulinids, crinoids, and brachiopods are common in these beds. In contrast to the younger groups, the marine facies of this group extends across the entire area traversed by this section. The thickness of the Wabaunsee group ranges from 39 to 160 feet.

Shawnee group. The Shawnee group, lying unconformably below the Wabaunsee group, ranges in thickness from 219 to 290 feet. The upper half of the group consists of gray to buff and tan finely crystalline fossiliferous limestones separated by thin beds of black, gray, red, and tan shale. Weathered fusulinids and small amounts of gray fossiliferous chert are present in some of the limestones. The lower half of the Shawnee group is mostly buff to gray and cream-colored finely crystalline to marly fossiliferous limestone, some of which contains weathered fusulinids and gray to tan fusulinid-bearing chert. Thin beds of black, tan, and red shale intervene between the limestone beds and in the westernmost wells a few beds of sandstone and dolomite are present.

Douglas group (Virgilian) and Pedee group (Missourian), undifferentiated. Either or both the Douglas and Pedee groups may be represented by the irregular sequence of red and green shale, calcareous sandstone, and thin-bedded limestone that is present below the Shawnee group and lies unconformably on the eroded top of the Lansing group. The sequence, 2 to 40 feet thick, serves as a good subsurface marker for determining the top of the Lansing group, which is a potential oil reservoir.

MISSOURIAN SERIES

Lansing, Kansas City, and Bronson groups, undifferentiated. The Lansing, Kansas City, and Bronson groups are usually treated as a unit in this area because it is not practical to attempt to distinguish the individual groups and formations. In general, the thickness of the unit increases westward, ranging from a minimum of 233 feet in well 10 to a maximum of 377 feet in well 2. The unit consists of thick beds of cream-colored to gray-buff cherty fossiliferous finely crystalline and oölitic limestone and thin beds of gray, tan, red, and black shale. Some of

the limestone beds contain pink chert in wells 5, 6, and 7. In wells 1, 2, 3, and 4, thin beds of fine-grained sandstone and sandy limestone are interbedded with the more typical marine limestones of the unit.

DESMOINESIAN SERIES

Marmaton group. In the eastern part of the area, the Marmaton group is characterized by thick beds of gray-green and maroon shale with some thin beds of black shale and gray to buff finely crystalline limestone. In the western part of the area, the shale beds are thin and beds of gray to cream-colored finely crystalline limestone containing gray, black, and tan dense chert predominate. Several of these limestone beds are very oölitic and contain the coral *Chaetetes.* Thin beds of sandy limestone and limy sandstone also are present in some wells. The thickness of the Marmaton group along the line of this section ranges from 161 to 291 feet. The upper boundary of the Marmaton group was readily determined in the eastern wells at the contact of thick red and green shales with the thick-bedded limestones of the overlying Lansing, Kansas City, and Bronson groups; in the western wells where such shale beds are absent, the top of the group was drawn at the top of a thin bed of sandstone commonly present at the unconformable contact of the Missourian and Desmoinesian Series in western Kansas and eastern Colorado. The lower boundary of the Marmaton group is marked by the Fort Scott limestone, a buff to tan, dense to finely crystalline, oölitic, and fossiliferous limestone that was easily recognized in the cuttings from wells 5, 6, 7, 8, and 9. In well 10 on the flank of the Central Kansas uplift, the Fort Scott limestone is either absent owing to nondeposition or only partly represented. West of well 5, the base of the Fort Scott limestone is determinable but its upper boundary is obscure owing to the absence of a shale facies that is present above it in the eastern wells.

Cherokee shale. The Cherokee shale exhibits a facies change from shale to limestone westward along this section. In wells 7 to 10, it consists chiefly of red, green, and yellow sandy shale, and a basal conglomerate that contains considerable weathered Mississippian and Ordovician chert. In wells 1 to 6, the Cherokee is made up of interbedded dark-colored finely crystalline to dense cherty limestone and black shale. Some of the limestones in the western wells contain oölites and tan, gray, and black chert. The base of the Cherokee shale is indefinite in the western wells so an arbitrary boundary corresponding to that described in two previously published cross sections[1] is shown on this section. This boundary is at the base of a brown dense limestone overlying an irregular sequence of black shale. As thus defined, the thickness of the Cherokee shale ranges from 37 feet in well 8 to 258 feet in well 2.

