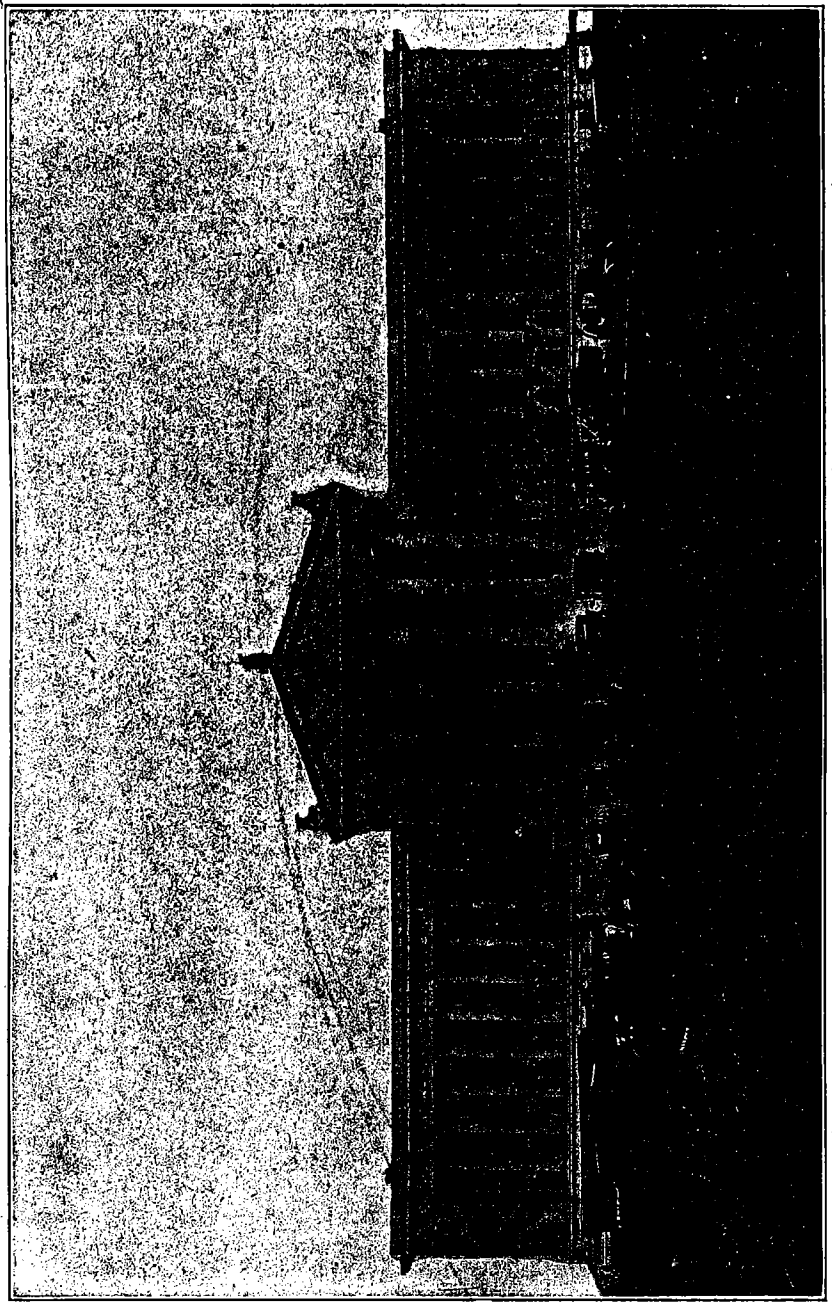

SOUTH FRONT OF STATE CAPITOL BUILDING, OKLAHOMA CITY OKLAHOMA.

OKLAHOMA GEOLOGICAL SURVEY

Governor Robert L. Williams, State Superintendent R. H. Wilson, President Stratton D. Brooks, Commission

C. W. Shannon, Director

BULLETIN NO. 27

GEOGRAPHY OF OKLAHOMA

BY

L. C. SNIDER

NORMAN

September, 1917

SCIENTIFIC STAFF.

C. W. Shannon ..... Director.
Geo. E. Burton ..... Assistant Director.
Fritz Aurin ..... Field Geologist.
C. W. Honess ..... Assistant Geologist.
V. V. Waite ..... Chemist.
Frank Gahrtz ..... Draftsman.

L. C. Snider, author ..... Assistant Director (1913-'14).

CO-OPERATIVE PUBLISHING CO., GUTHRIE, OKLA

GEOGRAPHY OF OKLAHOMA.

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GEOGRAPHY OF OKLAHOMA.

INTRODUCTION.

The urgent needs of the public schools of Oklahoma for available information concerning the geology, physiography, geography mineral resources, plant and animal life, history, development, industries, and institutions of the state; and similar demands of the general public for the same information, led to the preparation of the present publication. The chief purpose, then, of this publication is to give, in a brief manner, such information as above suggested. In connection with the regular duties of the field men of the Oklahoma Geological Survey, a large amount of valuable information is gained concerning the natural resources of the State, which are of value from an educational and scientific view, as well as from an economical standpoint.

Dr. L. C. Snider, formerly Assistant Director of the Oklahoma Geological Survey, began the preparation of the publication on the geography of Oklahoma while he was serving in the capacity indicated. The work had been only partly done when Mr. Snider severed his connection with the Geological Survey of the State. However, arrangements were made to bring the report to completion, and in addition to the work which Mr. Snider had prepared, various subjects, relating to the geography of Oklahoma, were given to persons qualified to write upon the subjects assigned.

Geography, in its broadest sense, is not confined to a description of the surface of the land, and the mineral resources, but includes a discussion of the peoples, animals, plants, and industries. In fact, geography is a history of the earth and its inhabitants, embracing all of the natural conditions and institutions which have brought about the present state of the region under consideration.

The only available source of information for the schools of the State, concerning the geography of Oklahoma, is through the publications of the Oklahoma Geological Survey, except for the brief Geography of Oklahoma, published by Dr. C. N. Gould, which has found a wide use in the schools of the State.

The present publication is not a text book, but a guide to supplement the study of geography and geology, and biological sciences in the schools of our State, as well as to serve the needs of the general public.

In the preparation of this report, acknowledgments are due to many persons.

Chapter I.—General Geography of Oklahoma—was prepared almost entirely by Mr. Snider. This chapter gives a brief discussion of the location and boundaries, surface, drainage, weather and climate of Oklahoma.

Chapter II.—Geology and Geologic History of Oklahoma—was prepared by Mr. Snider with some additional contributions by Mr. C. W. Shannon, Director of the Survey. This chapter deals with a general discussion of the character and distribution of rocks and minerals, and the structural and historical geology of the State.

Chapter III.—Physiographic Provinces of Oklahoma—was prepared chiefly by Mr. Snider, and, in part, by other members of the Geological Survey staff. In this chapter, the State is divided into eleven physiographic provinces, and a considerable discussion of each is given.

Chapter IV.—Mineral Resources of Oklahoma—prepared by Mr. Snider and Mr. Shannon, gives a discussion of the location, availability, supply and development of the various mineral resources.

Chapter V.—Agriculture in Oklahoma—was written by Mr. Shannon and Miss Charlie Nickle, Chief Clerk of Geological Survey, from data collected by Mr. Snider, with additional information gained at a later date.

Chapter VI.—History of Oklahoma—was compiled from material furnished by Mr. Snider, and briefly summarized information from the "History of Oklahoma" by Mr. J. B. Thoburn.

Chapter VII.—Education in Oklahoma—was compiled by Mr. George E. Burton, Assistant Director and Miss Charlie Nickle. This chapter gives a brief discussion of the history of education in Oklahoma, and a short description of each of the educational institutions.

Chapter VIII.—Animal Life in Oklahoma—was written by Mr. Howard Cross, of the Department of Zoology, Oklahoma University. Dr. H. H. Lane, Head of the Department of Zoology, offered much valuable assistance in the preparation of this chapter, and checked the scientific and common names used in the list of wild animals. Mr. Frank Rush, Forester in charge of the United States Game and Forest Preserve, in the Wichita Mountains, also furnished much information of value concerning the animal life of the State. Credit is due to many others who contributed to the data used in the chapter.

Chapter IX.—Plant Life in Oklahoma—was compiled from the manuscripts of unpublished reports on the plant life of Oklahoma, by Mr. G. W. Stevens, formerly Head of the Biological Department of Northwestern State Normal School, and Mr. C. W. Shannon, Director of the Oklahoma Geological Survey. These manuscripts mentioned include a report on the flowering plants of Oklahoma, by Mr. Stevens, and a report on the trees and shrubs of Oklahoma, by Mr. Shannon.

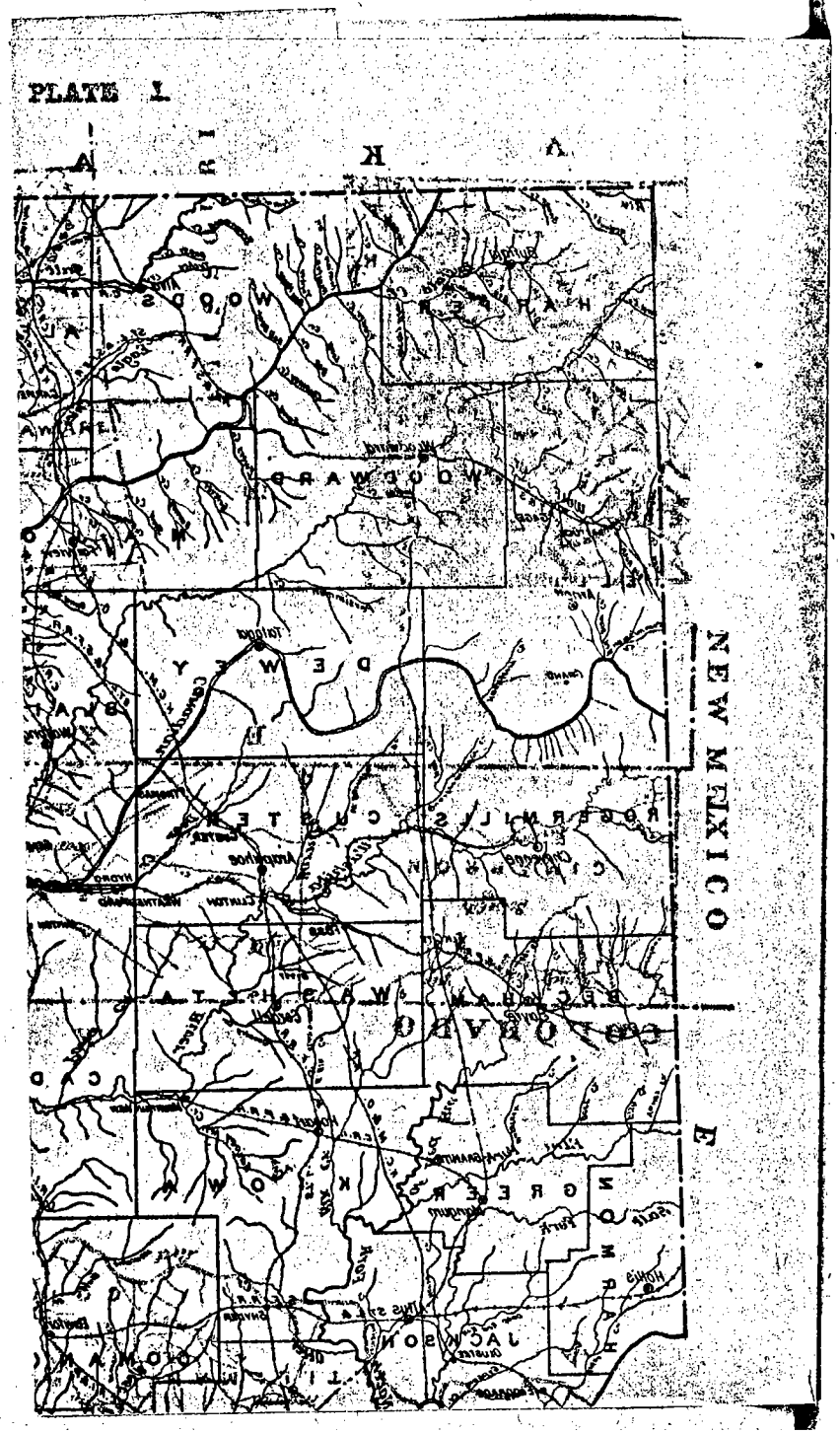
Chapter X.—A Discussion of the Physiography, Geology, Mineral Resources, Industries, and Population of the State by Counties—was

prepared chiefly by Mr. Snider, but considerable credit is due to Messrs. Shannon, Burton, Aurin, and Miss Nickle of the Geological Survey, in bringing the chapter to its final form and completion.

In the matter of illustrations, the publication will be of much value. In the selection of the illustrations for use in the report it was the purpose to secure those which would illustrate to the best advantage the principal resources and their development within the State.

C. W. SHANNON Director.

OKLAHOMA GEOLOGICAL SURVEY,
Norman October 1, 1917.



CHAPTER I.

GENERAL GEOGRAPHY OF OKLAHOMA.

LOCATION AND BOUNDARIES.

Oklahoma is located in the south-central part of the United States. The boundaries of the State were formed without any particular reference to Oklahoma, but the adjoining states were laid out and the remaining territory was left to the Indian tribes, and became known as Indian Territory. A tract of land near the center of the states remained unallotted to the Indians, and was called Oklahoma. There is some dispute as to the meaning of the word but the generally accepted notion is that it comes from two Choctaw words meaning "red men"—Okla (people), and homma or humma (red). By various treaties with the Indian tribes, the territory known as Oklahoma, open to settlement by the whites, was increased until it included practically the western half of the present State. The eastern half remained as Indian Territory until 1907, when it and Oklahoma Territory were together admitted into the Union as the State of Oklahoma. The history of the growth of Oklahoma Territory is given in some detail in a later chapter.

Red River on the south is the only natural boundary of Oklahoma. This river was established as the boundary between the Spanish possessions and the Louisiana Purchase. There was a dispute as to whether the South or North Fork of Red River was meant in this treaty, and for many years the territory between the two forks, now including the southern part of Beckham, and all of Greer, Harmon, and Jackson counties, was claimed by Texas. The Supreme Court of the United States decided in 1896 that this territory was part of the Louisiana Purchase, and it was added to Oklahoma, thus establishing the present southern boundary of the State.

The western boundary of the main portion of the State was established at the 100th meridian at the time of the Louisiana Purchase. When Texas was admitted as a slave state, a strip along the north end of the "Panhandle" was north of the parallel of 36° 30′, and could not be admitted to the Union as slave territory, according to the terms of the Missouri Compromise. It was therefore ceded to the Federal Government, and in 1896 was added to the Territory of Oklahoma. The

southern boundary of this strip was established by the admission of Texas. As just mentioned, the western boundary had already been established by the organization of the Territory of New Mexico in 1820, and the northern boundary was fixed at the 37th parallel by the organization of the Territory of Colorado.

The remainder of the northern boundary of Oklahoma was established at the 37th parallel by the organization of the Territory of Kansas. According to the Missouri Compromise, Kansas should have extended south to 36° 30' but this would have made it include part of the lands already granted to the Cherokee Nation, and would have divided these lands into free and slave territory, so the boundary was placed at 37°.

The eastern boundary of Oklahoma consists of three straight lines. The western boundary of Missouri was fixed when that State was admitted to the Union in 1820, at a line drawn due south from the junction of the Kansas and Missouri rivers. This established the eastern boundary of Oklahoma between the parallels of 37° and 36° 30'. In 1824 the western boundary of Arkansas was defined as a line running due south from a point 40 miles west of the southwest corner of Missouri. This line passed very near the present sites of Muskogee and Wilburton. Part of the territory included in Arkansas by this boundary had, however, been granted previously to the Choctaw Nation, and in 1828 the boundary was shifted to the east. It was then defined as beginning at the point where the eastern line of the Choctaw Nation crossed Red River and running due north to Arkansas River, thence in a straight line to the southwest corner of Missouri.

As defined by the boundaries outlined, the main portion of the State of Oklahoma lies between 37° N. latitude on the north, and Red River (approximately the 34th parallel) on the south, and from about 94° 30' W. longitude on the east to 100° on the west, with the northwestward extension (Panhandle) lying between the parallels of 36° 30' and 37°, and reaching west to 103° W. longitude. The greatest length of the State along the north line, including the Panhandle, is about 470 miles. The greatest length of the main portion of the State is about 320 miles, and the greatest breadth is about 225 miles. The total area is approximately 70,470 square miles.

SURFACE.

The surface of Oklahoma is, in general, a plain which slopes to the southeast. The altitude ranges from a little over 4,500 feet, near Kenton in the extreme northwest corner of the "Panhandle", to a little less than 400 feet at the extreme southeast corner of the State, where the Oklahoma-Arkansas line meets Red River. The rise from the southeast corner through the major portion of the State is very gradual, but through the western part of the main portion, and through the "Panhandle" the rise is much more rapid.

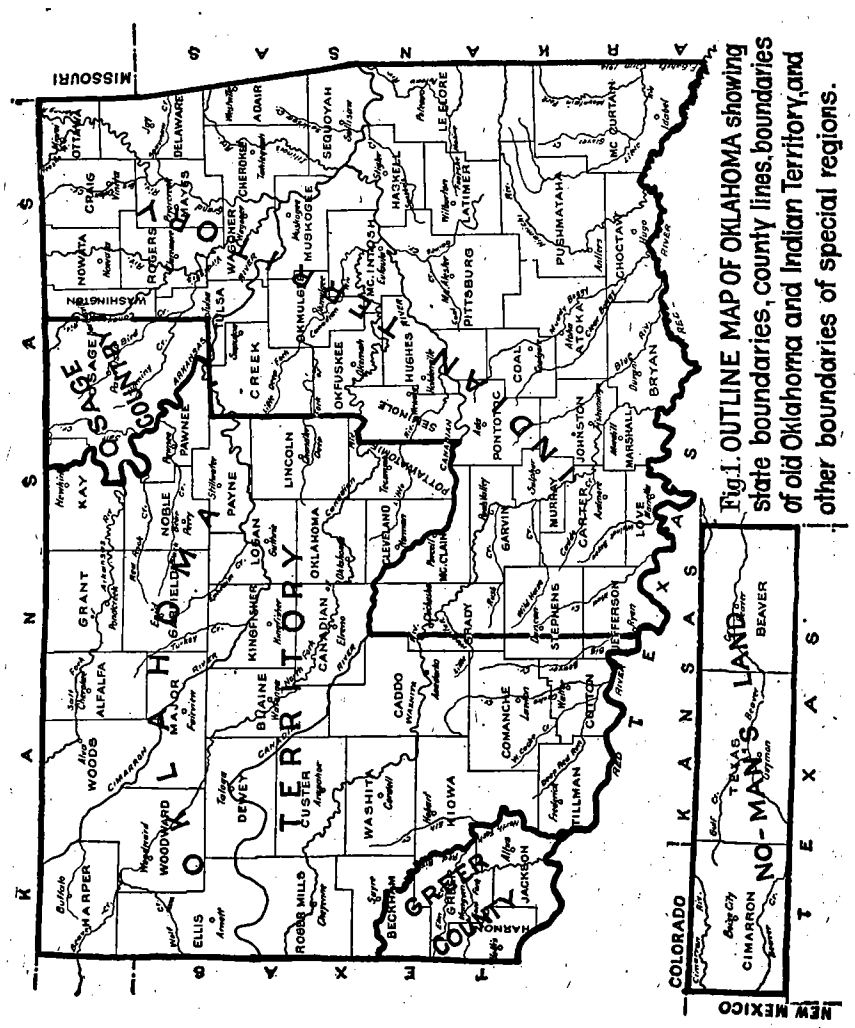


Fig. 1. OUTLINE MAP OF OKLAHOMA showing state boundaries, county lines, boundaries of old Oklahoma and Indian Territory, and other boundaries of special regions.

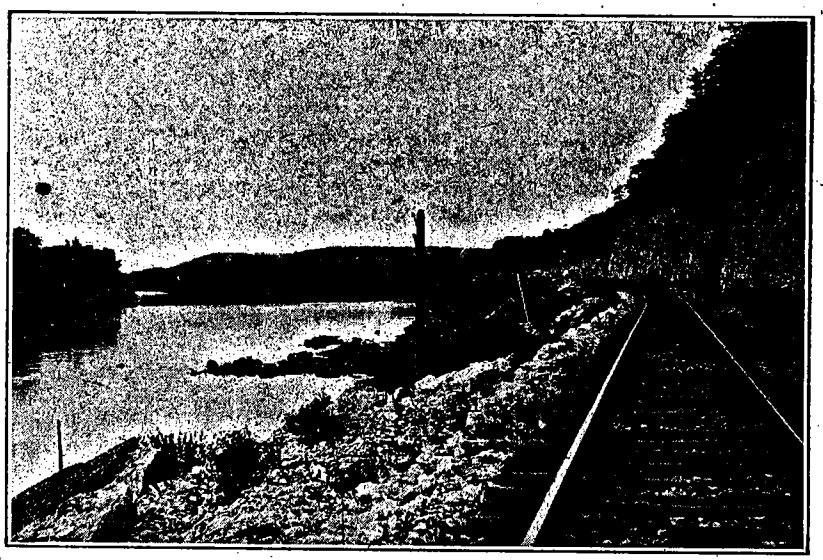
While the surface of the State as a whole is a plain, this plain is interrupted in different sections by broken or hilly land. The principal areas of hilly land are the Ozark Mountains in the northeastern part of the State, the Ouachita Mountains in the southeastern part, and the Arbuckle and Wichita mountains in the southern portion. In parts of western Oklahoma the streams have cut deep channels into the rocks, thus breaking the surface of the plain. In fact, only in the western portion, and in a belt through the central part of the State from north to south, is the surface very level. The greatest inequalities of surface, that is, the greatest difference in *levels* between the tops and bottoms of the hills, is in the southeastern part of the State, where some of the so-called mountain peaks rise as high as 1,500 feet above their bases.

The altitudes of some of the principal towns in the State are as follows:

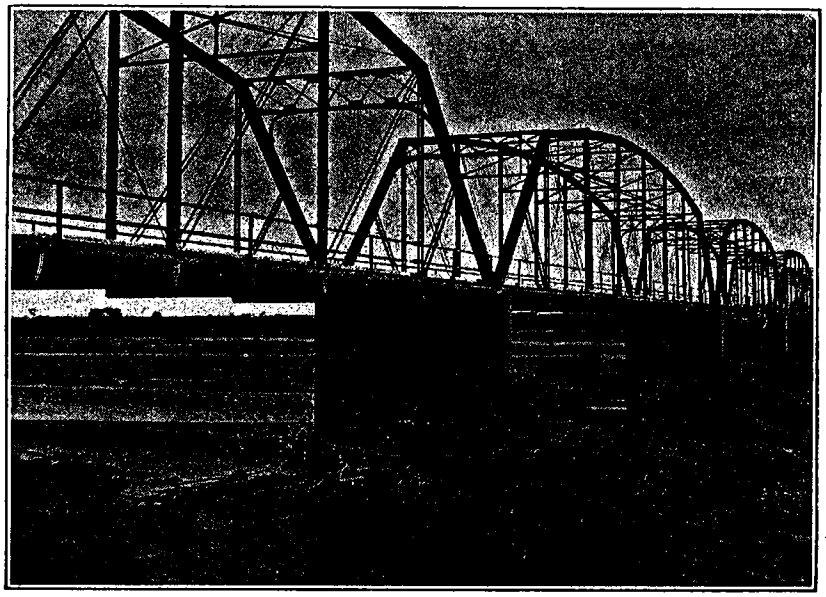
Idabel	474 feet.
Poteau	500 feet.
Miami	800 feet.
Ardmore	880 feet.
Oklahoma City	1,207 feet.
Newkirk	1,148 feet.
Alva	1,332 feet.
Lawton	1,096 feet.
Watonga	1,522 feet.
Altus	1,383 feet.
Sayre	1,810 feet.
Shattuck	2,232 feet.
Woodward	1,893 feet.
Goodwell	3,286 feet.
Kenton	4,500 feet.

DRAINAGE.

Oklahoma lies entirely in the Mississippi River Basin, and all of its surface drainage finds its way to the Mississippi through two major streams, Arkansas River and Red River. Arkansas River and its branches drain about three-fourths of the area of the State. Its principal branches from the north are the Verdigris, Grand, and Illinois rivers, and Sallisaw Creek. Those from the south and west are Salt Fork, Cimarron, North Canadian, South Canadian, and Poteau rivers. Red River drains the southern and southwestern parts of the State. The principal branches named from west to east are North Fork of Red River, Cache Creek, Beaver Creek, Mud Creek, Washita River, Blue River, Boggy Creek, Kiamichi River, and Little River. In the following paragraphs the streams are considered somewhat in detail.



A. VIEW ALONG GRAND RIVER NEAR STRANG, MAYES COUNTY.



B. VIEW ON SOUTH CANADIAN RIVER, THREE MILES SOUTHWEST OF NORMAN.

ARKANSAS RIVER DRAINAGE SYSTEM.

ARKANSAS RIVER.

Arkansas River is the largest river which flows across the territory included in Oklahoma. It enters the State near the middle of the north boundary and flows in a general southeasterly direction, but with a very winding course. As is the case with all the other rivers which flow across the Great Plains, the Arkansas is sand-choked. The water is always heavily charged with sediment, and is of a red color, although this color is not so marked in the Arkansas as in the streams farther south. During flood times the waters carry vast quantities of sand, and shift it and roll it along the bottom in enormous quantities. Sand bars and islands of sand are formed with each flood, only to be destroyed and built up in different localities with the next flood. During the dry seasons the river is almost or, in places, entirely dry, and the sand is left to the mercy of the winds which shift it about from place to place, building large sand dunes. Some of these reach for a considerable distance back from the river. This feature also is not nearly so pronounced along Arkansas River as it is along the Cimarron and Canadian.

Through the greater part of its course Arkansas River has a wide flood plain, and vast quantities of silt are deposited over this plain in times of highwater. This river bottom soil is very rich, and especially in the lower course of Arkansas River in Wagoner, Muskogee, and Haskell counties, and forms one of the richest farming regions in the State.

As has been said, the entire channel of Arkansas River is filled with sand. The depth of this sand at different places is not accurately known, but it probably averages over 30 feet. A large percentage of the water carried by the river probably moves down through this sand. Even at times when the river bed is dry, water will rise almost to the tops of holes dug in the sand.

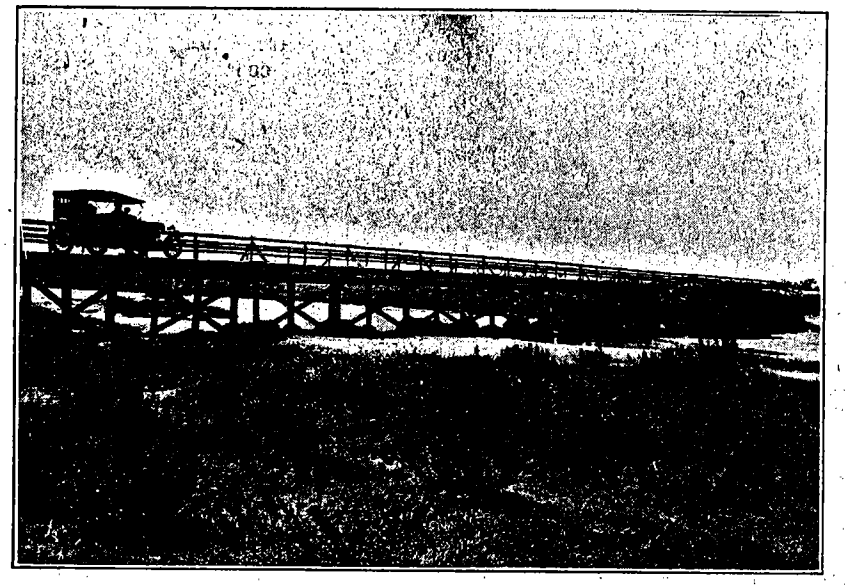
TRIBUTARIES.

Verdigris River joins Arkansas River from the north, near the city of Muskogee. The river rises in Kansas and flows with a very winding course in a southerly direction through Nowata, Rogers, and Wagoner counties. This river flows through most of its course on a bedrock of clay shale, which gives rise to large quantities of mud. It is markedly different from the Arkansas in the absence of sand bars and the sand-choked channel. The banks are usually steep. The waters are often muddy, but not so heavily charged with sediment as those of the Arkansas.

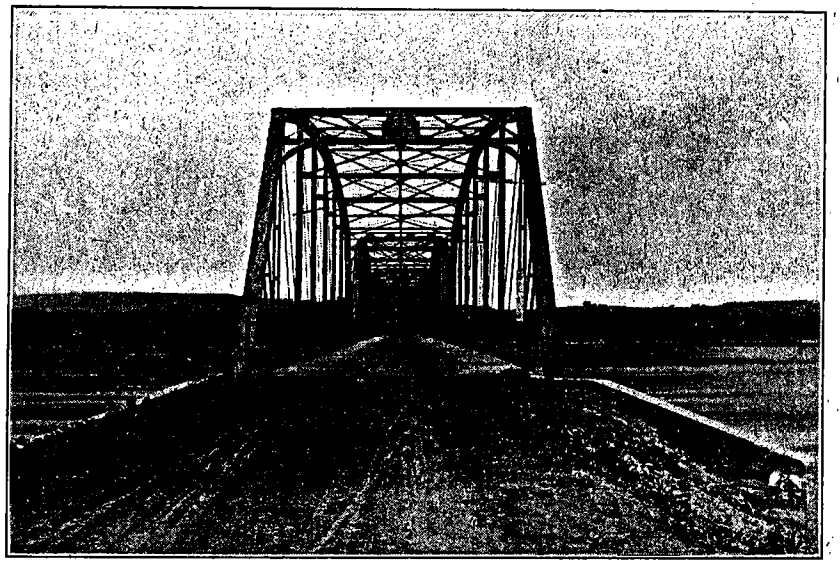
Grand River is formed by the junction of *Spring River* and *Neosho River*, near the town of Miami in Ottawa County.

These rivers rise respectively in Missouri and Kansas. From the junction of the two streams, Grand River (called Neosho by the

PLATE III.



A. VIEW ON BEAVER CREEK NEAR BEAVER, BEAVER COUNTY.



B. VIEW ON CANADIAN RIVER AT TALOGA, DEWEY COUNTY.

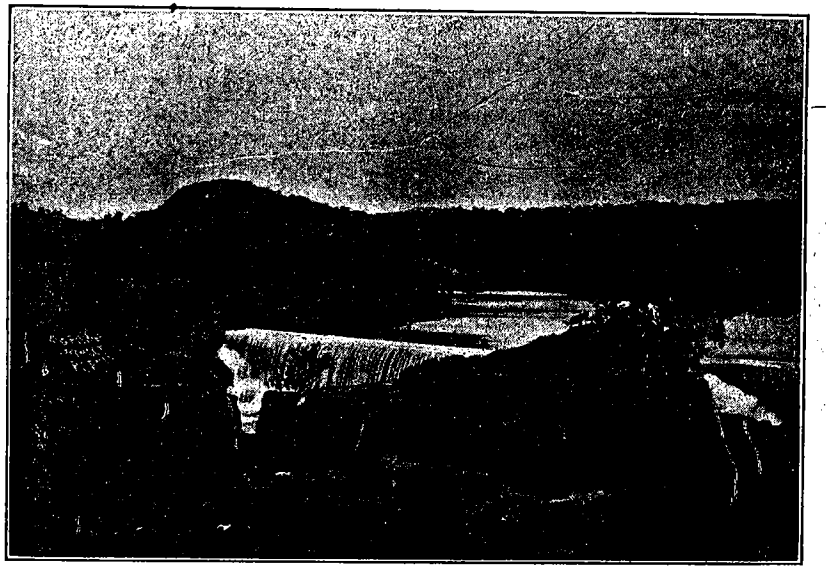
United States Geological Survey) flows in a direction slightly west of south, through the northeastern corner of Delaware County, through Mayes County, and between Wagoner and Cherokee counties, joining the Arkansas a few miles southeast of the mouth of the Verdigris, near Ft. Gibson. The region drained by Grand River is one of chert and limestone hills, which are for the most part heavily forested. The soil covering of the hills is usually thin, and contains sufficient fragments of chert to make it very porous, so that the rainfall soaks rapidly through the soil without washing much of it into the streams. The rocks of the region are very porous, and great quantities of water flow through underground courses and emerge as springs. As a result of these conditions the water in Grand River is very clear, and the channel contains very little mud, and practically no sand. Large bars and islands of coarse chert and limestone gravel are built up in times of high water. There is a marked difference between the tributaries entering Grand River from the west and those entering from the east. Those from the west, of which Big Cabin and Pryor creeks are the most important, drain a region underlaid by clay shale. They are able to wear their valleys down faster than Grand River, which flows on the resistant chert, and consequently have broad, flat flood plains, and very gentle gradient. They are muddy streams with steep banks, much more nearly resembling the Verdigris than the Grand, which they enter. The tributaries from the east, Cowskin River and Spavinaw, Spring, and Clear creeks, like Grand River, flow almost entirely through the chert hills region, and are clear streams with steep gradients. They carry practically no mud, but flow throughout their course over gravelly bottoms.

Illinois River and *Sallisaw Creek* are streams which resemble the Grand in almost every particular. They drain the greater part of Cherokee and Adair counties. Both streams rise in Arkansas and take a western and southern course, joining Arkansas River where it forms the southern boundary of Sequoyah County.

The principal streams joining the Arkansas from the south and west, the *Salt Fork, Cimarron* and *Canadian* rivers, are streams very similar to the Arkansas itself. They are all typical streams of the Great Plains, and all have their source in the foot hills of the Rocky Mountains, far to the west of Oklahoma. The three rivers are sand-choked and have great series of sand dunes built up along their courses, usually along the northern side of the stream. The sand dunes of the Cimarron reach as far as 15 miles from the river. The water of these rivers is of a very red color, due to the sand and clay material which is carried in suspension. All are subject to very rapid "rises." The valleys of all three streams are very narrow in proportion to the length of the rivers, and they have very few important tributaries in Oklahoma. The source of the water which flows through these streams is largely in the foot-hills of the Rocky Mountains, where the rainfall is much

PLATE IV.

A. VIEW ON RED RIVER AT ROCK BLUFF FERRY, NEAR LEON, LOVE COUNTY.



B. VIEW ON MEDICINE CREEK, AT MEDICINE PARK, NEAR LAWTON, COMANCHE COUNTY.

heavier than it is in the lower portion of the courses of the rivers. It is this fact which accounts for the "rises" which have been mentioned. Heavy rains far up the rivers, and also the snow melting in the spring on the mountains, throw vast quantities of water into the rivers through the narrow channels, and in spite of the fact that it is not increased by contributions from tributaries it rushes down the channel of the river with great force. Often a wall of water ten feet or more in height will advance very rapidly down the river and cause a great deal of destruction. The water of all of these rivers carries some salt in solution. This is especially true of the Cimarron, which flows across two large salt plains between Harper and Woods counties. These plains are fed by salt springs, and the water of the Cimarron for some distance below the plains is so salty that cattle will not drink it. North Canadian River is the only important tributary of the Canadian in Oklahoma. It is a stream similar to the Canadian itself, and flows through a narrow valley between the valleys of the Canadian and Cimarron. It is very similar to these two streams, but is considerably smaller.

RED RIVER DRAINAGE SYSTEM.

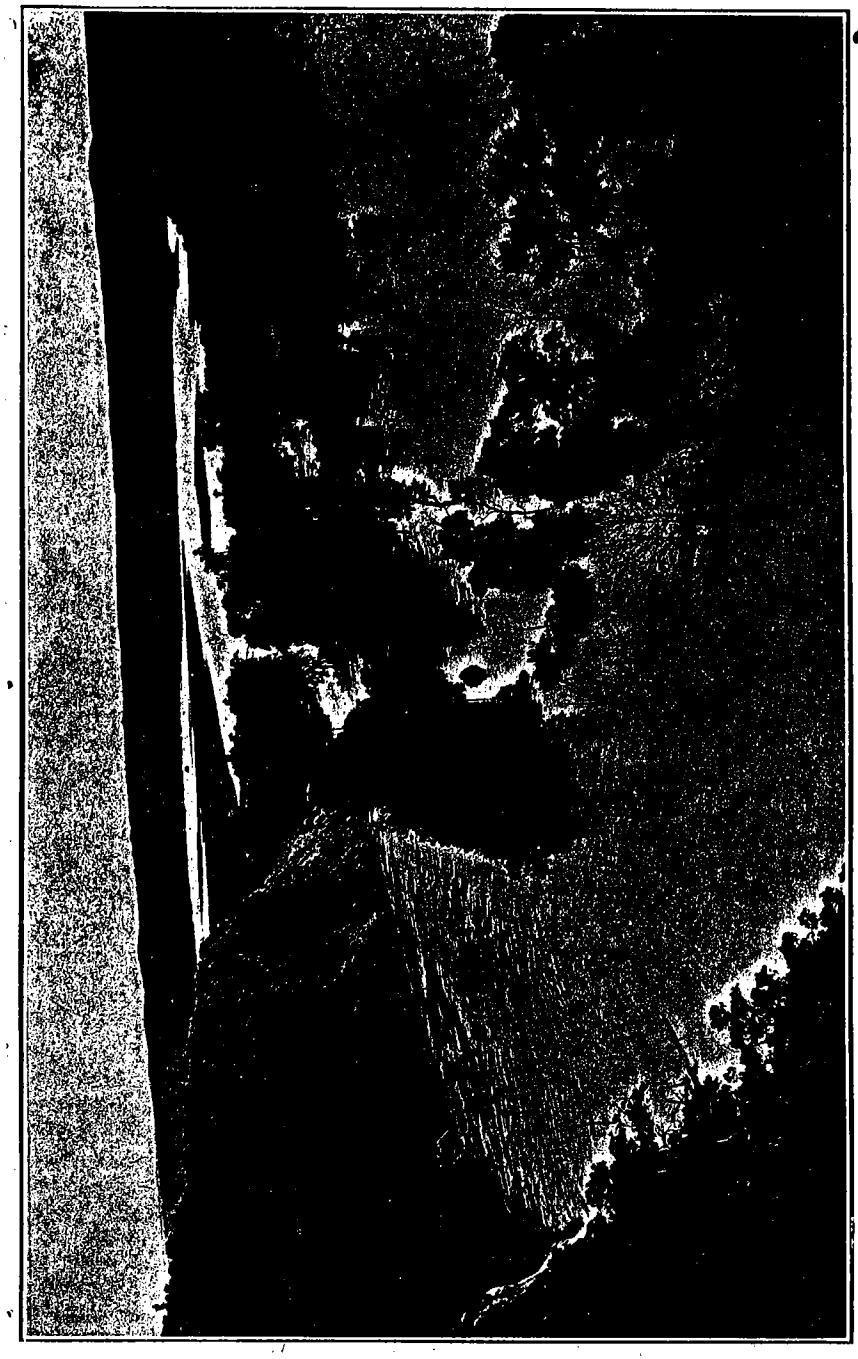
RED RIVER.

Red River forms the southern boundary of Oklahoma. It is also a typical plains river, is largely sand-choked, and in the upper part of its course has a great development of sand dunes. The water is very red, but not much more so than that of the Canadian or Cimarron. The amount of water carried in the dry seasons is very small, and at times the river is almost dry, although large quantities of water are moving slowly through the sand.

TRIBUTARIES.

The principal tributary to Red River in Oklahoma is *Washita River*, which, while a river of the plains, differs considerably from those already described. It carries much less sand, and usually has steep mud banks. It enters the State about the middle of the western boundary and flows in an easterly direction through Roger Mills, Custer, Washita, Caddo, Grady, and Garvin counties. Near the center of Garvin County it turns almost directly south through Murray County, flowing across the narrow portion of the Arbuckle Mountains. From the south line of Murray County it flows east through a corner of Carter County and the southern part of Johnston County, and then south through Marshall and Garvin counties. The valley of the Washita is wide, and the bottom lands form probably the largest and richest river valley region in the State. The *North Fork of Red River* drains the extreme southwestern portion of the State. It more nearly resembles the Cimarron and Canadian than it does the Washita. It is a river carrying much sand and with large areas of sand dunes along its course. *Kiamichi River* and *Little River* drain the southeastern corner of the State into Red River. These streams, with their numerous tributaries, more nearly

PLATE V.



WASHITA RIVER AT FLOOD TIME, ARBUCKLE MOUNTAINS, THREE MILES SOUTH OF DAVIS, JUNE 1908.

resemble Grand and Illinois rivers than they do any of the others described. They flow through a very rough country in which the soil is usually very thin. The water comes largely from sandstone areas, and is very clear. They are probably the best streams in the State for fish, and hundreds of hunters and fishers visit this section of the State every year. Kiamichi River forms the only important break or gap in the western part of the Ouachita Mountains, and on this account one line of the St. Louis & San Francisco Railroad has been built along it for many miles.

WEATHER AND CLIMATE.

GENERAL STATEMENT.

By weather is meant the combined effects of different factors on the atmosphere at a given time and place. The principal factors affecting the weather are temperature and humidity, or amount of moisture in the atmosphere. The amount of motion of the air (wind) may be regarded as another factor of the weather, although it is due primarily to variations in temperature. Climate may be regarded as the average weather of a given locality.

In general the climate of Oklahoma is temperate, although there are many extremes of weather both of hot and cold, wet and dry. The seasonal changes in temperature are rather great, ranging from below 0° in winter to above 100° in summer. As a whole the State is subject to rather strong winds, the result of great cyclonic movements of the atmosphere. The causes and mechanics of these movements are described in all texts of Physical Geography and need not be discussed here.