PRE-CHEROKEE ROCKS

In the four westernmost wells, a westward-thickened wedge of interbedded cream-colored glauconitic finely crystalline limestone, black dense limestone, black to green shale, and fine-grained sandstone intervenes between the Cherokee shale and the Mississippian rocks. The thickness of this wedge of rocks ranges from about 60 feet in well 4 to 390 feet in well 1. Progressively younger rocks are present at the top of the wedge in the western wells as indicated on the section by dashed lines. The general sequence of the pre-Cherokee rocks is best exhibited in well 1 where a bed of black shale containing a thin bed of anhydrite is present at the top. Alternating beds of black shale and dark limestone, 84 feet thick, underlie the black shale bed. The lowest limestone in this upper sequence contains considerable tan dense chert. Beneath this limestone is a 256-foot succession of black shale, thin dark-colored limestone, green bryozoa-bearing shale and fine-grained glauconitic sandstone. At the base of the pre-Cherokee unit is a bed of cream-colored, finely crystalline, glauconitic, pyritic, and crinoidal limestone that resembles the Morrow formation of Oklahoma and Arkansas. The fusulinid *Millerella sp.* is associated with this limestone in other wells south of well 1 but no fusulinids were found in the samples from wells on this section.

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[1]MAHER, J. C., 1946, Subsurface geologic cross section from Ness County, Kansas, to Lincoln County, Colorado: Kansas Geol. Survey, Oil and Gas Invest., Prelim. Cross Sec. No. 2, p. 6.

MAHER, J. C., 1947, Subsurface geologic cross section from Scott County, Kansas, to Otero County, Colorado: Kansas Geol. Survey, Oil and Gas Invest., Prelim. Cross Sec. No. 4, p. 7.

MISSISSIPPIAN SYSTEM

The Mississippian System consists chiefly of thick beds of light-gray to buff limestone and dolomite, some of which are cherty and others oölitic. The classification of these beds into five lithologic units follows that used by Lee[2] for the most part. A major angular unconformity is present at the top of the system and several minor unconformities separate formations within the system. The Mississippian rocks are present in all wells except well 10, which is on the west flank of the Central Kansas uplift. The range in thickness is from 124 to 539 feet.

MERAMECIAN SERIES

Ste. Genevieve limestone. The Ste. Genevieve limestone, the uppermost formation of the Meramecian series, was identified only in well 4. There it is represented by a bed of light-gray to cream-colored finely oölitic sandy limestone about 13 feet thick.

St. Louis limestone. The St. Louis limestone, 77 to 144 feet thick in wells 2, 3, and 4, is made up of beds of cream-colored finely crystalline oölitic limestone and buff dense limestone. Some of the beds near the base are cherty, glauconitic, and slightly sandy. The oölites in the St. Louis limestone are larger than those in the overlying Ste. Genevieve limestone.

Spergen and Warsaw limestones, undifferentiated. The rocks assigned herein to the Spergen and Warsaw limestones, undifferentiated, differ in lithologic character from well to well; they consist chiefly of buff to gray finely granular slightly cherty dolomite and buff to gray, finely to coarsely crystalline, glauconitic, oölitic, and cherty limestone. Some of the beds of dolomite have a distinctive dark-buff color and resinous luster. This sequence overlies unconformably the Keokuk and Burlington limestones, undifferentiated. It ranges in thickness from 35 to 122 feet in wells 1, 2, 3, 4, 6, 7, and 8, and owing to post-Mississippian erosion is absent in wells 5, 9, and 10. The foraminifer *Endothyra,* which is common in the Spergen limestone on the outcrop, is present in the samples from some wells.

[2]LEE WALLACE, 1940, Subsurface Mississippian rocks of Kansas: Kansas Geol. Survey, Bull. 33, pl. 7.

————1943, The stratigraphy and structural development of the Forest City basin in Kansas: Kansas Geol. Survey, Bull. 51, p. 66.

OSAGIAN SERIES

Keokuk and Burlington limestones, undifferentiated. Because of their lithologic similarities, the Keokuk and Burlington limestones are generally regarded by oil geologists as a single unit called "Boone" or "Osage." This unit ranges in thickness from 47 to 118 feet along the line of this section. It is characterized by beds of buff to gray finely granular, glauconitic, very cherty dolomite and buff to gray finely crystalline, cherty limestone. The chert is abundant and quite distinctive. Although white devitrified and gray spicular types make up a large percentage of the chert, a small amount of gray glauconitic chert, generally present in the lower beds but not restricted to them, is an important aid in distinguishing this unit from the older Viola limestone. A thin bed of white fine-grained sandstone is present near the middle of the unit in wells 5 and 6. In some wells drusy quartz is abundant; in well 1, a trace of galena was found at the base of the unit. The Keokuk and Burlington limestones, undifferentiated, are present in all wells except well 10.

KINDERHOOKIAN SERIES

Gilmore City limestone. The Gilmore City limestone, which unconformably underlies the Keokuk and Burlington limestones, consists chiefly of buff to cream-colored finely crystalline oölitic limestone. The oölites generally are irregular in size and distribution. A few thin beds of dolomitic limestone are present in the middle of the Gilmore City in wells 4, 8, and 9, and a thick bed of dolomite lies at the base in well 1; these beds are regarded as facies of the more typical oölitic limestones of other wells. The Gilmore City limestone is present in all wells except well 10. Its thickness ranges from 20 feet in well 7 to 145 feet in well 4.

"Misener sand." In wells 1, 2, and 5, a thin bed of white to gray fine to coarse-grained sandstone 2 to 20 feet thick, underlies the Gilmore City limestone. A thin bed of dolomite is included in the sandstone in well 5. This sandstone is regarded as basal Mississippian in age and is termed "Misener sand" in accordance with the common usage of oil geologists in Kansas.

ORDOVICIAN AND CAMBRIAN SYSTEMS

In this area the Ordovician System includes in descending order the Viola limestone, Simpson rocks, and the Arbuckle group; the Cambrian System includes the Bonneterre dolomite and the Lamotte sandstone. Widespread unconformities are present at the top of the Viola limestone, Simpson rocks, and Arbuckle group. Wells 6, 7, 8, and 9, which were abandoned in the Arbuckle limestone, penetrated 100, 163, 180, and 160 feet respectively of Ordovician and Cambrian rocks; wells 1, 2, 3, 4, 5, and 10 penetrated the entire Ordovician and Cambrian sequence which ranges in thickness from 372 feet in well 3 to 666 feet in well 4.

BEDS OF TRENTON AGE

Viola limestone. Beds tentatively assigned to the Viola limestone are present in wells 7, 8, and 9, which are in a structurally low area. In well 8, these beds include an upper brown finely crystalline glauconitic dolomite about 10 feet thick, and a lower gray very finely granular silty dolomite about 13 feet thick. In well 9, the upper brown finely crystalline glauconitic dolomite is about 18 feet thick and overlies a 34-foot bed of buff to brown finely crystalline slightly porous dolomite that contains much light-gray to tan dense chert that is typical of the Viola limestone of Kansas. The evidence is inconclusive as to whether the upper member in these wells is really equivalent to the upper noncherty part of the Viola limestone of eastern Kansas or is equivalent to one of the lower formations of the Kinderhookian Series. Moreover, the true relationship of the entire Viola sequence of these wells to the Viola limestone of the Arbuckle Mountains of southern Oklahoma and to the Galena limestone of the Upper Mississippi Valley has not been established.

BEDS OF BLACK RIVER AND CHAZYAN AGE

Simpson rocks. Beds of pale-green plastic shale and buff finely crystalline dolomite containing light-gray to white dense chert, lying below the Viola limestone in wells 7, 8, and 9, herein are called Simpson rocks in accordance with the general practice in Kansas. The correlation of these beds with any specific part of the Simpson group of southern Oklahoma, however, has not been accomplished. The thickness of these beds is 3 feet in well 7, 2 feet in well 8, and 17 feet in well 9.