Most of these movements cross the State from northwest to southeast, but some of them have their origin over the Gulf of Mexico and advance toward the north.

In the following paragraphs the different factors of the weather, the temperature, the humidity—including rain, snowfall, and cloudiness—and the winds are noticed in some detail.

TEMPERATURE.

Since the temperature decreases one degree for every 65 feet of elevation, where other conditions are the same, the northern and western parts of the State are usually cooler than the southern and eastern parts. The variations from east to west are increased by the effect of the Gulf of Mexico, which moderates the temperature of the southeastern portion.

The following table compiled from reports of the United States Weather Bureau gives the maximum, minimum, and mean temperatures at Oklahoma City for each month of the 10-year period from 1902 to 1911 inclusive.

Table showing the maximum, minimum, and mean temperatures at Oklahoma City for each month of the 10-year period from 1902 to 1911, inclusive.

YEAR	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE			JULY			AUGUST			SEPT.			OCTOBER			NOV.			DECEMBER		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
1901	68	9	40.	66	13	36.6	84	14	48.8	89	31	57.9	93	45	67.4	96	51	78.7	102	66	84.9	104	64	82.	92	41	73.5	92	35	66.2	79	26	51.2	70	2	36.3
1902	70	0	35.8	72	5	35.4	79	22	51.	93	38	61.3	88	51	70.2	99	50	77.	95	65	78.8	101	58	83.2	94	45	67.4	84	39	63.	75	28	53.	70	12	36.4
1903	70	13	38.6	69	4	34.6	77	18	48.9	87	33	59.8	84	35	65.	91	48	70.5	101	60	80.	97	61	79.5	94	44	70.6	89	38	61.8	84	13	42.1	63	14	41.1
1904	67	3	36.3	90	12	43.8	88	19	56.	90	35	58.	88	47	66.8	90	56	74.2	95	64	80.	99	59	78.8	96	50	74.	90	34	63.5	74	17	52.6	69	11	39.2
1905	63	2	28.6	65	11	27.4	82	38	56.7	88	36	58.4	87	50	69.2	95	62	78.3	95	56	77.	98	63	80.4	96	51	75.6	84	32	59.2	82	18	52.6	57	20	38.
1906	74	12	40.	75	5	40.4	73	16	40.5	86	37	62.3	89	42	68.3	95	52	74.6	95	57	75.8	92	52	76.4	89	46	73.2	83	27	56.2	81	18	46.9	74	13	43.2
1907	73	15	41.7	98	9	42.7	97	27	59.6	88	32	54.4	90	34	60.3	90	52	74.2	97	62	79.6	102	65	82.2	102	45	74.4	88	38	61.5	74	18	47.4	67	19	41.6
1908	66	17	40.8	79	10	44.	91	28	55.	84	34	59.1	89	40	67.	89	57	73.7	93	60	76.6	97	58	79.2	95	40	72.	85	33	59.4	80	19	49.6	73	20	42.8
1909	79	1	37.6	77	7	43.6	83	25	49.2	90	31	58.4	90	33	66.8	98	57	76.6	102	62	83.3	108	62	83.	100	43	74.9	90	36	62.3	84	29	56.1	67	6	31.
1910	75	11	39.3	71	7	35.4	87	33	60.5	89	35	61.3	92	45	64.9	87	53	76.2	104	64	82.6	106	53	80.8	100	48	77.6	94	28	62.8	81	22	51.	64	14	38.8
Average for 10 years			37.87			38.39			52.62			59.09			66.59			75.40			78.87			81.55			73.32			61.59			50.75			38.94

The extreme range in temperature in Oklahoma as shown by the table is from 11° below zero to 108°. For the whole State the extreme shown in the reports available for the same period are 25° below zero to 116°. The first killing frosts in the fall usually occur in the first half of October and the last in the spring during April. In some parts of the State killing frosts have been known to occur as late as May 15, but this is very unusual.

The following chart shows the average monthly temperature of Oklahoma for a period of 10 years.

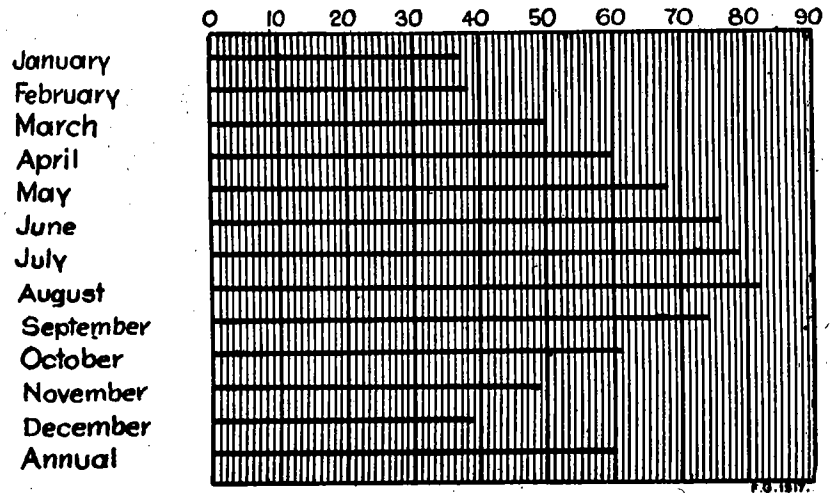


Fig. 2. CHART SHOWING THE AVERAGE MONTHLY TEMPERATURE IN OKLAHOMA.

PRECIPITATION.

GENERAL.

The term precipitation is used to cover both rainfall and snowfall. In making the reports of the Weather Bureau the snowfall is reported as an equivalent amount of rainfall. Usually 10 inches of snow are taken as equivalent to one inch of rain. For the greater part of Oklahoma, therefore, the precipitation may be regarded as the rainfall, with very little error.

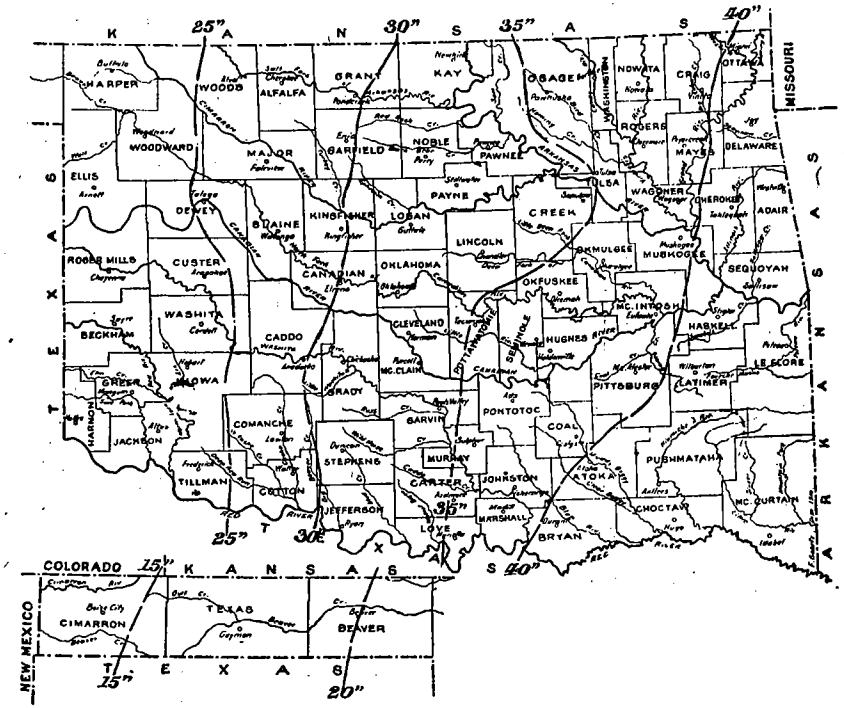


Fig. 3. MAP OF OKLAHOMA SHOWING MEAN ANNUAL RAINFALL.

The average annual precipitation in Oklahoma varies from about 45 inches in the southeastern corner to about 15 inches in the northwestern corner. Considerably over one-half of the State receives an average annual precipitation of 30 inches or over and may be considered as well-watered. The western portion lies in the semi-arid region. The accompanying diagram (fig. 3) shows the mean annual precipitation for the State. The

greater part of the precipitation occurs in the warmer months of the year, April to September inclusive. The percentage of the rainfall of the year occurring in these months is shown in figure 3.

The following table compiled from the annual reports of the United State Weather Bureau, shows the annual precipitation for the years 1901 to 1910 inclusive. The towns shown in the table have been selected from different portions of the State. In several cases the report for some of the towns is incomplete for some years. Whenever possible the report for a town in the same general vicinity is given, as, Gage or Hooker for Beaver, Weatherford for Arapaho, and Marlow for Chickasha or Fort Sill. These substitutions are all indicated in the notes to the table.

SNOWFALL.

In the preceding paragraphs, and in the table, both snowfall and rainfall are included in the term precipitation. In the following table the snowfall in inches is given for alternate winters since 1901-02 for a few localities in the State.

Table Showing Snowfall in Inches.

	1901-02	1903-04	1905-06	1907-08	1909-10
Hartshorne	12.0	5.0	10.5	.....	6.1 3
Muskogee	11.1 1	Trace	6.0	.....	6.0
Oklahoma City	7.7	2.1	3.4	0.5	2.9
Ardmore	2.0 2	6.4	5.0	.....	7.1
Fort Sill	5.2	2.0	7.0	Trace	6.0 4
Beaver	9.0	1.0	.....	.....	9.5 5

1. For Webber's Falls
2. For Healdton
3. For McAlester
4. For Cache
5. For Hooker

SUNSHINE.

As a whole, Oklahoma is blessed with a large amount of sunshine. There are very few long spells of cloudy weather. The percentage of hours of sunshine out of the possible hours at Oklahoma City for the years 1900-1910 inclusive, varies from 57 to 72, with the average about 65 per cent. The months July, August, and September have the most sunshine, the hours of sunshine being usually 80 to 85 per cent of the possible hours. The percentage during the winter months usually runs about 50, although there is considerable variation in this respect.

The number of clear, partly cloudy, and cloudy days at Oklahoma City for each year is shown in the following table:

Table Showing Clear, Partly Cloudy, and Cloudy Days at Oklahoma City, by Years, 1900-1910.

Year	Clear	Pt. Cloudy	Cloudy
1900	146	102	117
1901	157	123	85
1902	145	129	91
1903	164	123	78
1904	156	142	68
1905	132	139	94
1906	138	108	119
1907	134	123	108
1908	192	103	71
1909	148	124	93
1910	173	139	53

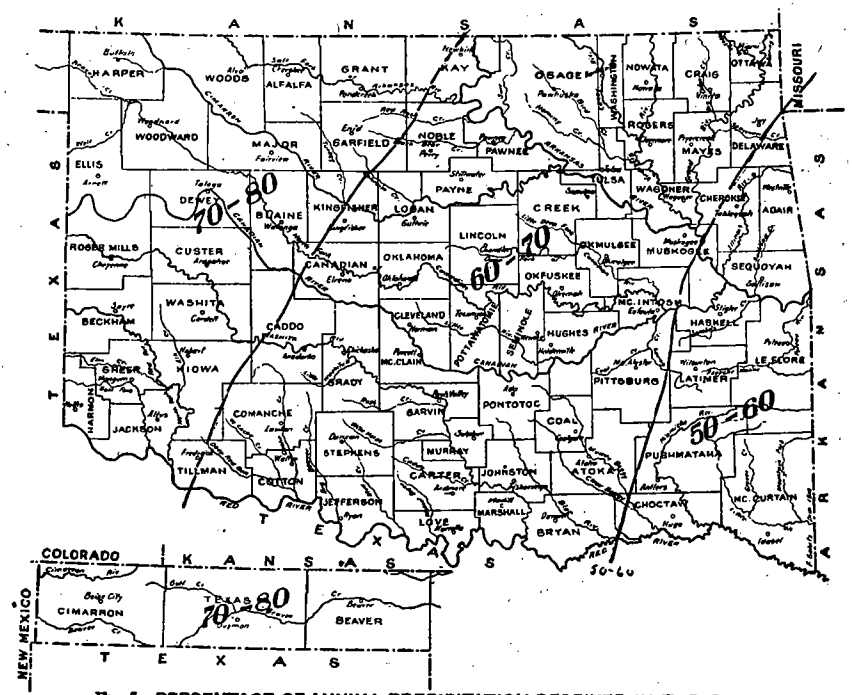


Fig. 4. PERCENTAGE OF ANNUAL PRECIPITATION RECEIVED IN THE SIX WARMER MONTHS APRIL TO SEPTEMBER, INCLUSIVE.

WINDS.

The prevailing winds in Oklahoma are from the south. The tables of the Weather Bureau at Oklahoma City for 1900-1910 inclusive, a total of 132 months, show that south winds prevailed for 94 months, southeast for 10 months, north for 25 months, northwest for 2 months, and northeast for 1 month. The winter months have prevailing north winds, with December and March occasionally showing prevailing northeast and northwest winds. The prevailing southeast winds are commonly in the spring and fall months.

A striking feature of the temperature in Oklahoma is the great and sudden drops which take place on the approach of a "norther" or blizzard in the late fall and winter months. These storms usually follow a period of warm weather with light south winds. The change from these conditions to a strong cold north wind is almost instantaneous and the temperature drops very rapidly. Changes of from 80 degrees to below freezing, a drop of 50 degrees or more, not uncommonly take place in less than 12 hours and the greater part of the change takes place in the first hour or two after the wind changes to the north. In the plains states north of Oklahoma these "northers" or blizzards are usually accompanied by great snows, but in Oklahoma there is usually very little snowfall with the storms, except in the northwest portion.

It is not known just what causes these "northers." At least a partial explanation may be suggested by the relative position of the Rocky Mountains and Oklahoma with reference to the high and low pressure at the time of the occurrence of the "northers." To produce such decided drops in temperature in such short time, an enormous amount of air must be brought from the north. To produce a "norther" in Oklahoma a low pressure must center to the south of the State and a high pressure somewhat to the north. The movement of the air in the high pressure is spirally outward, and clockwise. Consequently movement of some of the air from a "high" located as above described, is toward the southwest. Air moving in this direction is deflected to the south by the Rocky Mountains, and there is a tendency for more air to pass over a given space than there would be if the Rocky Mountains did not deflect this air. Consequently a great deal of air must pass over a comparatively narrow space. In order to do this it must move quite rapidly. Then, too, the path of this air is over the Prairie Plains, where there is very little resistance to retard its velocity.

An interesting phase of Oklahoma weather is the occurrence of tornadoes. The greater number of these storms occur in the spring months, though they have been known to occur in every part of the year.

In general, the conditions under which tornadoes occur are as follows: A condition of unstability is made when a layer of warm air underlies cold air. The upper pressure of the lighter warm air against the overlying cold air becomes enormous, and if this pressure becomes great

PLATE VI.

PONCA CITY CYCLONE, APRIL 24, 1912 (Photograph by Drake, Ponca City.)

enough the warm air breaks through the layer of cold air. The warm air in going upward moves spirally, the direction of rotation being counter-clockwise in the northern hemisphere. The place where the air is draining spirally upward is called the xortex of the tornado. The surface air moves inward from all directions to this vortex, where it passes rapidly upward. The movement of air reaches its greatest velocity in the vortex. The vortex is usually marked by a funnel-shaped cloud which is characteristic of tornadoes. The air in the vortex of a tornado is under very low pressure. The great destruction to buildings is not due altogether to the velocity of the wind, but to the fact that there is a sudden reduction of air pressure surrounding the building. It is an interesting fact that the walls of most buildings destroyed by tornadoes are blown outward.

Tornadoes usually occur in the southeast quadrant of the low pressures. In this quadrant the northwest-moving surface winds carry warm air beneath the overlying colder air and make ideal conditions for the formation of tornadoes. Tornadoes nearly always travel toward the northeast.

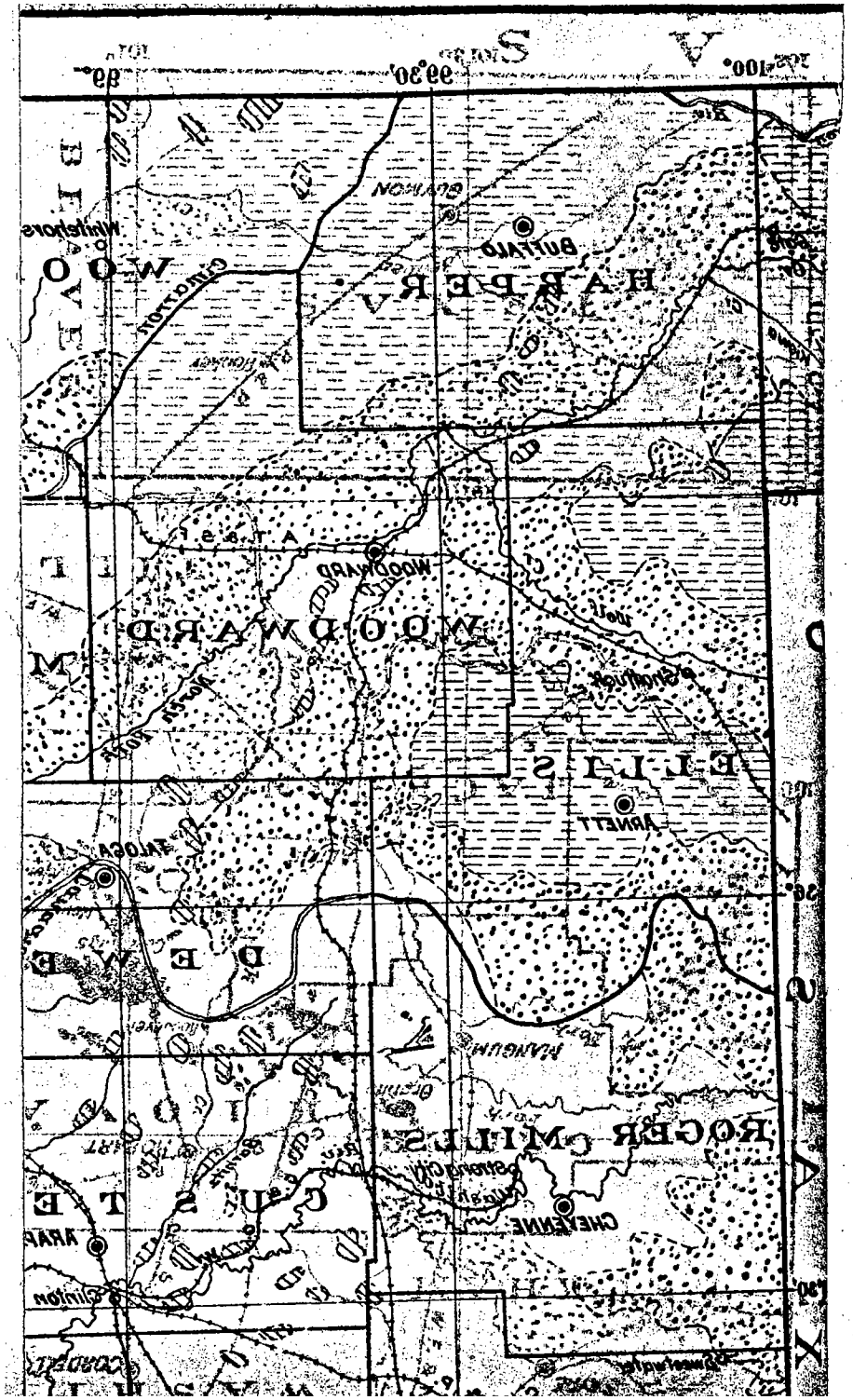
If a tornado is seen approaching the observer directly, the quickest way to safety is to go as quickly as possible at right angles to the path of the storm. Nearly always this would be either southeast or northwest. Northwest is preferable, as the zone of destruction is usually narrower in that side of the tornado's path.

The storm cellar or cave is the best protection against a tornado. Such cellars should be equipped with axes as there is a chance of debris blocking the exit from the cellar after the storm is over.

The southwest corner of a basement is the safest place in case a cave is not accessible.

While the destruction of particular tornadoes is usually great, they must be classified as sensational. They claim considerably fewer victims than do railroad accidents.

The ordinary gentle breeze moves at the rate of about 2 miles per hour. The wind of a "windy day" moves from 15 to 60 miles an hour, and the destructive storm moves from 60 to 100 miles per hour.



CHAPTER II.

GEOLOGY AND GEOLOGIC HISTORY OF OKLAHOMA.

INTRODUCTION.

In dealing with the geology of any region we are concerned principally with the study of the rocks, that is, their nature and composition. and the position in which they lie. The first subject—the study of the kinds of rocks and the relation of the different rocks to each other, is known as stratigraphy, or stratigraphic geology. The second subject—the study of the position of the rocks, is known as structural geology. In addition to these two, a third subject may be considered—the history of the conditions under which the rocks were deposited, and under which they have come into their present form, or historical geology.