BEDS OF BEEKMANTOWN AND ST. CROIXIAN AGE

Arbuckle limestone and Bonneterre dolomite.— All wells on this section were drilled into or through the Arbuckle-Bonneterre rocks. Wells 6, 7, 8, and 9 penetrated these beds to depths of 100, 146, 155, and 91 feet. The six wells that were drilled through this interval revealed thicknesses ranging from 360 feet in well 1 to 649 feet in well 4. The general sequence of the Arbuckle-Bonneterre is exhibited in well 4 where it can be grouped roughly into the following units from the top downward: (1) light-gray to cream-colored finely crystalline dolomite with cream-colored dense chert, 80 feet thick; (2) gray to buff finely to coarsely crystalline slightly sandy dolomite containing siliceous oölites and oölitic chert, 110 feet thick; (3) buff to gray finely crystalline sandy dolomite, 55 feet thick; (4) light-gray to white finely to very coarsely crystalline dolomite, 108 feet thick; (5) cream to buff finely crystalline sandy dolomite, 60 feet thick; (6) cream to gray coarsely crystalline dolomite, 69 feet thick; (7) tan to gray finely to very coarsely crystalline sandy dolomite, 90 feet thick. Many of these units were recognized in other wells of the section. The dashed correlation line at the top of unit 7 represents the top of what is commonly called the Bonneterre dolomite by many Kansas petroleum geologists.

Lamotte sandstone. The Lamotte sandstone, which marks the base of the Paleozoic rocks, ranges in thickness from 9 feet in well 3 to 71 feet in well 2. It consists of white dolomitic and glauconitic sandstone composed chiefly of coarse subround quartz grains.

PRE-CAMBRIAN ROCKS

Wells 1 to 5 and 10 were drilled into igneous and metamorphic rocks of pre-Cambrian age. The greatest penetration, 79 feet, was made in well 4.

STRUCTURAL FEATURES

The major structural features of the region traversed by this section are the Central Kansas uplift and the Las Animas arch. The axis of the Central Kansas uplift, which extends northwestward from south-central Kansas into Nebraska, passes about 25 miles northeast of the east end of the section. The uplift originated in pre-Cambrian time and was rejuvenated several times thereafter[3]. Rocks of Pennsylvanian age are the oldest sedimentary beds that extend across the uplift, although many older Paleozoic formations probably were deposited over the uplift and were removed later during several periods of erosion. Remnants of these older Paleozoic formations are present on the flanks of the uplift, and their beveled edges in regular succession have been found in wells located progressively farther from the crest. This condition is illustrated by wells 8, 9, and 10, at the east end of the section. Well 10 is highest on the flank of the uplift, and there all Mississippian formations and the upper formations of the Ordovician System are absent; well 9, farther down the flank than well 10, drilled through lower Mississippian limestone, Viola limestone, and Simpson rocks before reaching the Arbuckle limestone; well 8, located even farther down the flank, penetrated younger Mississippian formations above the formations present in well 9.

The Las Animas arch, a regional structural feature in the exposed Cretaceous rocks, extends northeastward across eastern Colorado and loses most of its prominence in both the surface and subsurface beds near the west end of the cross section. Owing to the small number of wells in eastern Colorado, this arch has been only vaguely outlined in the subsurface rocks and its structural evolution is not thoroughly understood. Well 1, near the crest of the arch, shows little structural relief as compared to well 2 and offers little evidence of the history of the arch.

Although the Central Kansas uplift and the Las Animas arch are the only regionally important structural features in the area traversed by this section, an important anticline is present in T. 13 S., R. 30 W., Gove County, Kansas, as shown by well 5. There considerable upwarping took place in early Pennsylvanian time, and the Mississippian rocks younger than the Keokuk and Burlington limestones were removed by erosion. About the same time, a westward-thickening wedge of Cherokee shale and pre-Cherokee Pennsylvanian rocks was deposited against the west flank of this anticline. The magnitude of this anticline, as depicted on the section, is somewhat exaggerated due to the southward deviation of the line of section to include well 4.

[3]KOESTER, E. A., 1935, The geology of the Central Kansas uplift: Am. Assoc. Petroleum Geologists Bull., vol. 19, no. 10, p. 1405.

OIL AND GAS

Oil and gas are produced in western Kansas from the Lamotte sandstone, Arbuckle limestone, Simpson rocks, Viola limestone, Mississippian limestone, the "Patterson sand" of the Cherokee shale, the Sooy conglomerate, limestone beds of the Lansing and Kansas City groups, limestone beds at the top of the Shawnee group and several limestone and dolomite beds in the Chase and Sumner groups. Important unconformities are associated with each of these formations and groups except, perhaps, the limestone and dolomite beds in the Chase and Sumner groups. Commercial quantities of oil and gas have not been found as yet in any of these reservoirs along the line of this section. The nearest oil field is the Ellis pool, about 10 miles northeast of well 9. There the oil comes from the Arbuckle limestone.

Conditions favorable to the accumulation of oil and gas within the area traversed by this section are suggested by the structure and stratigraphy between wells 4 and 6. There lower Cherokee and pre-Cherokee Pennsylvanian rocks, some of which are sandstones, wedge out against the west flank of an anticline in Mississippian and older beds. The Keokuk and Burlington limestones mark the top of the uplifted Mississippian beds in well 5. These beds or some immediately above in the Spergen and Warsaw limestones are reported to have yielded 8 barrels of oil and 4 barrels of water a day in the Globe Oil & Refining Company No. 1 Snyder well in sec. 8, T. 14 S., R. 29 W., only 2.5 miles southeast of well 5. In the Snyder well, these beds were reported to be about 70 feet below the eroded top of the Mississippian rocks.

STATE GEOLOGICAL SURVEY OF KANSAS

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PART 2. SILICIFIED ROCK IN THE OGALLALA FORMATION, by John C. Frye and Ada Swineford, pp. 33-76, pls. 1-8, fig. 1, July 1, 1946.

PART 3. GROUND-WATER CONDITIONS IN ELM CREEK VALLEY, BARBER COUNTY, KANSAS, by Charles C. Williams and Charles K. Bayne, pp. 77-124, pls. 1, 2, figs. 1-9, September 16, 1946.

PART. 4. STRIP-MINED AREAS IN THE SOUTHEASTERN KANSAS COAL FIELD, by G. E. Abernathy, pp. 125-144, pls. 1-3, fig. 1, November 15, 1946.

PART 5. GROUND-WATER CONDITIONS IN ARKANSAS RIVER VALLEY IN THE VICINITY OF HUTCHINSON, KANSAS, by Charles C. Williams, pp. 145-215, pls. 1-6, figs. 1-11, December 30, 1946.

PART 6. CRETACEOUS STRATIGRAPHY OF THE BELVIDERE AREA, KIOWA COUNTY, KANSAS, by Bruce F. Latta, pp. 217-260, pls. 1-3, figs. 1-4, December 30, 1946.

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PART 2. MAGNETIC SURVEY OF THE BALA INTRUSIVE, RILEY COUNTY, KANSAS, by Robert M. Dreyer, pp. 21-28, figs. 1-4, June 15, 1947.

PART 3. THE LATE PLEISTOCENE LOESSES OF CENTRAL KANSAS, by John C. Frye and O. S. Fent, pp. 29-52, figs. 1-3, pls. 1-2, September 15, 1947.

University of Kansas
State Geological Survey of Kansas

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1947

Oil and Gas Investigations
Preliminary Cross Section No. 5

SYSTEM	SERIES	GROUP	FORMATION
PERMIAN	GUADALUPIAN	NIPPEWALLA	Blaine (?) formation
	LEONARDIAN		Stone Corral (?) dolomite
		SUMNER	Ninnescah shale
			Wellington formation
	WOLFCAMPIAN	CHASE AND COUNCIL GROVE	
			Foraker(?)limestone
		ADMIRE	
PENNSYLVANIAN	VIRGILIAN	WABAUNSEE	
		SHAWNEE	
		DOUGLAS AND PEDEE	
	MISSOURIAN	LANSING, KANSAS CITY, AND BRONSON	
	DESMOINESIAN	MARMATON	
		CHEROKEE	
		PRE-CHEROKEE ROCKS	
MISSISSIPPIAN	MERAMECIAN		Spergen and Warsaw limestones
	OSAGIAN		Keokuk and Burlington limestones
	KINDERHOOKIAN		Gilmore City limestone
			"Misener" sand
CAMBRIAN & ORDOVICIAN	CROIXIAN & BEEKMANTOWNIAN	ARBUCKLE	
			Bonneterre (?) dolomite
			Lamotte sandstone
PRE-CAMBRIAN ROCKS			