The study of the rocks of any region is extremely important in connection with the study of its development in any line. The nature of the surface, the characteristics of the drainage, and most important of all. the soils of a region are dependent primarily on the nature of the underlying rocks. On this account it is necessary to give considerable attention to the rocks of Oklahoma. In this chapter the different kinds of rocks are described briefly, the distribution of the different kinds in Oklahoma is noticed at some length, and finally, a brief geologic history of the region now known as Oklahoma is given.

ROCKS AND MINERALS.

CLASSIFICATION.

Rocks are the materials which form the earth's crust. They are of many kinds, according to their composition and physical characteristics. However, they may be divided into two great classes—the igneous and sedimentary.

The igneous rocks are those which have been formed by the cooling of a molten mass or magma. They are the crystalline rocks and are composed of interlocking crystals of a great number of minerals. The best known type of the igneous rocks is granite, which occurs in enormous quantities, and which is well known as a building material. There are a great number of other varieties of igneous rocks, but they are of very small importance in Oklahoma and need not be noticed here.

GRANITE.

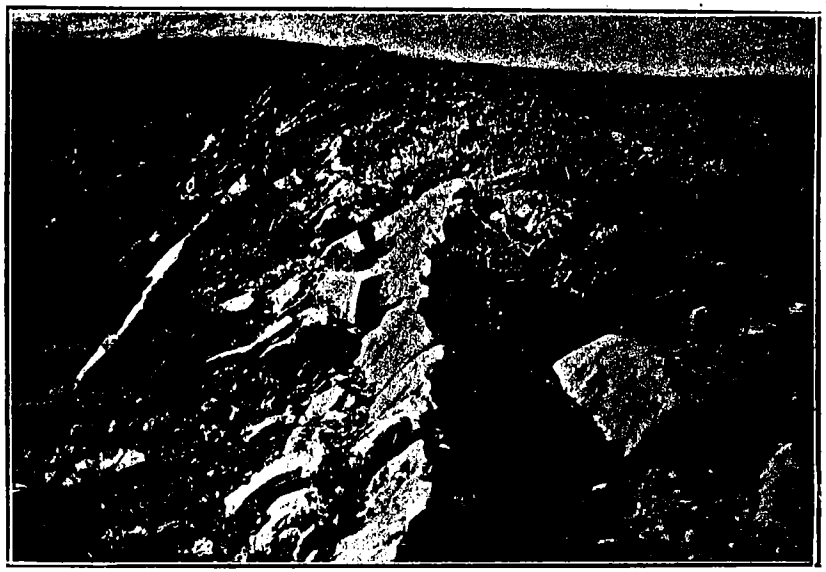
Granite is usually of a gray to red color, is a very hard, compact rock, and occurs in great masses which are not separated into layers. The masses are often cracked so that the rock may be quarried in blocks of small dimensions, but nothing resembling regular bedding of the rocks occurs in granite. Granites occur principally as the cores of mountain ranges, or as masses which were intruded into older rocks at considerable depth, and which have since been exposed by erosion.

CONGLOMERATES, SANDSTONES, SHALES, AND LIMESTONES.

The sedimentary rocks, as their name indicates, are formed as sediments, either under water or from the air. The aerial or wind-blown deposits are of some importance in Oklahoma, but the rocks deposited from water cover most of the earth's surface. They are easily divided into three or four distinct classes. When material is washed down from the earth's surface into the water, the coarse material is deposited very close along shore, while the finer material is carried farther and farther from the shore and deposited far out in the large bodies of water. Rocks which have been formed near shore will, as a rule, consist of gravel and sand. The proportion of gravel and sand will depend upon the nearness of high land, the amount of run-off of the streams, and the presence or absence of strong currents in the water in which the materials are deposited. Farther out from shore only sand and mud are deposited, and the material is finer as the distance from the shore increases. Far out from shore (or even close to shore near very low lands) there will be little or no deposit of fragmental materials brought down from the lands, but only a limy mud which may be formed from the material brought down from the land in solution. This lime may be precipitated from solution by chemical reaction, but is very largely taken out by the shell-bearing life forms of the sea and built up into their shells. When the animals die the shells, or the material derived from them, sink to the bottom and are built up into considerable layers.

In case the sea withdraws from a certain area the gravels, sands, muds, and limy muds or marls are gradually consolidated and cemented into hard rock. A gravel cemented into hard rock is called a conglomerate; a sand, a sandstone; a mud, a shale or a slate; and a limy mud or marl, a limestone.

It is evident from the nature of the formation of these rocks that there is no hard and fast line separating the different varieties. Some sand will be mixed with the gravel, and the gravel will grade outwards from the shore or beach, from coarse to fine gravel and finally into sand without any sharp line of demarcation. Some fine sand will be deposited with the mud and some of the finest mud may extend far out where the principal deposit is lime. We have, then, all gradations between the different types. For instance, we may have the conglomerate with



A. STEEPLY TILTED BEDS OF LIMESTONE WITH INCLUDED PEBBLES. THIS LIMESTONE IS TERMED CONGLOMERATE. VIEW FOUR MILES WEST OF ARDMORE.

B. BOONE FORMATION SHOWING INCLUDED CHERT NODULES.

pebbles so fine that it may be a question whether to call it conglomerate or a sandstone; we may have sandy shales or shaly sandstones; we may have calcareous (limy) clays and clayey limestones. However, this does not interfere with a general classification of the sedimentary rocks into conglomerates, sandstones, shales, and limestones.

CHERT OR FLINT.

Still another variety of sedimentary rocks which is of considerable importance in Oklahoma is chert or flint. While the quantity of this rock in general is very much less than that of the other types, locally it is very abundant. It is a very hard, brittle, and extremely fine-grained rock composed entirely of silica. It is formed, probably, by the precipitation of the silica from solution.

GYPSUM.

Gypsum is another type of sedimentary rock. It is composed of calcium sulphate, is very soft, and usually white in color. It occurs as lumps or nodules in other rocks, and also as definite beds which may extend over large areas. Where it occurs in beds it was produced probably by the evaporation of sea water in enclosed or partially enclosed basins. It is an important economic resource, being used largely for the manufacture of plaster. Large deposits of gypsum occur in western Oklahoma.

COAL.

Coal is a rock which is produced by the gradual alteration of immense beds of plant matter buried with the rocks. It is thought that at different times in the earth's history, swamp conditions existed over large areas. These swamps were near sea level and were surrounded by very low lands. As the plants which grew in the swamp fell they were protected from decay by the water, and collected in enormous quantities in an almost pure condition, since very little sand or mud was carried into the swamps. After a considerable thickness of this plant material accumulated, a subsidence of the swamps permitted the sea to cover them and deposits of mud and sand covered the layers of plant material—or a rise of the surrounding lands may have caused the swamps to be covered with mud and sand. After the plant material was covered, the pressure of the overlying beds gradually changed it into coal. Coal beds occur in eastern Oklahoma and are an important economic resource.

SOILS.

When rocks have been exposed for a great length of time to the action of the weather, the cementing material is dissolved and the rocks break down into what is known as mantle rock. The mantle rocks, while forming an extremely small part of the earth's crust, are of first import-

PLATE IX.

VARIETIES OF COAL—A, SPLINT. B. BITUMINUS. C, "PINE NEEDLE". D, CANNEL.

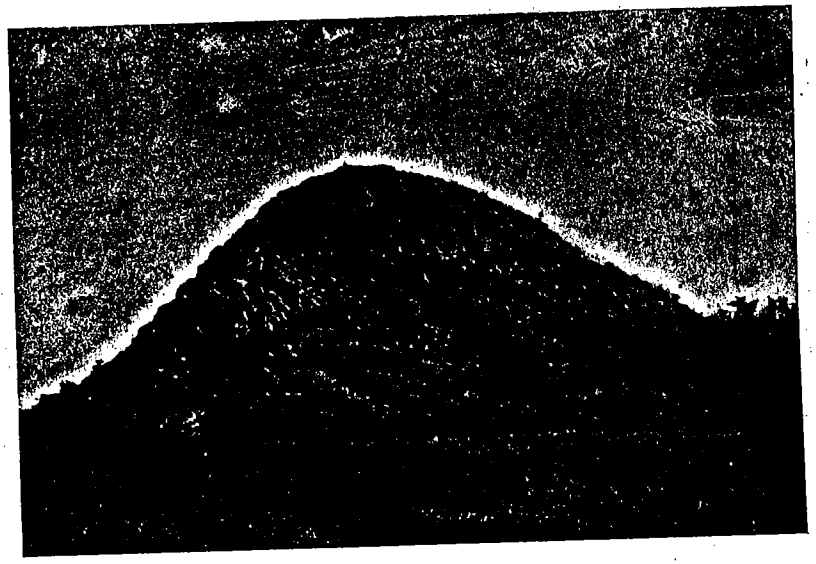
ance from an economic standpoint. The upper surface of the mantle rocks becomes covered with vegetation. The materials from the decaying vegetation penetrate the uper portion of the loose mantle rock and form soils. The nature of the soils in Oklahoma depends more upon the character of the underlying rock from which it was formed than upon any other single factor. A soil derived from a conglomerate is a gravelly soil; the soil from a sandstone is a loose, sandy loam; the soil from a shale is a "tight" clay soil, usually very hard to drain. Limestone, as a rule, produces a rich, fertile soil. The lime is almost, or quite, dissolved and the soil is formed entirely from the clay and sand which exist as impurities in the limestones. Most limestone soils are black, but some are of a bright red color.

In addition to the two great classes of rocks, the igneous and sedimentary, a third class, the metamorphic, is sometimes recognized. These are either igneous or sedimentary rocks which have been so changed by heat or pressure, or both, that they have lost their original characteristics. Thus granite may be metamorphosed into schist, limestone into marble, sandstone into quartzite, and shale into slate or schist. These rocks are of little importance in Oklahoma. Some of the shales in the southeastern part of the State are somewhat slaty, and the limestone is changed to marble.

DISTRIBUTION OF ROCKS IN OKLAHOMA.

IGNEOUS ROCKS.

Igneous rocks occur in Oklahoma principally in two areas, the Arbuckle Mountains in the south-central part of the State, and the Wichita Mountains in the southwestern part. There are also two very small areas, one in Mayes County, and the other in the northwestern corner of the State in Cimarron County. In the Arbuckle Mountains east of Washita River there is an area of over 100 square miles which is underlaid by a coarse-grained gray to pink granite. This area lies to the north of Tishomingo, and the granite is known as the Tishomingo granite. The granite area extends east and west almost across the middle part of Johnston County. West of Washita River are two small areas of granite porphyry known as East and West Timbered Hills. The combined area is not more than 2 or 3 square miles. All of the peaks of the Wichita Mountains are composed of granite or related igneous rocks, such as diorite, gabbro, porphyry, and other varieties. These granite peaks are distributed from Lawton, in Comanche County, northwestward across Kiowa County to Granite, in Greer County, a distance of about 60 miles. The granite of the Wichita Mountains varies from a gray or almost black to a rather dark red. Much of it is suitable for building purposes and several small quarries have been operated from time to time in this area. The third area of igneous rock is in northwestern Mayes County, along Spavinaw Creek near the town of Spavinaw. This area is only a few hundred feet long and about 100 feet wide. The igneous



A. GRANITE HILL WEST OF LUGERT, RISING ABRUPTLY FROM THE LEVEL PLAINS SURROUNDING THE WICHITA MOUNTAINS.

B. VIEW ON EAST SLOPE OF BLACK MESA, NORTHWEST CORNER OF CIMARRON COUNTY. THE SURFACE ROCK IS BASALTIC LAVA.

rock is a pink granite which was forced up into a crack in the sedimentary rocks and cooled into its present condition. The fourth area is in the extreme northwestern corner of the State in Cimarron County. Black Mesa, the highest elevation in the State, is composed of lava of comparatively recent geologic age.

SEDIMENTARY ROCKS.

Conglomerates are not of common occurrence in Oklahoma. Around the Arbuckle Mountains there are considerable areas where the bed rock is a conglomerate of limestone pebbles and boulders cemented together. The town of Sulphur is built on this conglomerate, and anyone who has visited the town will remember the conglomerate in the cuts for streets, and in the railroad cuts between Davis and Sulphur.

Another conglomerate, which is of some importance as a source of gravel, exists north from the Arbuckle Mountains, passing a short distance east of Shawnee, where the gravel from the conglomerate has been worked. Some of the hills in an area near Red River in southwestern Love and southeastern Jefferson counties are capped by a conglomerate consisting of quartz pebbles of various colors, very firmly cemeted. These conglomerates are of value for ballast, road material, and concrete fillers.

Sandstones are well distributed in almost all parts of the State. In most places the shales and sandstones are interbedded, that is, beds of sandstone are separated by beds of shale, and a great thickness of rock may be made up of alternating beds of shale and sandstone. In some regions, however, the sandstones are so abundant that they may be called sandstone areas. The mountains in the east-central and southeastern parts of the State, such as the Sansbois, Cavanal, Sugar Loaf, Winding Stair, Jackfork, Kiamichi, and Pine, are composed very largely of sandstone. Thick sandstone beds form the hills in a large area in the north-central part of the State, which includes most of Seminole, Hughes, Okfuskee, and Creek counties. Thinner sandstone beds are present farther to the northeast, and are of much less importance than in the region just mentioned. Thin sandstones also occur in the western part of the State, where they are of a red color, but they form a small proportion of the rocks in this region.

Shales occur interbedded with the sandstones in all the regions mentioned, but are of most importance in the western half of the State. Practically all the surface west of the main line of the Atchison, Topeka & Santa Fe Railway is underlaid by red shales with some red sandstones and some important beds of gypsum. This whole area is known as the Redbeds area and is described more fully as such in another section.

Limestones occur in five rather distinct areas. The extreme northeastern portion of the State, including all of Delaware, and the greater parts of Ottawa, Mayes, Cherokee, and Adair counties, is underlaid by

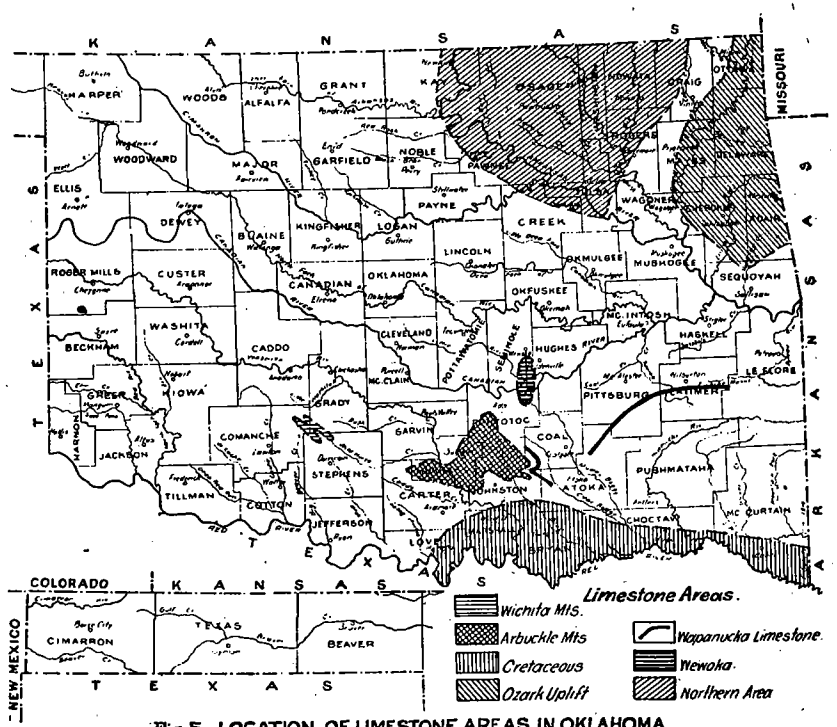


Fig 5. LOCATION OF LIMESTONE AREAS IN OKLAHOMA.

a thick formation of limestone with a great deal of chert. When the rock weathers the limestones dissolve and the chert remains as a mantle rock, so that the region is called the Chert or Flint Hills, but the quantity of the limestone in the bedrock is much greater than of the chert or flint. To the west of this area, across Rogers, Nowata, and Washington counties, there are several beds of limestone, some occurring as far west as Newkirk and Blackwell in Kay County. A third area in which limestones are important is the belt along Red River in the southeastern part of the State, south of the Arbuckle and Ouachita Mountains. A single limestone formation of considerable importance, economically, outcrops from Wapanucka and Atoka north and east almost to the Arkansas line. Several limestone formations are present in the Arbuckle Mountains. One of them is about a mile thick. The same formation outcrops along the north side of the Wichita Mountain region.

Chert has already been mentioned as occurring with the limestone in the northeastern part of the State. It also occurs in the limestones in the north-central limestone area. One formation in the Arbuckle Mountains consists largely of chert. In two areas in the Ouachita Mountains, one along the line between Latimer and Pushmataha counties and another in central McCurtain County, chert is very abundant. Important beds of gypsum are interbedded with the red shales in the western part of the State. Coal beds are present in the east-central and northeastern parts of the State.

Large areas of wind-blown sand occur along the streams in the Redbeds region in the western part of the State.

STRUCTURAL GEOLOGY OF OKLAHOMA.

The structure of Oklahoma may be best thought of by picturing the four mountain areas of the State, the Ozark Mountains in the northeastern part, the Ouachita Mountains in the southeastern, the Arbuckle Mountains in the south-central, and the Wichita Mountains in the southwestern part of the State. The rocks in each of these areas are strongly folded and, especially in the Ouachita Mountains, faulted. Between the Ozark Mountains on the northeast and Ouachita and Arbuckle mountains on the south and southwest is the Arkansas Valley trough in which the rocks are thrown into strong folds, but with only a minor amount of faulting. In the greater part of the State the rocks have a gentle dip in a general westerly direction away from the Ozark and Arbuckle uplifts. The general westward dip is interrupted in many places by very gentle folding. The westward dip continues nearly to the western border of the State, becoming more and more gentle as the distance from the mountains increases. Along a line extending in a general north-south direction, about the longitude of Alva and Arapaho, the rocks are very nearly level, and from there on west have a very slight eastward dip.

HISTORICAL GEOLOGY.

GENERAL DISCUSSION.

Geologists divide the time included in the history of the earth into great eras, or periods of time, in which certain great events took place, in the same way that historians divide the history of the United States into the era or period of discovery, era of colonization, Revolutionary era or period, and so on. In geology the great eras are established on the basis of the remains of life (fossils) found in the rocks which were formed during that period.

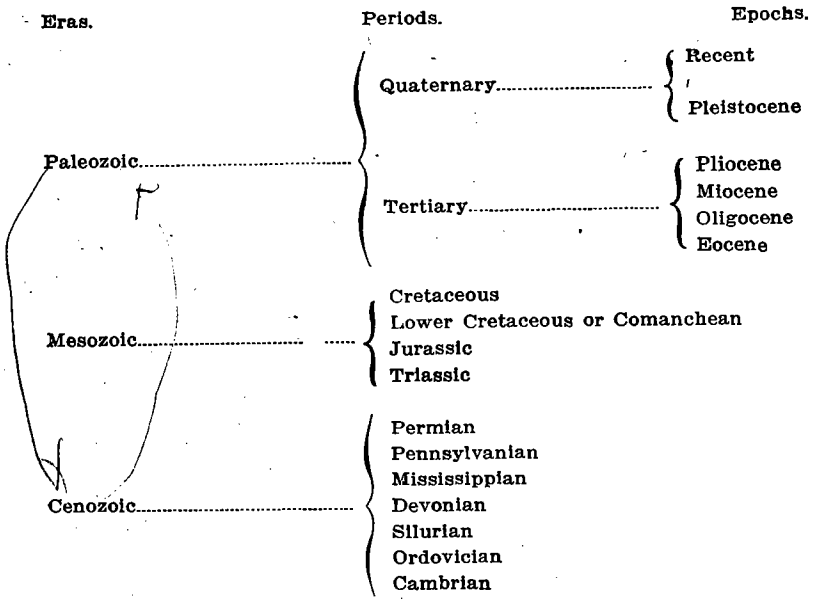
It has already been noted in the discussion of rocks and minerals that there are two great classes of rocks, the igneous, or those which have cooled from a molten condition, and the sedimentary, or those which were deposited as sediments from water or from the atmosphere. The sedimentary rocks which were deposited in water usually contain the remains of living organisms which were buried in the sediments at the time they were deposited, and which remain in the rocks to tell us of the kind of beings which inhabited the earth at the time the rocks were formed. Any remains of life forms which are found buried in rocks are called fossils. Among these fossils those of the animals living in the sea are the most common, since most of our sedimentary rocks were deposited in the sea or arms of the sea. However, land animals were often buried in swamps, or their skeletons washed down into the beds of streams and covered by sand or gravel so that they have been preserved. Naturally, only the hard parts of the animals are preserved, and animal fossils consist almost entirely of the shells of sea animals and the teeth and bones of land animals. From a study of these hard parts the trained observer can determine the nature and many of the characteristics of the animal to which they belonged. The science dealing with the ancient life of the earth, that is, the study of fossils, is called paleontology. Plants are also often preserved, the woody part being replaced by stone which preserves the original structure of the wood, or the impression of leaves, bark, or stems remains in the sand or mud in which they were buried.