1 GULF OIL CORP. NO.1 U.P.-LARSEN
Cen. SE NW sec. 15, T.13S., R.49W.
CHEYENNE COUNTY, COLORADO
Elevation 4518 feet
T.D.6360

2 SINCLAIR-PRAIRIE OIL CO. NO.1 GLAD AND BROCK
SE NW NE sec.19, T.13S.,R.42W.
WALLACE COUNTY, KANSAS
Elevation 3808 feet
T.D.6000

3 MORGAN, FLYNN, & COBB NO.1 MC MILLEN
Cen. NW sec. 9, T.13S.,R.37W.
LOGAN COUNTY, KANSAS
Elevation 3143 feet
T.D.5465

4 ALMA OIL CO. NO.1 WATCHORN
Cen. SW NE sec.13, T.15S.,R.33W.
LOGAN COUNTY, KANSAS
Elevation 2780 feet
T.D.5750

5 CITIES SERVICE OIL CO. NO.1 VICTORY LIFE INS. CO.
CSL. NW NW sec. 24, T.15S.,R.30W.
GOVE COUNTY, KANSAS
Elevation 2780 feet
T.D.5169

6 TEXON OIL CO. NO.1 SMITH
NE cor. sec. 13, T.15S.,R.28W.
GOVE COUNTY, KANSAS
Elevation 2527 feet
T.D.4645

7 VALERIUS-BOUCHER OIL CO. NO.1 SAMSON
NW cor. NW sec. 24, T.15S.,R.27W.
GOVE COUNTY, KANSAS
Elevation 2524 feet
T.D.4813

8 BARTLETT NO.1 PFANNENSTIEL
Cen. SE NW sec. 30, T.13S.,R.25W.
TREGO COUNTY, KANSAS
Elevation 2416 feet
T.D.4684

9 PHILLIPS PETROLEUM CO. NO.1 FOLKERS
SW cor. SW sec. 31, T.11S.,R.23W.
TREGO COUNTY, KANSAS
Elevation 2351 feet
T.D.4602

10 CENTRAL COMMERCIAL CO. NO.1 LOCKER
SW NE NE sec. 1, T.11S.,R.22W.
TREGO COUNTY, KANSAS
Elevation 2229 ± ref
T.D.4731

Whitehorse sandstone
Dog Creek shale
Blaine formation
CHEROKEE
PRE-CHEROKEE ROCKS
Ste. Genevieve limestone
St. Louis limestone
Spergen and Warsaw limestones
"Misener" sand
Bonneterre (?) dolomite
Lamotte sandstone
PRE-CAMBRIAN ROCKS
Sea Level
From driller's log
Stone Corral dolomite
Ninnescah shale
Wellington formation
Nolans limestone
Winfield limestone
Fort Riley limestone member
Florence limestone member
Barneston limestone
Wreford limestone
Beattie limestone
Neva limestone member
Grenola limestone
Americus limestone member
Foraker limestone
Fort Scott limestone
Spergen and Warsaw limestones
Keokuk and Burlington limestones
Gilmore City limestone
VIOLA
SIMPSON ROCKS
ARBUCKLE
N S No samples

EXPLANATION

Limestone; Sandy limestone; Dolomitic limestone; Dolomite; Sandy dolomite; Anhydritic dolomite
Sandstone; Limy sandstone; Dolomitic sandstone; Red shaly sandstone; Anhydrite or gypsum; Salt
Conglomerate; Variegated shale; Red or maroon shale; Green shale; Gray shale; Black shale
Red sandy shale; Green sandy shale; Red limy shale; Gray limy shale; Green limy shale; Red dolomitic shale; Coal or lignite; Glauconite; Chert
Oolites; Oolitic chert; Schist; Granite; Unconformity; N S No samples

Horizontal scale: 5 0 25 Miles

The nomenclature and classification follow the usage of the State Geological Survey of Kansas. Not all the formation and member names are shown.

Drafting of cross section by Jessie C. Kirby

INDEX MAP SHOWING LINE OF CROSS SECTION NO.5 AND PREVIOUSLY PUBLISHED SECTIONS
0 10 20 30 40 50 Miles
Scale

SUBSURFACE GEOLOGIC CROSS SECTION FROM TREGO COUNTY, KANSAS, TO CHEYENNE COUNTY, COLORADO

BY JACK B. COLLINS