In the early part of the earth's history the animal and plant life included only the more simple forms, and the more complex forms developed from the simpler forms with the passing of time. Consequently if the study of the fossils in certain rocks shows that only the simpler ancestral forms of life are present, these rocks can safely be said to be older than other rocks which contain the remains of more highly developed forms of animal or plant life. Paleontology, then, forms the principal basis for the division of the earth's history into eras.

The great eras into which the earth's history is divided are as follows, beginning with the youngest:

(5) The Cenozoic (recent life) era.
(4) The Mesozoic (middle life) era.

(3) The Paleozoic (Early life) era.
(2) The Proterozoic (earlier life) era.
(1) The Archeozoic (ancient life) or Archean era.



The divisions of the Archeozic and Proterozoic apply to only small areas and are not important in Oklahoma.

The rocks deposited during each period of time are called a system of rocks, and the same name is applied to the system as to the period. For example, the Pennsylvanian system includes all the rocks which were deposited in the time included in the Pennsylvanian period. The names of the systems (and periods) of the Paleozoic era are taken from places where the rocks were first studied, or where they are well developed. The names Cambrian, Ordovician, and Silurian are taken from Wales; Devonian comes from Devonshire, England; Mississippian and Pennsylvanian from the Mississippi River and the State of Pennsylvania; and Permian from Perm, a province of Russia. To say that rocks are of Pennsylvanian age simply indicates that they are of the same age (were deposited at the same time) as the great coal-bearing series of rocks in Pennsylvania.

In Oklahoma, the rocks range in age from Archeozoic or Proterozoic to Recent. All the systems of the Paleozoic, the Comanchean and Cretaceous systems of the Mesozoic, and the Miocene or Pliocene, Pleistocene, and Recent of the Cenozoic, are found.

GEOLOGIC HISTORY OF OKLAHOMA.

We know little about the history of the region now included in Oklahoma during the time before the Paleozoic, since the rocks of the Archeozoic or Proterozoic are exposed only in small areas in the Arbuckle and Wichita mountains. All that we can say is, that the area of Oklahoma appears to have been a land surface for a great length of time before the Cambrian period and during the early part of that period. About the middle of Cambrian time the sea advanced over most or all of the area, and sand and mud were deposited in the shallow waters which covered the old land surface. During the Ordovician, Silurian, and Devonian periods the area of Oklahoma was mostly covered by shallow waters, but at times portions of the area were elevated into land so that there are many breaks in the history of the rocks as shown by the fossils. During the Mississippian period the sea probably covered all of the region, and rocks of considerable thickness were deposited. During Pennsylvanian times the region now included in Oklahoma stood near sea level so that there were great swamps in which the vegetation accumulated to considerable thickness. From time to time the sea advanced over the area, and beds of mud and sand were deposited over the beds of vegetable matter, thus preserving them to form coal beds. At or near the close of the Pennsylvanian period there were great movements of the earth's crust which resulted in the rocks which had been deposited in a level-lying position being bowed up into folds or domes in parts of the State. In some places the force was sufficient to cause breaks in the rocks and to shove them over each other for some distance. The Ozark, Ouachita, Arbuckle, and Wichita mountains are the remnants of domes which were made in the rocks at this time, and the rocks in the areas between the Ozarks and the Ouachitas and between the Ouachitas and Arbuckles were tilted and thrown into great folds at the same time. These mountain regions are described more fully in another section.

During the Permian period the eastern part of the State was probably land. Great thicknesses of rocks were deposited over the western part of the State. These rocks of a deep red color are known as the Redbeds. It is certain that part of these rocks were deposited in bodies of water, but the conditions of deposition are not thoroughly understood. It is probable that at least parts of the Redbeds are land (wind-blown) deposits.

At the close of the Paleozoic era the area of Oklahoma was all land and remained so during the Triassic and Jurassic periods of the Mesozoic. During Lower Cretaceous (Comanchean) time the sea advanced from the south and covered the eastern part of the State north to the Ouachita and Arbuckle mountains, and probably the whole western third of the State. This submergence was comparatively short and before the

end of Cretaceous times all of Oklahoma was land and has remained so to the present.

During a part of the Cenozoic era (Tertiary) the Rocky Mountains stood higher, relative to the land to the east of them, than they do now, and vast quantities of gravel were carried down from them by floods and by streams and spread out as a blanket over the lowlands. Considerable deposits of these Teritary gravels, as they are called, are found in the northwestern counties of Oklahoma.

During Pleistocene and Recent times the area of the State was probably in much the same condition as at present. The deposits of these periods consist of alluvium along the streams.

DISTRIBUTION OF THE ROCKS.

As has been said, the rocks of the Archeozoic or Proterozoic eras occur at the surface in only small areas in Oklahoma. What may be called the cores of the Arbuckle and Wichita mountains are composed of igneous rocks (granites and similar rocks) which may be either Archeozoic or Proterozoic. Such rocks undoubtedly underlie the whole State, but over the greater portion are buried under some thousands of feet of younger sedimentary rocks. Most of the hills of the Wichita Mountains are of these old rocks. In the Arbuckle Mountains they occur in these areas—one east and two west of Washita River.

The older Paleozoic rocks, the Cambrian, Ordovician, Silurian, and Devonian, also occur in the Arbuckle and Wichita mountains, where they lie steeply upturned against the older granite cores. Ordovician, Silurian, and Devonian rocks are present also in the Ozark Mountains, in the bottoms of the deeper valleys which the streams have cut through the younger rocks lying above them. Rocks older than Mississippian are also shown in two or three areas on the Ouachita Mountains.

Mississippian rocks occur in two large areas, the Ozark Mountain region in the northeastern corner of the State, and the Ouachita Mountains in the southeast. The principal formation in the Ozark region is a mass of limestone and flint or chert about 300 feet thick. The rough, angular pieces of flint which cover the hillsides in this region give the area the name of Flint Hills by which it is commonly known. The Mississippian rocks of the Ouachita Mountains consist of shales and sandstones about 10,000 feet thick. One heavy bed of sandstone about 3,800 feet thick is responsible for the ranges of high hills or mountains of this region, such as the Kiamichi, Jackfork, and Winding Stair mountains.

The Pennsylvanian rocks occupy a broad L-shaped area in the eastern part of Oklahoma. They are continuous with rocks of the same age in Arkansas on the east and in Kansas on the north. In the southern and eastern part of the area the rocks are entirely of sandstone and shale in alternate layers and have a total thickness of about 14,000 feet.

To the north the rocks thin considerably and there are several limestone beds with the shales and sandstones. This system of rocks is very important from an economic standpoint, since it contains all the coal beds of the State, and, with a few minor exceptions, all the oil and gas deposits. The shales of the system furnish most of the raw material used in the State for clay products, building and paving brick, and the limestones are valuable for building stone, for burning into lime, and for crushed rock for concrete work and road material. The Pennsylvanian rocks of the east-west limb of the L are folded into broad arches and troughs which extend generally in a northeast-southwest direction. Those of the north-south limb dip or slope gently to the west and pass under the younger Permian rocks above them.

The Permian rocks outcrop over most of the western half of the State. In general these rocks are soft red shales and sandstones, and in a rough way the area of Permian rocks may be considered as the Redbeds area. However, some of the uppermost Pennsylvanian rocks in central Oklahoma are red, and there is a small area of non-red Permian rocks in Kay and adjoining counties. The Permian rocks are soft and weather easily, forming a deep rich soil. The Redbeds are probably over 3,000 feet thick. Besides the soil, the only economic products of the Permian system in Oklahoma are gypsum, which occurs in thick ledges in the western part of the State, and shales, which are used in the manufacture of brick. The Permian rocks have not been much disturbed since they were deposited, and lie nearly level.

The Lower Cretaceous (Comanchean) rocks form the surface rocks of the southern portion of the State, between the Arbuckle and Ouachita mountains on the north and Red River on the south. The area is continuous with a much larger area of these rocks in Texas. Small patches of Lower Cretaceous limestone are found on the hills in some of the western counties of the State, and are probably the remnants of a continuous body connecting the Lower Cretaceous areas of Texas and Kansas, the greater part of which has been removed by weathering agencies. The Lower Cretaceous rocks in southern Oklahoma consist of limestones and soft shales with sandstones at the bottom and top of the series. The economic products are the soils, which are very rich, especially on the shales and limestones; the limestones and some asphalt. The limestone could be used for crushed rock and building stone, but little use has been made of it as yet. All of these rocks are nearly level, dipping very gently to the southeast.

The Tertiary rocks are soft, unconsolidated clays, sands, and gravels, which form a covering of at most a few hundred feet in thickness over the Redbeds in parts of the northwestern portion of the State. The Panhandle counties, Cimarron, Texas, and Beaver, have most of their area covered by these rocks, and there are also large areas in Harper and Ellis counties. In the valleys of the streams the washed-in or alluvial soil is often of sufficient depth to be classed as a distinct formation—the Re-

cent alluvium. Along the rivers in the western part of the State there are large areas of sand hills. The hills are composed of sand blown by the wind from the river beds.

The areas of the different rock systems are shown on the accompanying map (Pl. VII). The areas of igneous rocks are shown in solid black, and those of the sedimentary rocks in patterns of lines. The areas occupied by the Paleozoic systems older than the Mississippian are too small to be shown for each system on a map of so small a scale. Consequently the Cambrian, Ordovician, Silurian, and Devonian are all mapped together as pre-Mississippian. The belts of alluvium are not shown, but the larger areas of sand hills are indicated by a distinct pattern.

CHAPTER III.

PHYSIOGRAPHIC PROVINCES OF OKLAHOMA.

GENERAL STATEMENT.

On account of the differences in the character of the surface bedrock and soils, and the consequent differences in industries and population, it is possible to divide Oklahoma into a number of fairly distinct regions. In most cases the boundaries between these regions are sharp, but in some cases two adjoining regions grade into each other imperceptibly. In a general way, the State can be divided into mountains or hilly areas and plains or valley regions. Of the mountain or hilly areas there are four. The great plains and valley regions may be separated into seven divisions.

Ozark Mountains in northeastern Oklahoma.
Ouachita Mountains in the southeastern part of the State.
Arbuckle Mountains in the south-central part.
Wichita Mountains in the southwestern part.
Red River or Cretaceous region south of the Arbuckle and Ouachita mountains.
Lower Arkansas Valley between the Ozark and Ouachita mountains.
Sandstone Hills region lying to the west of the lower Arkansas Valley.
Prairie Plains along the west side of the Ozark Mountains.
Redbeds Plains occupying a broad strip north and south through the middle part of the State, with an extension to the west along the southern border.
Gypsum Hills lying to the west of the Redbeds Plains.
High Plains in the extreme northwestern part of the State.

OZARK UPLIFT OR MISSISSIPPIAN REGION.

The Ozark Uplift includes a large area in southern and southwestern Missouri. northwestern Arkansas, southeastern Kansas, and extends a distance of several miles into the northeastern part of Oklahoma. The area includes all of Delaware, the greater parts of Ottawa, Mayes, Cherokee, and Adair, with small portions of Wagoner and Craig counties.

The rocks underlying this portion of the State belong principally to what is known as the Boone formation, a series of cherts and limestones of Mississippian age. On weathering, the limestone is dissolved from the formation and the chert remains as a covering of mantle rock several feet deep over the tops of the flat hills and the slopes. It is this fact which has given the well known name of Flint Hills to the region. Locally, the larger streams have cut down into older rocks lying beneath the Boone formation. The principal areas of these older rocks lie north and northeast of Tahlequah on Illinois River and Barren Forks. Around the edge of the uplift is a fringe composed of the outcrops of Mississippian rocks of Chester age. These do not attain a very great thickness in Oklahoma, and the width of their outcrop is in most places less than one mile. The entire section as exposed in the region is as follows:

Table of correlations for northeastern Oklahoma.

Systems.	*Formations.*	*Approximate eastern equivalents*
Pennsylvanian system	*Winslow formation* in southern part of area, *Cherokee formation* in northern part of area, *Morrow formation* in southern part of area.	Lower Allegheny Upper Pottsville Lower Pottsville
Unconformity, slight in southern part of area, but representing very late Mississippian, all of Pottsville, and part of Allegheny time in northern part of area.		
Mississippian system	*Pitkin formation* in southern part of area. *Fayetteville formation* (with the Wedington sandstone member in the southeastern part of area). *Mayes formation.*	Chester
Unconformity representing most of Warsaw and all of Salem, St. Louis and Ste. Genevieve time.		
	Boone formation (with the St. Joe limestone member at the base).	Lower Warsaw Keokuk Burlington Kinderhook, in part.
Unconformity representing most or all of Kinderhook time.		
Devonian (?) system	(with Sylamore sandstone member at base in southeastern part of area).	Ohio shale

Table of correlations for northeastern Oklahoma. —(Continued).

Unconformity representing late Silurian and nearly all of Devonian time in the southeastern part of area.

Systems.	*Formations.*	*Approximate eastern equivalents*
Silurian system	*St. Clair marble* in the southeastern part of area.	Part of Niagaran.
Unconformity representing late Ordovician and early Silurian time.		
Ordovician system	*Tyner formation.* *Burgen sandstone.*	Trenton-Lorraine St. Peter

The structure of the Ozark region is rather complex. A series of folds extends in a general northeast-southwest direction. In places the folds are broken by longitudinal faults. Some cross-folding and doming are present. The details of the structure are given in Bulletin No. 24 of the Oklahoma Geological Survey, and portions of the area are described in Folios 122 and 132 of the Geologic Atlas of the United States published by the United States Geological Survey.

The surface of the region consists of a plain into which the streams have cut narrow V-shaped valleys, leaving between them broad, flat-topped hills. Many of these flat areas are treeless and are called prairies. The larger ones are given distinctive names, such as Cowskin Prairie in northern Delaware County. The hillslopes are steep and covered with a mantle of loose chert, which in many places reaches a depth of 20 or 30 feet. The surface as a whole slopes to the southwest, away from the center of the uplift. The greatest elevation on the ridges in the northeastern corner of the area is about 1,150 feet, while that of the streams in the southeastern part is about 600 feet. The maximum elevation of the hills above their bases is about 400 feet and the average about 250 feet.

The entire region lies in the drainage basin of Arkansas River. The greater part of the drainage is carried into Arkansas River through Grand River and its tributaries. Grand River is formed by the junction of Spring and Neosho rivers near Miami in Ottawa County and flows southwest and south into Arkansas River at Fort Gibson. The principal tributaries of the Grand within this area are Lost Creek, Cowskin River, Honey, Drowning, Spavinaw, Salina, Spring, Coal, Fourteen Mile, and Ranger creeks. The southern portion of the area is drained directly into Arkansas River through Bayou Manard, and Greenleaf creeks, Illinois River, Vian, Sallisaw, and Lee creeks, and several smaller streams. All the streams of the area are clear, rapid-flowing streams. Their bottoms are gravelly, and they carry practically no mud.

On account of the solution of the limestones much of the drainage is underground. Sink-holes are numerous on the broad, flat-topped hills, and springs abound in the valleys and along the streams.

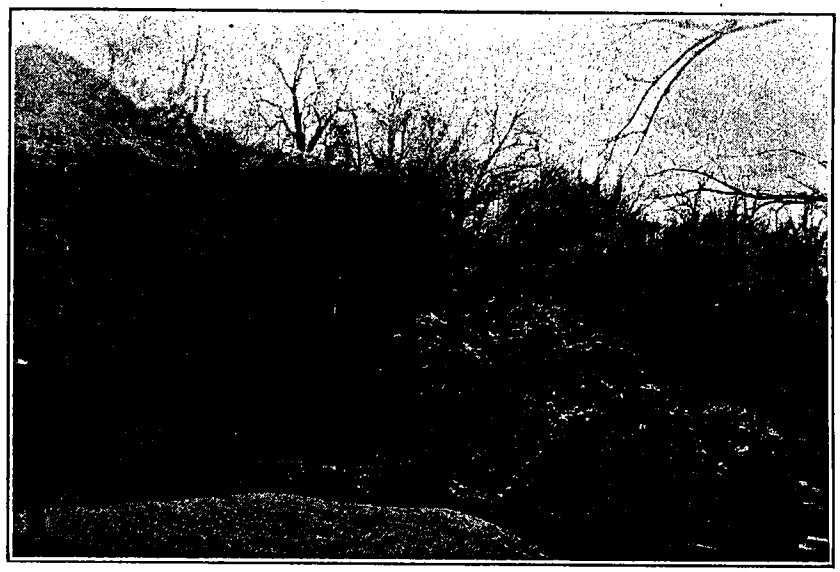
The soils of that portion of the area underlaid by Boone chert con-

sist of loose, cherty material. On the flat-topped hills there is in most cases a considerable thickness, as much as 10 or 15 feet, of soil with very little chert, but below this depth it grades rapidly into loose chert. and shortly into solid rock. On the slopes of the hills there is little or no soil at the surface, but sufficient in the lower part of the mantle or loose chert to support good tree growth. The Boone chert soil, where it is of sufficient thickness, is a very fertile soil. and is especially adapted to the raising of fruits. The famous Ozark Mountain fruit region of southwestern Missouri and northwestern Arkansas is in this same physiographic region and has the same soil as that which covers the hills in northeastern Oklahoma. However, the lack of transportation facilities has prevented any great development of the fruit raising industry in Oklahoma. Farming is carried on to a considerable extent on the flat-topped hills and prairies, but the principal crop on these areas is hay, made from the native grasses. As a rule, it is not possible to cultivate the hillslopes.

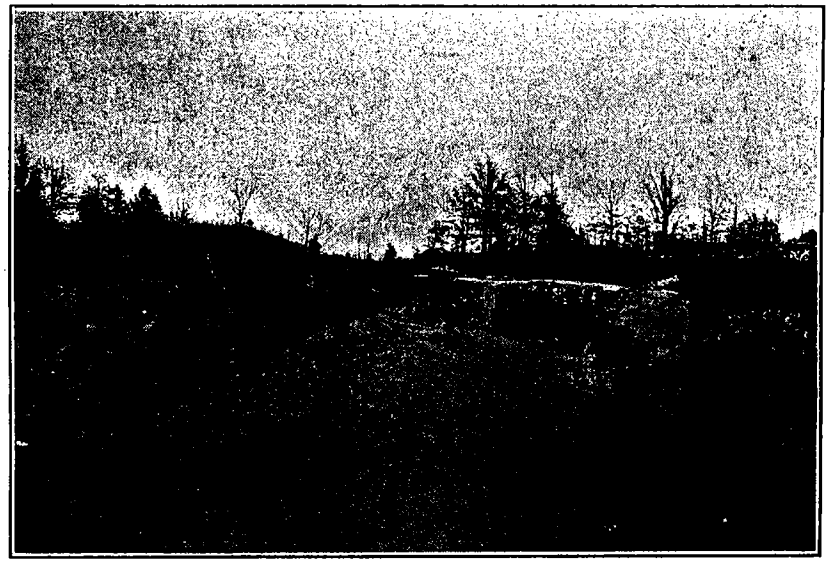
The valley soils are fertile, although usually quite stony. The ordinary farm crops are raised in the valleys, but the area of this soil is very small in proportion to that of the hill land. The valleys and slopes. as well as the tops of many of the ridges, are covered with timber. Lumbering was formerly an industry of considerable importance, but the larger timber has been removed and at present the principal lumber industry is the production of railroad ties and cord-wood. The forests consist principally of blackjack and post oak. In the southern part of the region some pine is found. There are practically no manufacturing industries in the area.

The principal mineral resources of the region are lead and zinc. which occur only in the extreme northern part, near Miami in Ottawa County. The conditions of their occurrence, and the mining industry near Miami are considered fully in the section on mineral resources. The chert or flint of the area furnishes an inexhaustible supply of road material, but very little use has been made of it as yet. Limestone has been quarried for crushed stone at Keough, near Fort Gibson. The Kansas City Southern Railway has a large chert gravel pit north of Stilwell. The material is used for ballast. The chert "tailings" or chats from the mines at Miami have been used with considerable success upon the roads of that vicinity. The transportation facilities of the region are poor. The main line of the St. Louis & San Francisco Railroad crosses the north end of the area. The main line of the Missouri, Kansas & Texas Railway nearly parallels the western margin of the area. The Okmulgee-Fayetteville branch of the St. Louis & San Francisco Railroad crosses the southern portion; the Kansas City Southern Railway touches the southeastern corner; and the Rogers-Grove branch of the St. Louis & San Francisco Railroad penetrates the northern portion at Grove. A large central area consisting of southern Delaware, eastern Mayes, and northern Cherokee counties is without railroad facilities. The roads are on the section lines only in the leveler parts. In the hillier regions it is not feasible to open up the section lines.

PLATE VII.



A. OUTCROP OF GRAND FALLS CHERT, NORTHWEST OF PEORIA.



B. QUARRY OF TRIPOLI BEDS, NORTHEASTERN OKLAHOMA.

None of the roads are improved but many of them are fairly good on account of their natural surfacing of crushed chert.

The region as a whole is sparsely populated. Most of the land belongs to the fullblood Cherokee Indians and the greater part of the inhabitants of the hillier districts are Cherokees. Around the edges of the uplift and in the larger valleys there are numerous white settlers. The chief important towns within the area are Tahlequah and Westville in the southern part, and Grove in the northern part. Miami, Afton, Vinita, and Pryor Creek are located on the prairie plains just off the edge of the chert hills.

OUACHITA MOUNTAIN REGION.

The Ouachita Mountains lie in southwestern Arkansas and southeastern Oklahoma. The region in Oklahoma includes southern Leflore, southern Latimer, southeastern Pittsburg, northeastern Atoka, practically all of Pushmataha, and the northern two-thirds of McCurtain counties.

The bed-rocks of the region consist of a great thickness of shale and sandstone with considerable chert. Limestones are almost absent from this section. The section as exposed in the area is as follows:

1. Stringtown shale (Ordovician) consists of black and blue shales with some chert. It is about 600 feet thick with the base not exposed.

2. Talihina chert (Ordovician) consists principally of bluish, greenish, and white chert with thin, cherty, and clayey shales, and some thin lentils of blue lime stone. It is about 1,150 feet thick.

3. Standley shale consists of bluish, greenish, black, slaty shale with thin sandstone and considerable chert. It is about 6,100 feet thick.

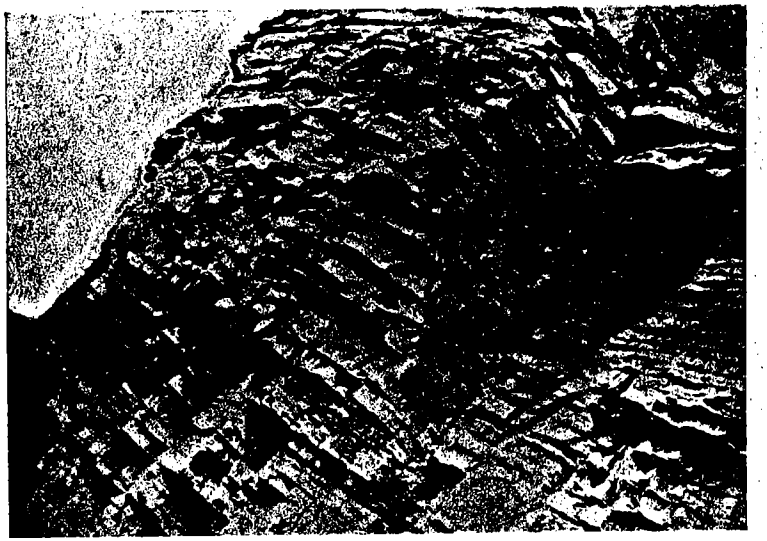
4. Jackfork sandstone consists of heavy, massive beds of brown sandstone separated by much thinner bands of shale. It is about 3,800 feet thick. The age of the Jackfork and Standley is not established, but from the evidence of some poorly preserved plant remains found near the base of the Standley they are probably Mississippian. During the summer of 1916 a field party of the Oklahoma Geological Survey collected several specimens of fossil plants from the Jackfork sandstone, and while these have not been studied in detail, they show some evidence that the Jackfork may be Pennsylvanian.

5. Caney shale consists of greenish to black clay shale, and has a thickness of about 1,600 feet. It is of upper Mississippian age.

By far the greater portion of the area is underlaid by the Standley shale and Jackfork sandstone. Rocks older than the Standley shale are known in three areas: A narrow strip extending northeast from Atoka a distance of about 10 or 15 miles; an area in the southern part of Latimer County extending across into Pushmataha County; and in a broad belt extending from northeast to southwest through McCurtain

PLATE XIII.

A. VIEW OF QUARRY AT CHOCKIE, SHOWING THIN BEDDED, STEEPLY DIPPING STRATA OF THE WAPANUCKA LIMESTONE.



B. SHOWING STEEPLY DIPPING STRATA OF THE WAPANUCKA LIMESTONE AT LIMESTONE GAP, EIGHT MILES SOUTH OF KIOWA.

County. In the last named area the rocks below the Standley shale, that is, those equivalent to the Talihina chert and Stringtown shale, may be divided into several formations which have been recognized and mapped in the larger portion of the Ouachita Mountains in Arkansas. These are, named from the top down, Arkansas novaculite, Missouri Mountain slate, Blaylock sandstone, Polk Creek shale, and Bigfork chert. Still older unnamed shales, sandstones, and limestones are exposed in the central part of this area. The structure of the region is very complex. A series of strong folds extends northeast-southwest across the region. The largest of these exposes the large area of Ordovician and possibly older rocks mentioned in the preceding paragraph. On the flanks of these major folds are numerous minor folds, many of which are overturned. Faulting is common.

No description of the geology or structure of the entire region in Oklahoma has been published. The Atoka folio (No. 79) of the Geologic Atlas of the United States published by the United States Geological Survey, describes a small area on the western margin. A description of the region in Arkansas may be found in a bulletin of the Arkansas Geological Survey, entitled *Slates of Arkansas*.

The surface of the region is very much rougher than that of any other part of Oklahoma. The thick Jackfork sandstone is very resistant to weathering and forms high, rugged ranges of hills which are known locally as mountains. On account of the duplication of the outcrop, due to the folding and faulting which the rocks have undergone, there are several of these mountains. The principal ones have distinctive names, such as Winding Stair, Kiamichi, Jackfork, Pine, Rich, and Blackfork mountains. Rich Mountain, in the southeastern part of Leflore County, is the highest of these hills, reaching an elevation of over 3,000 feet above sea level, and an elevation of almost 2,000 feet above the streams at its base. The general slope of the region from this high point is to the south. The southern margin along the boundary between this region and the Red River limestone area has an elevation of about 500 feet.

The principal streams of the region rise near the northern boundary and flow south to Red River. The resistant layers of rock and the complicated structure cause the streams to flow in very winding courses. Kiamichi River, the principal stream, rises in Arkansas, flows west in a winding course through the southern part of Leflore and northwestern part of Pushmataha counties, then swings south and back to the southeast through the eastern part of Choctaw County. Little River rises in the extreme southwestern part of Leflore County, flows first west, then south, then southeast, in a course nearly parallel to that of Kiamichi River to near Garvin in McCurtain County, where it turns almost directly east and crosses the Arkansas line some distance before it joins Red River. Glover Creek, Lukfata Creek, and Mountain Fork River are important tributaries of Little River flowing nearly south and joining Little River in its eastward course. A narrow strip along the northern

PLATE XIV

GORGE OF THE WASHITA RIVER AT CRUSHER.

part of the area is drained northward into Poteau River through several tributaries, of which the most important are Black Fork and Fourche Maline rivers. All the streams of the Ouachita Mountains are clear and rapid-flowing.

The soils of this region are in general thin and poor. There is practically no soil on the mountains and hills of the Jackfork sandstone. The broad flats of Standley shale are covered to a thickness of several feet with soil which is very "tight" and poorly drained. The soil of the Talihina chert area is somewhat better than that of the Jackfork or Standley, but is in most places very thin. Only in the stream valleys is agriculture of any importance as an industry.

The whole area is covered with a thick growth of timber and lumbering is the most important industry. The pine forests which cover most of the area have been pretty well worked over, although considerable good timber remains. Some attempts have been made at mining lead and zinc, some of which still bear promise of being successful. Manganese ore occurs in nodules in the Arkansas novaculite, but not in sufficient quantity to be of much importance. The reported discovery of gold and silver near Albion a few years ago caused great excitement, but nothing has resulted from it. Some cattle are grazed in the forests and small prairies, but the industry is not of great importance. The region is very poorly provided with railroads. Only one railroad crosses the area, the Paris line of the St. Louis & San Francisco Railroad, which crosses in a north-south direction following the course of Kiamichi River for a long distance. The main line of the Chicago, Rock Island & Pacific Railroad runs within a few miles of the northern border of the area, and the Ardmore branch of the same road almost touches the northwest border. The main line of the Missouri, Kansas & Texas Railway touches the region on the west. The country roads are in general mere trails through the forests. The surface of the region is so rough that it is not feasible to lay out the roads on section lines. Few changes or improvements have been made in the roads of most of the area since Statehood. In the rougher portions none of the streams are bridged, and in fact there is very little traffic of any kind.

The region is by far the most sparsely settled of any portion of Oklahoma. None of the towns within the area has as many as 1,000 inhabitants, and there are only a few villages of more than 100 inhabitants. In the valleys of the principal streams there are small farms, but most of the land has been allotted to the fullblood Choctaw Indians and no improvements have been made upon it. The majority of the inhabitants outside the villages are Choctaws.

ARBUCKLE MOUNTAIN REGION.

The Arbuckle Mountain region lies in the south-central part of the State. It contains nearly all of Murray County, the northern half of Johnston County, the southern part of Pontotoc County, and the southwestern part of Coal County. The area is roughly triangular in shape,

with the base of the triangle to the southeast, and contains approximately 860 square miles. This region is geologically one of the most interesting in the State, and more material has been published about this area than about any other of equal size in the State.

The rocks of the Arbuckle Mountains consist of the central core of pre-Cambrian granites and related rocks surrounded by steeply-dipping strata of Paleozoic sedimentaries. The stratigraphic section as exposed in the mountains is as follows

		Feet Thick.
No. 13.	Caney shale, (Mississippian), black and green clay shale	1,600
No. 12.	Sycamore limestone, (Mississippian), lenticular mass of blue limestone	0 to 200
No. 11.	Woodford chert, Devonian (?), black shale and brown chert in alternating layers	650
No. 10.	Bois d'Arc limestone, Devonian	0 to 190
No. 9.	Harrigan shale, Devonian	0 to 166
No. 8.	Henryhouse shale, Silurian	0 to 223
No. 7.	Chimneyhill limestone, Silurian	0 to 53
No. 6.	Sylvan shale, Silurian	60 to 300
No. 5.	Viola limestone, Ordovician	500 to 700
No. 4.	Simpson formation, Ordovician shales, sands, and limestones	1,200 to 2,000
No. 3.	Arbuckle limestone, Cambrian and Ordovician	4,000 to 6,000
No. 2.	Reagan sandstone, Cambrian	0 to 500
No. 1.	Granite and related rocks, pre-Cambrian age.	

The surface of the Arbuckle Mountain region is in general a plateau, sloping from an elevation of 1,350 feet in the western part to one of 750 feet in the eastern. The plain is considerably dissected by erosion. The effects of the erosion are greatly influenced by alternation of hard and soft strata, and by the structure of the rocks. The hard formations stand out as mountains or ridges, and the softer ones form valleys. The width of the ridge or valley produced by a given formation depends upon the position of the strata, which varies from nearly horizontal to vertical. The highest elevations in the region are two mountains of granite porphyry west of Washita River, known as East and West Timbered Hills. These reach an altitude of about 400 feet above their bases. The hills and ridges are mostly prairie, while the valleys are timbered.

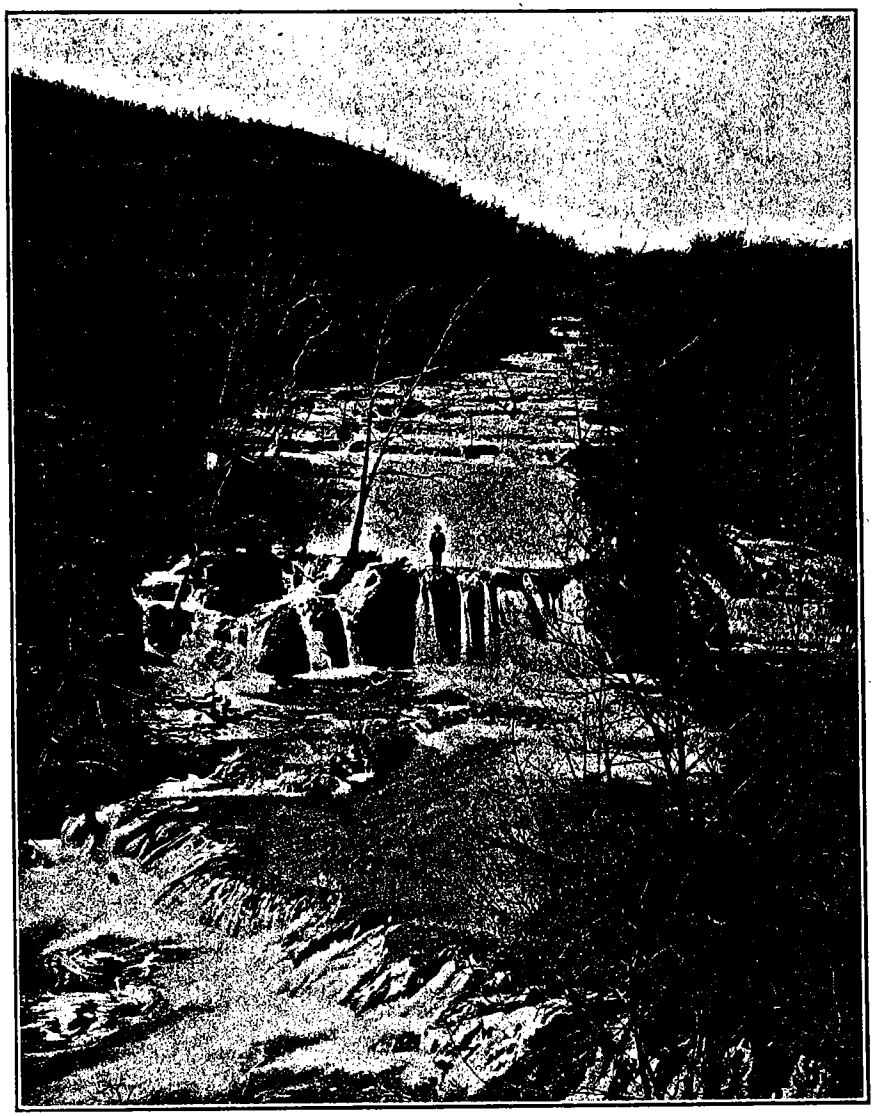
The drainage of the Arbuckle Mountain region is into Washita River, which flows almost directly from north to south across the region. In the lower part of its course through the mountains the river has cut a narrow gorge between hills of limestone rising about 300 feet above the water level. The principal tributaries of the Washita from the west are Colbert, Honey, Falls, Coal, and Caddo creeks. The last named creek flows entirely outside the mountain area but receives from the north the drainage from the southern slope of the mountains through Dalton, Spring, Hickory, Henryhouse, and Tulip creeks. From the

east and northeast the Washita receives the waters of Mill, Rock, Pennington, and Cedar creeks, and of Blue River, all of which have the major portions of their courses within the mountain area. All the streams of the region are clear and rapid-flowing. Many of them, especially those west of the mountains, have many beautiful waterfalls. Turner Falls on Honey Creek southwest of Davis is probably the best known of these falls. The drainage of the area underlaid by Arbuckle limestone is largely underground. Sinkholes are numerous, and very large springs, the mouths of underground streams, occur along the principal drainage. In its underground course through the Arbuckle limestone the water dissolves large quantities of calcium carbonate, which is precipitated as travertine when the streams flow on the surface. Especially large deposits of travertine have been formed at Turner Falls on Honey Creek, and at the numerous small falls on Falls Creek. In general, the larger tributaries of the Washita in this region flow across the strike, while the secondary streams flow in the valleys formed by the outcrops of the softer formations. Artesian water conditions are found in several localities, due to the steep dip of the formations. The artesian water is generally highly charged with minerals, as is also the water of many of the true springs of the region. The best known mineral waters occur in wells and springs at Sulphur and Bromide.

The soils of the region are generally thin. Locally, on the granite areas the soil is of sufficient depth to permit of farming and is quite fertile. The limestone outcrops are in most places washed almost clear of soil and are suitable only for grazing land. The shale outcrops and the narrow stream valleys have a fairly deep soil and support a small farming population.

Agriculture and grazing are the principal industries. As has been stated, the valleys are farmed to a considerable extent, while practically all of the hill land is pastured. Efforts have been made ever since the coming of the white man into the region to develop the mining industry. Gold and silver have been reported in paying quantities at several localities and considerable excitement has been produced at different times by these reports. However, up to the present no paying deposits of gold, silver, or copper have been found, although all three metals certainly exist in very small quantities. Zinc has been found in commercial quantities near the West Timbered Hills west of Davis. It is, however, as a rule, finely disseminated through the rock and the ore is difficult to mine. This, and the distance from transportation and fuel supplies, renders the utilization of the ores impracticable except at times when the price of zinc is unusually high. The mountains contain inexhaustible supplies of limestone and granite for building purposes. The limestone, however, is not especially adapted to quarrying and in most places is so badly cracked and checked by the movements which the strata have undergone that it cannot be obtained in large blocks. It is utilized for crushed stone at two plants near Crusher on the Gulf, Colorado & Santa Fe Railway in the gorge of Washita River. The granite has been quarried for building stone north of Tishomingo and for crushed stone at Ravia.

PLATE XV.



TRAVERTINE FALLS IN HONEY CREEK, EAST TIMBERED HILLS, SEVEN MILES SOUTHWEST OF DAVIS.

Granite gravel and "rotten" granite have been utilized at Tishomingo and near Mill Creek. Some of the sandstone ledges of the Simpson formation are practically pure quartz sand and are well adapted for use as glass sand. The quantity of this substance available in the region is enormous but it has been utilized so far only at Roff and Hickory, where sand washing plants have been operated for the past few years. Large deposits of asphalt occur in the mountains and also in the rocks immediately surrounding the mountains. The deposits at Buckhorn and Gilsonite near Sulphur, and at Woodford, northwest of Ardmore and near Ada, have been worked intermittently for several years. The limestone and shales are locally adapted for use as materials for the manufacture of Portland cement. The cement plant at Ada secures its material from the Viola limestone and Slyvan shale southwest of the town.

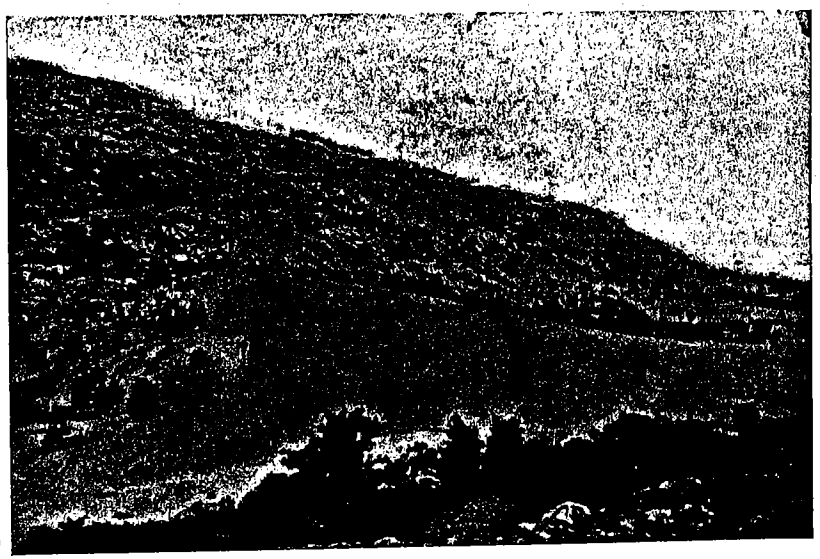
Transportation facilities in the region are poor. The Gulf, Colorado & Santa Fe Railway crosses the mountains from north to south through the gorge of Washita River. A main line of the St. Louis & San Francisco Railroad crosses from north to south, an average distance of about 20 miles to the east of the Gulf, Colorado & Santa Fe line. For the greater part of its course through the mountains it utilizes the divide between Mill Creek and Rock Creek. The Ardmore branch of the Chicago, Rock Island & Pacific parallels the southeastern edge of the mountains between Olney and Randolph, crossing the extreme southeastern extension between Wapanucka and Fillmore. Country roads are, in general, unimportant lanes, on section lines only in the flatter portions of the region. The population of the region as a whole is sparse. There are no large towns within the mountains. Davis, Sulphur, Ada, Wapanucka, and Tishomingo are located around the margin of the region and draw a considerable portion of their trade from the mountain area.

WICHITA MOUNTAIN REGION.

The Wichita Mountains consist of ranges and groups of hills extending from Lawton in Comanche County north and west across Kiowa County to Granite in Greer County. The length of the area from east to west is about 60 miles, and the width from north to south is about 25 miles. The long axis of the Wichita Mountains is in the same direction as that of the Arbuckle Mountains and the two uplifts were undoubtedly produced by the same force.

The rocks of the Wichita Mountain region are of the same general nature as those in the Arbuckle region. However, the Redbeds were deposited much higher, relatively, on the Wichitas than on the Arbuckles, so that nearly all of the Paleozoic rocks are covered, and only the highest portions of the granite mountains protrude above the plain formed by the level line of the Redbeds. Nearly all of the hills forming the group are composed of granite or other igneous rock. In the northeastern part of the region there are small areas of Reagan sandstone hills, of Arbuckle limestone covering considerable area, and three small moun-

PLATE XVI.



A. ALLUVIAL CONE EAST OF LUGERT. THE AREA BARREN OF VEGETATION IS COMPOSED OF GRAVEL AND SMALL BOULDERS.

B. GRANITE AREA NORTHWEST OF GRANITE, SHOWING DRAINAGE CONTROLLED BY JOINTS.

tains or knobs of Viola limestone. These formations are, in general, very similar to the formations of the same name in the Arbuckle Mountains, so it is presumed that the other formations of the Arbuckle region are present in the Wichita region, but buried beneath the Redbeds.

The Wichita Mountains proper comprise a considerable area extending from Fort Sill north of west to Cooperton. The mountains are composed principally of a granite which is fine to medium-grained, and generally of a pink color. The extreme southeastern portion of the mountains is composed of porphyry, and considerable areas along the northern boundary and some isolated areas within the mountains are composed of gabbro or closely related rocks. The mountains rise abruptly from the flat Redbeds plains. Some of the higher peaks have received distinctive names, such as Mount Scott, Mount Sheridan, Saddle Mountain, Haystack Mountain, and Mount Baker. These rise from 700 to 900 feet above their bases. To the west of the Wichita Mountains proper are many isolated peaks and ridges of granite and gabbro or related rocks rising above the Redbeds plains. The most important area of gabbro west of the Wichita Mountains lies around the town of Cold Springs, while the largest granite area is near the town of Lugert. Many of these isolated peaks or ridges have been given local names, among which are Navajo, Twin, Little Bow, Tepee, Dome, Devil's Canyon, Quartz, and Headquarters mountains. Some of these rise to elevations of 300 to 500 feet above the plains, but none of them is so high as the more important peaks of the Wichita Mountains proper. The central portion of the Wichita Mountain group is sometimes called the Raggedy Mountains.

The drainage of the region is south into Red River. The North Fork of Red River crosses the western part of the area and receives the drainage of a considerable area. Its principal tributaries in the region are Tepee and Elk creeks. The northeastern portion of the mountains is drained southeast through Medicine Bluff Creek into Big Cache Creek. The south and central portions are drained south through a number of small streams into Red River, while a small area in the northern part of the mountains is drained north through tributaries of Washita River. All these streams lie partly in the mountains proper and are in the granite areas, but the greater part of their courses is in the Redbed plains surrounding the granite.

The soils of the greater part of the whole region belong to the Redbeds plains rather than to the mountains, strictly speaking. The granite peaks are, in general, washed almost or quite free from soil. In the large granite area of the Wichita Mountains proper some of the stream valleys contain sufficient soil for farming, but in general the hills are bare, or support a scanty growth of trees. The greater part of Wichita Mountains proper is included in the Wichita National Forest and Game Reserve. If we consider the region as a whole, agriculture is by far the most important occupation, but if we consider only the granite or limestone areas, agriculture is not of very great importance. The soil from the gabbro and related rocks is much deeper and richer than that of the granite and in these areas farming

is of more importance. Reports of the finding of gold and silver in commercial quantities have been circulated at various times and the mountains have been the scenes of great excitement. The amount of money expended in attempting to find gold and silver in this area probably totals hundreds of thousands of dollars, but so far no returns have been secured from this expenditure. Gold, silver, and copper are known to occur in small quantities at various localities, but, so far, none of the deposits has proved to be of commercial importance. The granites and gabbros have been quarried for building and monumental stone at several localities near railroads. The quarrying industry is described fully in bulletin No. 20 of the Oklahoma Geological Survey.

The main line of the Chicago, Rock Island & Pacific Railway passes near the eastern end of the mountains, one branch of the St. Louis & San Francisco Railroad parallels the southern border of the area, and another branch of the same system crosses it from north to south, west of the center. The Kansas City, Mexico & Orient, and the Mangum branch of the Chicago, Rock Island & Pacific cross the northwest portion of the area. The granite and limestone areas of the region are very sparsely settled. The flat land between the ranges and peaks supports a good farming population, but these areas are a part of the Redbeds plains rather than of the mountains themselves.

RED RIVER OR CRETACEOUS REGION.

This area lies in the southeastern part of the State, between the Arbuckle and Ouachita mountains on the north and Red River on the south. The length of the area from east to west is about 170 miles, and its greatest width is about 45 miles, although the average width is considerably less than that amount. The area includes all of Marshall, Bryan, and Choctaw counties, nearly all of Love County, and parts of Carter, Johnston, Atoka, Pushmataha, and McCurtain counties.

The rocks of the Red River limestone area belong to the Lower Cretaceous or Comanchean system. They are the northeastward continuation of the great belt of rocks of this area which extends southward through central Texas and far into Mexico. They consist of sands, shales, and limestones. The complete section is as follows:

		Feet Thick.
7.	Silo or Woodbine sandstone, brown friable sandstone locally hardened by iron cement with some shale and shaly limestone. The total thickness of this formation as shown in Oklahoma is	500
6.	Bennington limestone. Blue shell limestone	10 to 15
5.	Bokchito formation. Red and blue shale with thin limestones and soft sandstones	140
4.	Caddo limestone. Yellow and white limestone with thin, marly beds	60
3.	Kiamichi formation. Soft blue shale with thin beds of shell limestone in the lower part	150
2.	Goodland limestone. Massive white limestone	25
1.	Trinity sand. Fine gray to yellow unconsolidated sands with conglomerate beds locally at the base.	

The rocks outcrop in parallel east-west belts.

The general structure of this region is that of a monocline dipping very gently to the south and southeast. The rocks lie on the sharply upturned edges of the much older rocks of the Arbuckle and Ouachita mountain region which pass southward under the nearly level-lying Cretaceous rocks. The general dip to the south and southeast is about 20 to 30 feet to the mile. This dip is interrupted locally by gentle folding. While the region has not been worked in detail, at least two folds are known in the region. One anticlinal fold extends north of west from the vicinity of Madill and another parallels it at a distance of 6 or 8 miles to the south. Further work in the region is likely to show the presence of more of these folds. The surface of the region is comparatively smooth. The alternation of hard and soft strata produces a stairstep topography, with the limestones forming steep northward-facing escarpments and having gently-dipping slopes to the south and southeast. In the broad belt of Trinity sand around the northern margin there are several deep canyons.

The drainage is entirely to the south and southeast into Red River, which forms the southern boundary of the region. Washita, Blue, Kiamichi, and Little rivers, and Boggy Creek are the principal streams. The streams in this region have rather a low gradient and as a rule fairly steep mud banks. Underground water is found principally in the Trinity sand, which forms a great artesian reservoir for the southern part of this region and over large areas southward into Texas. The water in this sand is usually of exceptional purity.

The soils of the region are principally deep, black soils, formed by the decomposition of the limestones and marly shales which comprise the greater part of the geologic section. Around the northern margin is a belt of as much as 10 miles in width, of very sandy soil, the product of the Trinity sand. In the extreme southern part, along Red River, are considerable areas of very red, sandy, clay soils which have been deposited by or have been blown from Red River in comparatively recent times.

The deep, black limestone soils make this region one of the most fertile in the State and agriculture is by far the most important industry. Even the sandy soils on the outcrop of the Trinity sand are quite fertile and are farmed to a large extent. Cotton is the principal crop, although corn and wheat do well. The sandier portions of the region are timbered and lumbering is an industry of some importance. Several of the smaller towns are important lumbering centers, but the majority of the timber comes from the Ouachita region to the north rather than from the limestone area. The mineral industries are of little or no importance. The limestones are used on a small scale for local purposes, but have not been quarried and shipped. Most of the clays contain too much lime to be of value in clay products. Some asphalt deposits are known but none of sufficient size to be commercially important. Oil was found several years ago at Madill, but the pool proved to be very small. The oil is exceptionally high grade and in spite of the small production the wells at Madill are still being pumped. Gas is being found at Lark in the southern part of Marshall County. Small quantities of a very heavy oil have been found near Mannsville.

Two lines of the St. Louis & San Francisco and the main lines of the Missouri, Kansas & Texas, of the Gulf, Colorado & Santa Fe, and of the Missouri, Oklahoma & Gulf railways cross the region from north to south. A line of the St. Louis & San Francisco extends east from Ardmore nearly the full length of the region. A short line of railroad extends from Valliant to Broken Bow. The country roads are generally unimproved. In wet weather the roads over the limestone belts are almost impassable.

This region is comparatively thickly populated on account of the agricultural value of the territory. A great deal of the land belongs to the members of the Choctaw and Chickasaw Indian tribes, and a large portion of it is not highly improved.

LOWER ARKANSAS VALLEY REGION.

This region lies in the east-central part of the State and includes all of Haskell and McIntosh counties, and parts of Sequoyah, Muskogee, Hughes, Coal, Pittsburg, Latimer, and Leflore counties.

The rocks of the region consist of an enormous thickness of alternating sandstones and shales of Pennsylvanian age. The shales are as a rule dark in color, and vary in texture from very fine-grained shales to sand-shales, and finally into sandstone. The sandstones are very uniform, medium-grained, and brown in color. The shales greatly predominate in amount but the resistant nature of the sandstones gives one the impression, especially in the hilly regions, that they are more abundant than the shales. The geologic section is as follows:

5. Boggy shale consists generally of black shale with thin bands of sandstone irregularly distributed; about 3,000 feet thick.

4. Savanna formation comprises three sandstone groups separated by shales. The total thickness is about 1,200 to 1,500 feet in the southern part of the area, but the formation thins rapidly and disappears in the northern part. This is the great mountain-making formation of the region.

3. McAlester shale consists of black shales with thin, lenticular sandstones and coal beds, of which two are workable, and is about 2,000 to 2,500 feet thick.

2. Hartshorne sandstone is made up principally of sandstone, but is shaly in the lower portion. The formation contains one bed of workable coal near the top.

1. Atoka formation consists principally of shale, but with important sandstone groups distributed through the formation at intervals of about 1,000 feet. Its total thickness in Oklahoma is between 6,000 and 7,000 feet.

The structure of this region consists of a series of rather sharp folds with their axes extending in a general northeast-southwest direction.

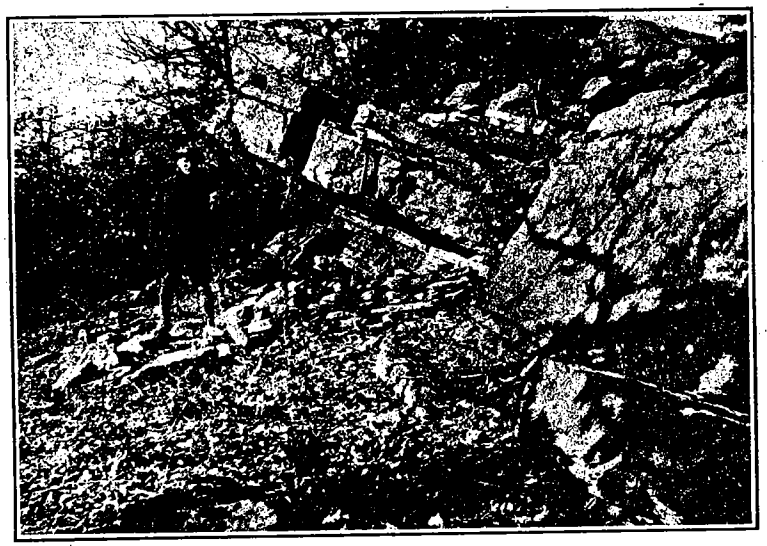
Some faulting and cross-folding occur. The dips from the axes of these folds vary from 2° to 3° to as high as 50° or 60°. The structure is described fully in the papers mentioned in the previous paragraph.

The region lies in the drainage basin of Arkansas River. The lowlands in the valley of the river and its tributaries are very flat, and the natural drainage is poor. The tops of the majority of the hills are broad and flat, and are at nearly the same level, and can be considered as forming a highland plain into which the streams have cut rather broad, deep valleys. A few isolated peaks rise above the level of the highland plain to heights of 1,500 feet or more. The largest of these peaks are known as mountains, and are named. The principal ones are Sugarloaf, Poteau, Backbone, Cavanal, Pigeon, Sans Bois, Tucker Knob, Panther, Beaver, Brooken, and Short mountains.

In general the relation of the structure to the topography is intimate. All of the larger hills or mountains are synclinal, and many of the smaller features are also related to the structure.

The drainage of the area is entirely into Arkansas River. Poteau River carries the drainage of the eastern part of the area northward into the Arkansas, and the principal tributary of the Poteau, Fourche Maline Creek, drains a long, narrow strip along the southern border of the area. Another important tributary of the Poteau, from the west, is Brazil Creek, which drains a considerable territory in northeastern Latimer,

PLATE XVII.



SHOWING INCLINED BEDS OF HARTSHORNE SANDSTONE, SOUTH OF HARTSHORNE.

southeastern Haskell, and northwestern Leflore counties. Sugar Loaf, Nail, and Gap creeks, and James Fork flow into Poteau River from the east. Canadian River flows through the northwestern part of the area, but it has no very important tributaries within the area, and drains a comparatively small portion of it. The portion of the area between the drainage basins of Poteau and Canadian rivers is drained directly into the Arkansas through Cache and Sansbois creeks.

The soil of the region outside of the larger stream valleys is rather poor. The hills, which are composed largely of the Savanna sandstone and the Boggy formation in which sandstone is also abundant, are entirely too rough for farming purposes and are of value only for grazing. All except the very roughest portions are covered with a good growth of natural grass. Most of the hills are covered with timber, but the growth is too scrubby to be of much value. The broad flat outcrop of the McAlester shale and the more level portions of the outcrop of the Atoka formation give a prairie country, but the natural drainage is poor and the soils are very tight clay soils of small fertility. Although farming is carried on to considerable extent on this flat plain, the poorer portions are left in pasture. The broader stream valleys and some of the narrower valleys in rougher parts have fairly fertile soil and practically all such areas are in farms.

While agriculture and grazing must be considered as principal industries of the region as a whole, locally the mining of coal is far more important. Important beds of workable coal are present in the McAlester and Hartshorne formations, and less important beds in the Boggy shale. All these beds are mined at different localities, and practically all the coal mining industry of the State is centered in this region. The Wapanucka limestone, which extends along the southern boundary of the region, is used for crushed stone at Limestone Gap and Hartshorne. A large Portland cement mill has been built at the latter place and is reported to be in operation. Natural gas has been found at Coalgate, near McAlester, at Red Oak, Stigler, Poteau, and other localities. The wells are of only moderate size. So far, no petroleum has been found in the region.

The main line of the Missouri, Kansas & Texas Railway crosses the western part of the area from north to south. The Kansas City Southern crosses the extreme eastern part, and the Chicago, Rock Island & Pacific, and Midland Valley railways give east-west connections. The country roads are on the section lines in the more level parts. The mountainous regions are practically without roads. The population of the region is rather sparse; in the rougher portion extremely so. McAlester, Wilburton, and Poteau are the centers of the coal mining industry. Stigler, Eufaula, and Checotah are the principal towns in the northern and western parts of the area.

SANDSTONE HILLS REGION.

The Sandstone Hills region is not sharply marked off from the surrounding areas. The limestones whose outcrops form the Prairie Plains region which has just been described, die out to the south and their place is taken by shales and sandstones. The amount of sand, both relatively and absolutely, increases tremendously to the south. There is thus a transition from the Limestone Hills region to the Sandstone Hills region. To the southeast the Sandstone Hills region grades into the lower Arkansas Valley region. The line between the two regions is not sharp, but may be approximated as the change from the sharply-folded region to the region of monoclinal dip to the west. For most purposes the line of the Missouri, Oklahoma & Gulf Railway between Tupelo and Henryetta, the line of the St. Louis & San Francisco Railway between Henryetta and Tulsa, and the line of the Atchison, Topeka & Santa Fe Railway from Tulsa to the State line may be taken as forming the southeastern and eastern boundary of the area. To the west the region grades imperceptibly into the Redbeds Plains, so this boundary must also be arbitrary. For practical purposes the line of the Eastern Oklahoma branch of the Atchison, Topeka & Santa Fe from Pauls Valley to Shawnee, and a line drawn from Shawnee to Pawnee and thence north to the State line may be taken as the western boundary. To the south the region is set off rather sharply from the Arbuckle Mountain region. The area as thus outlined includes all or parts of Pontotoc, Hughes, Okmulgee, Tulsa, Creek, Okfuskee, Osage, Pawnee, Payne, Lincoln, Seminole, and Pottawatomie counties.

The rocks of the region consist principally of alternating sandstones and shales. Except in the extreme southern part it is impossible to give detailed sections. The section as worked out by Taff in the Coalgate quadrangle above the Boggy shale is as follows:

4.	Calvin sandstone	200 feet thick
3.	Senora formation	500 feet thick
2.	Stuart shale	250 feet thick
1.	Thurman sandstone	200 feet thick

These formations probably continue to the north for some distance beyond the region in which they have been mapped, but as they are followed north they thin and the sandstones disappear, while limestones come into the section. It is probable that these formational lines extend as far south as Arkansas River. Practically all of Osage County has been surveyed by the United States Geological Survey, but the results have not been published.

The sandstones and shales have a general westward and northwestward dip which increases gradually from the Kansas-Oklahoma line to the south. Along the State line it is probably not over 30 or 40 feet per mile, while in the latitude of Tulsa it is probably 50 to 60 feet to the mile. The general westward dip is interrupted in many places by gentle folding, many of the folds being important reservoirs for oil and gas. Of these the best known is that east of Cushing, the famous Cushing oil and gas field.

The surface of the region is rough. The shales weather very rapidly leaving the sandstone ledges forming pronounced escarpments and hills. The sandstones are of sufficient thickness to produce large blocks which cover the tops and slopes of the hills. The hill lands have elevations of some 300 to 400 feet above the lowlands. The soils of the region are as a rule fairly fertile. In the valleys are good farming lands, and on the broader, flat-topped ridges the soil is of sufficient depth to support good plant growth. The slopes are usually covered by sandstone boulders and are not suitable for farming. Grazing is an important industry.

The principal mineral resources are oil and gas which are found in enormous quantities. The Cushing pool, which has already been mentioned, the Paden pool in Okfuskee County, the many pools in Osage County, pools in the vicinity of Sapulpa and Tulsa, including the famous Glenn Pool, are all located within this area. The shales are in many places suited for the manufacture of clay products and have been utilized for brick at Sapulpa, Tulsa, Pawhuska, and Cleveland. The sandstone has been used in local buildings but is not of great value as a building stone.

Transportation facilities are fairly good. The lines of the Chicago, Rock Island & Pacific; St. Louis & San Francisco; Missouri, Kansas & Texas; Atchison, Topeka & Santa Fe; Fort Smith & Western; and the Midland Valley afford connections in all directions.

The population is sparse in the hilly regions and comparatively dense in the level regions of good farming lands. The distribution of the population is affected at present tremendously by oil and gas and the cities in the area owe a great part of their growth to the development of oil and gas pools in their neighborhood. Tulsa, Sapulpa, Cushing, and Drumright are the best examples of oil and gas towns. Ada has natural gas and some important factories. The towns in the southern portion of the area are simply trading places supported by the population of their immediate vicinity. The most important of these towns are Wewoka, Holdenville, and Okemah.

PRAIRIE PLAINS REGION.

This region comprises a narrow belt on the west side of the Ozark Mountains and to the north of the Lower Arkansas Valley. It is the eastern portion of the area of Pennsylvanian rocks. It comprises all or parts of Nowata, Craig, Washington, Tulsa, Rogers, Mayes, Wagoner, and Muskogee counties.

The rocks of the region consist principally of shales and limestones, with some sandstones of Pennsylvanian age. The stratigraphy is rather complicated on account of the dying out of the limestones southward

from the Kansas line, and the increase in the thickness of the shales, and the coming in of sandstone in the same direction. The matter of formational names in this region is in a rather unsatisfactory condition and it is not thought worth while to attempt to give this in detail in this connection. The structure is in general a monoclinal slope to the west and northwest, away from the Ozark Mountains. The average dip varies from about 30 feet to the mile near the Kansas line to 50 or 60 feet to the mile in the southern portion of the region. The general dip is interrupted in many localities by gentle folding and terracing. Practically all the anticlinial folds have proved to carry oil and gas and these have been studied in great detail.

The surface slopes to the south and east. The alternation of hard and soft strata, combined with the prevailing west dip, gives rise to a stairstep topography with the limestones and sandstones forming eastward facing escarpments with gentle slopes to the west and with broad valleys underlaid by shale separating the limestone ridges. The drainage is into Arkansas River, which crosses the southern portion of the area. Practically all of the area is drained into the Arkansas through the Verdigris and Caney, its principal tributaries. These are rather sluggish streams with steep mud banks through the greater part of their courses. Ground water is not very abundant but is found in sufficient quantities for local use in the sandstone beds which occur in the shales.

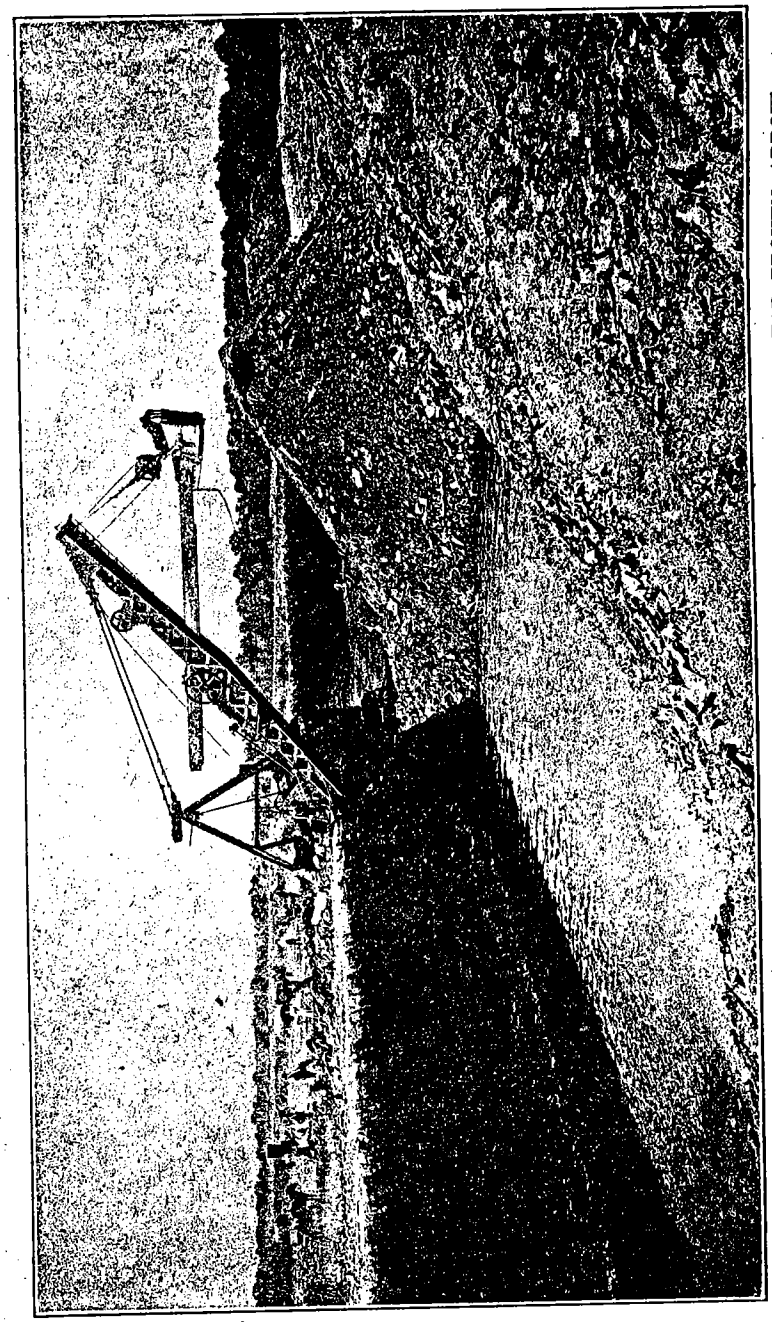
The soils are fairly deep and of moderate fertility. On the limestone scarps the soil is very thin, but there is usually a sufficient amount to support a good growth of grass.

Farming is the principal permanent industry of the region. The flat prairies on the shale outcrops are especially noted for their production of a fine grade of prairie hay of native wild grass. This is the principal agricultural industry in eastern Rogers, Nowata, and western Mayes counties, and the greater part of Craig County. Cotton is raised in the southern portion.

REDBEDS PLAINS REGION.

This region is limited on the east by the Sandstone Hills region, as just outlined, and on the west by the Gypsum Hills. It extends entirely across the State in a north-south direction, widening toward the south and entirely surrounding the Wichita Mountain region which has been described. As considered here, the region includes all or parts of Kay, Pawnee, Noble, Payne, Lincoln, Logan, Pottawatomie, Oklahoma, Cleveland, McClain, Garvin, Carter, Jefferson, Stephens, Cotton, Tillman, Comanche, Kiowa, Caddo, Grady, Canadian, Kingfisher, Blaine, Major, Garfield, Grant, Alfalfa, and Woods counties. This region has not been investigated geologically to the extent that the areas to the east have been. United States Geological Survey Water Supply Paper No. 148,

PLATE XVIII.



STRIPPING COAL WITH STEAM SHOVEL NEAR BROKEN ARROW.

by C. N. Gould, deals with the stratigraphy and water resources of a considerable portion of the area. This includes practically all the available information in regard to the geology of the region.

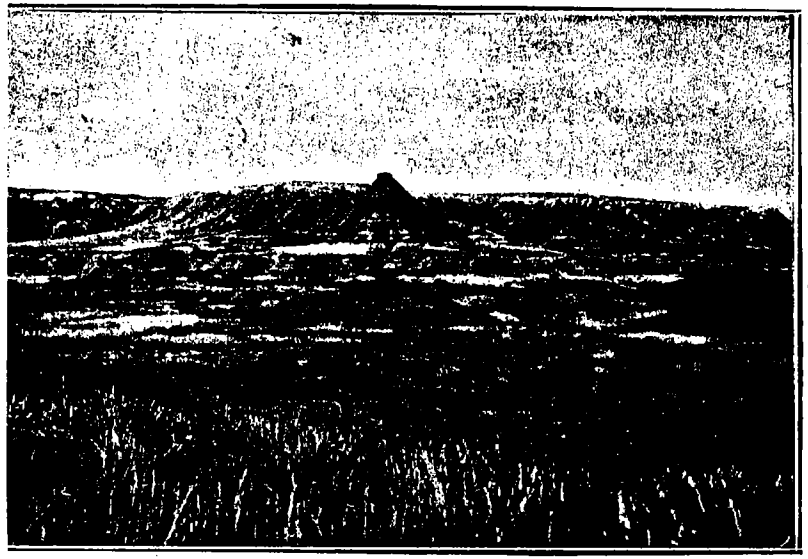
The rocks of the region are soft red shales with thin red sandstones, which are, as a rule, quite soft and do not produce pronounced escarpments. The greater part of the area is included in the outcrop of the Enid formation of the Permian system. This formation consists of a great thickness of red clay and soft shales with thin sandstones. The exact thickness is not known but varies probably between 1,200 and 1,600 feet. In the lower part of the formation, that is, the eastern part of the area, sandstones are much more abundant than higher in the section. Some red sandstones with smaller proportions of shales in the eastern part of the area belong to the Pennsylvanian system and are equivalent to non-red formations of the Sandstone Hills region farther north. An area comprising most of Kay County is included in this region. The general physiographic features are the same as in the rest of the region. The rocks, however, are non-red limestones and shales of Permian age. To the south these grade into red rocks.

The surface slopes to the south of east. In general it is a slightly rolling plain. The streams have cut only shallow, narrow channels and the ridges between the stream courses are broad and flat-topped. Only in the eastern portion (in the region where the Redbeds Plains grade into the Sandstone Hills) is there any great relief. Over most of the area the elevation of the hills above the streams at their base is not much more than 100 feet. The extreme eastern portion is covered by a growth of black-jack oak. Over the most of the area timber, pricipally elms and cottonwoods, occurs only along the streams.

The drainage of the greater part of the area is to the south of east into Arkansas River through Salt Fork, Cimarron, North Canadian, and Canadian rivers. These streams are typical plains streams, flowing in broad, shallow valleys with sand-choked channels. All of them have considerable areas of sand dunes along their courses. The streams are closely spaced and their tributaries within this area are short and unimportant. The southern portion of the area is drained into Red River through several small tributaries, among which are Deep Red Run, Cache, Big Beaver, and Mud creeks, and Walnut Bayou. An area in the south-central part is drained by Washita River and its tributaries, Little Washita, Rush, Wild Horse, and Caddo creeks.

The soils of the region are in general of considerable depth and of medium to great fertility. Practically all the region is in farms. All of the standard farm crops are raised in abundance, cotton being the principal crop in the southern portion and wheat in the northern. Corn is grown throughout the area, but is not so dependable a crop as it is farther east, on account of the lighter rainfall. The sorghums (cane, kafir, milo maise, and feterita) are grown extensively. The proportion of these crops to corn increases across the area from east to west. Stock raising is an important industry throughout the area, and considerable

PLATE XIX.



BAD LAND TYPE OF TOPOGRAPHY WHICH OCCURS IN PARTS OF THE REDBEDS REGION..

acreage in the rougher portions is devoted to pasturage. Oil and gas occur in considerable quantities in Kay County and prospecting is being carried on in other parts of the region. There are no mineral industries beyond the manufacture of brick from the red clay shale in a few localities.

Railroad transportation is afforded by the lines of the Atchison, Topeka & Santa Fe; Chicago, Rock Island & Pacific; and the St. Louis & San Francisco railways in a north-south direction, and by branches of the same systems to the east and west. The country roads are laid out on section lines and are among the best in the State. The red clay soil usually contains a sufficient proportion of sand to produce a natural sand-clay road, which is good at almost all times in the year. With a very moderate amount of work these roads can be kept in first class condition. The local transportation in the sand hills region is a difficult problem, but no part of the region is far enough removed from clay banks to make the claying of the roads very expensive.

This region is the longest settled portion of the State, and the population is fairly dense and well established. It is almost entirely an agricultural community and the towns are principally trading centers. Oklahoma City, Guthrie, Shawnee and Enid are the only large cities within the area with any important manufacturing industries. Newkirk

and Blackwell are located near oil fields and have some industries located on this account. Other important county seat towns and trading centers are Alva, Cherokee, Perry, Stillwater, Kingfisher, Chandler, Anadarko, Chickasha, Norman, Pauls Valley, Purcell, and Duncan.

GYPSUM HILLS REGION

This region lies immediately west of the Redbeds Plains region, and in general characteristics is very similar to that region. It is separated from it on account of the presence of important ledges of gypsum which produce somewhat rougher topography than prevails in the Redbeds Plains. It contains all or parts of the following counties: Woods, Harper, Woodward, Major, Dewey, Blaine, Canadian, Custer, Washita, Beckham, Greer, Harmon, Jackson, Kiowa, Comanche, and Caddo.

The rocks of the region belong to the Redbeds of the Permian system. The formations are as follows:

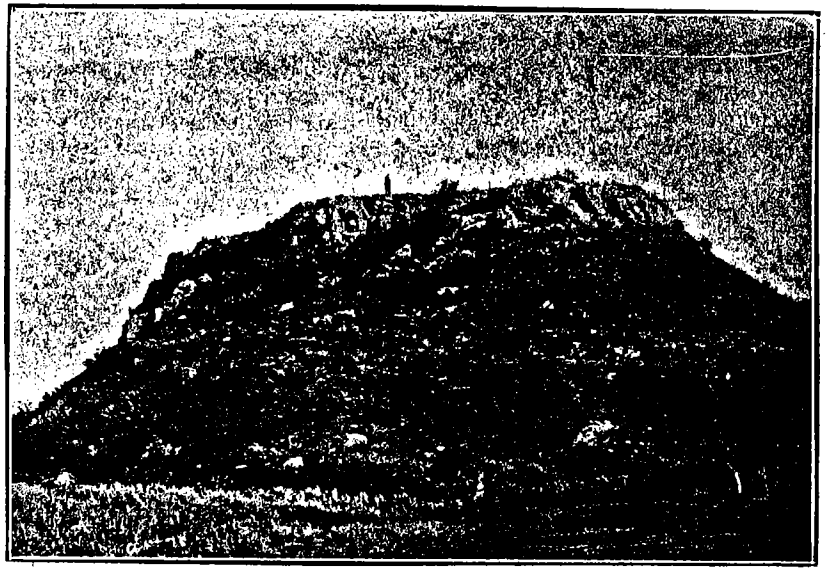
3. Greer formation, consisting of red shales with numerous ledges of gypsum. In the southern part of the area there are five distinct gypsum members: Hasey, Kiser, Haystack, Cedartop, and Collingsworth, but in the major part of its outcrop the gypsums of the formation are irregular and lenticular. The Mangum dolomite is a ledge at the top of the formation which may be traced for many miles. The total thickness of the formation is less than 300 feet.

2. The Woodward formation, which consists of the Dog Creek shales, the Whitehorse sandstone, and the Day Creek dolomite members. The total thickness of the formation is about 400 feet.

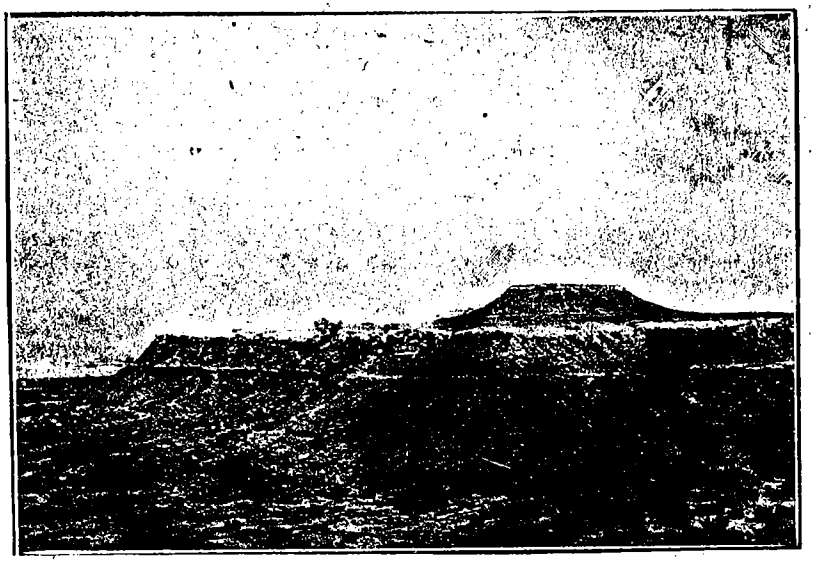
1. The Blaine formation, which consists of the Ferguson, Medicine Lodge, and Shimer gypsum members, outcrops along Cimarron River in the northern part of the area. It thins and disappears to the southeast in central Canadian County. The total thickness of the formation is about 100 feet.

The Blaine formation outcrops in a narrow belt along the northeastern margin of the region, the Greer outcrop forms the great central and southern part, and the Woodward formation outcrops in a belt between the outcrops of the Blaine and Greer formations.

The structure of the region is very simple. In the eastern portion the rocks have a very gentle westward dip. Over the greater part they are practically level, and in the western portion have a very gentle eastward dip. In other words, this region lies at the bottom of the great geo-syncline between the Arbuckle and Ozark mountains on the east and the Rocky Mountain uplift on the west. In the southern portion of the area the Wichita Mountains interrupt the general structure and the Redbeds dip gently away from the mountains in all directions. The presence of a few small folds is known, and others may be found by



A. GYPSUM CAPPED HILL IN BLAINE COUNTY.



B. EROSIONAL FEATURES IN THE GYPSUM HILLS REGION. THREE DISTINCT BEDS OF GYPSUM ARE EXPOSED IN THIS AREA.

careful prospecting.

The surface is in general a plain into which the streams have cut channels which are not of great depth, but are deeper than the channels in the Redbeds Plains to the east. The greatest relief is in the northern portion, where the streams have cut narrow canyons of from 200 to 400 feet in depth in the Blaine formation. This formation rises as a very sharp, flat-topped scarp, facing to the northeast above the level plain of the Enid formation. In the central portion of the gypsum region the surface is rolling, the irregular gypsums producing round hills rather than the steep, continuous escarpments such as is produced by the Blaine formation. In the southern portion the gypsums are continuous and give a steep escarpment similar to that of the Blaine formation. This escarpment is especially noticeable along North and Elm Forks of Red River.

The surface as a whole slopes to the southeast, rising gradually and rather rapidly from the eastern margin of the area to the westward.

The drainage of most of the area is through the same streams as that of the Redbeds Plains. The Salt Fork of Arkansas River, Cimarron, North Canadian, Canadian, and Washita rivers drain the greater part of the region. All except the Washita are typical plains streams with sand-choked channels and broad belts of sand dunes along their courses. The Washita carries much less sand, and as a rule has steep mud banks. The southwest portion of the Gypsum Hills is drained south into Red River through North Fork, with Elm Fork and Salt Fork as its principal tributaries. The underground water in the Gypsum Hills as well as in the Redbeds Plains is of irregular occurrence and generally of poor quality, except in the sand hills areas. Springs are abundant in the sand hills areas, especially at the contact of the sand and the Redbeds.

The soils of the Gypsum Hills region are very similar to those of the Redbeds Plains. On the outcrop of the gypsum formation the soil usually contains a considerable percentage of gypsum but seldom sufficient amount to be harmful. The soils on the Woodward formation are locally quite sandy and in general are poorer than those of the Blaine and Greer formations.

Agriculture and grazing are the only important industries. The crops are in general the same as those in the Redbeds Plains father east, but the decrease in average rainfall to the west causes more of the land to be devoted to pasture. Dry farming is practiced extensively and corn is largely replaced by sorghums, especially toward the northwestward part of the area, where milo maize is the principal grain and forage crop. Cotton is the staple crop in the southern part of the area, and wheat in the northern part. The important mineral resources are gypsum and salt. The gypsums of both the Blaine and Greer formations are suitable for manufacturing into plaster, and several plants have been established in the region. Most of these utilize the gypsum from the Blaine formation. There are plants at Watonga, Southard, Bickford, Okeene, Darrow, Alva, Rush Springs, and Eldorado. The supply of gypsum is inexhausti-

PLATE XXI.

ENTRANCE TO GYPSUM CAVE, FIVE MILES NORTHWEST OF WEATHERFORD.

ble, but the distance of the deposits from large building centers and from fuel makes the marketing conditions very difficult.

Large springs of salt water come from the Redbeds rocks below the gypsum ledges at several localities in the region. At a few localities these springs supply sufficient brine to produce enormous quantities of salt if it were utilized. Little and Big Salt Plains on Cimarron River between Woods and Harper counties, the salt plain on Salt Creek west of Ferguson in Blaine County, a small salt plain near Carter in Beckham County, and the Chaney and Kiser salt plains on Elm Fork of Red River in Harmon County are the most important of these localities. The salt at each of these localities forms incrustations over the valley floors, sometimes to a thickness of several inches. The amount of brine furnished by the springs is difficult to estimate but it is sufficient to make many carloads of salt daily. However, the larger plains, those on Cimarron River and Elm Fork, are far removed from railroads and the salt is utilized only in a small local way. The Blaine County plain on Salt Creek is only four or five miles from the railroad and could be utilized. A plant was erected at Ferguson several years ago but has been abandoned and dismantled.

The population of the Gypsum Hills region is somewhat more sparsely distributed than that of the Redbeds Plains. Aside from the county seats, there are few towns of over 1,000 inhabitants. With the exception of the gypsum mills, and several brick plants, there is practically no manufacturing industry and the towns are simply trading centers for their surrounding neighborhoods. Altus, Mangum, Hobart, Clinton, Fairview, and Woodward are the principal towns. The St. Louis & San Francisco, the Kansas City, Mexico & Orient, and the Wichita Falls & Northwestern railroads cross the region in a north-south direction, and two branches of the Chicago, Rock Island & Pacific, one of the St. Louis & San Francisco, and one of the Atchison, Topeka & Santa Fe from the east to west.

HIGH PLAINS REGION.

The High Plains region occupies the extreme northwestern portion of the main part of the State, and all of the Panhandle. The counties included are Roger Mills, Ellis, Harper, Woodward, Woods, Beaver, Texas, and Cimarron.

The rocks of the region consist of the Quartermaster formation of the Permian system, and loose sands, clays, and gravels of Tertiary age, which overlie the Quartermaster. These are rather irregularly distributed and are generally not very thick. Locally they reach a thickness of 400 to 500 feet. Within the Tertiary rocks the distribution of the clay, sand, and gravel is very irregular. The sands and gravels are sometimes well cemented, forming what is known as the mortar beds.

The region is located on the eastward-dipping monocline of the eastward slope from the Rocky Mountains. The dip is, however, very gentle. The surface is a plain into which the streams have cut narrow V-shaped

A. EROSIONAL FEATURES IN THE DAKOTA SANDSTONE NEAR KENTON, CIMARRON COUNTY.

B. CIMARRON RIVER AND TRIBUTARIES AS VIEWED FROM THE EAST SLOPE OF BLACK MESA, NORTHWEST CIMARRON COUNTY.

canyons. The areas between the streams are broad and flat-topped. The general slope is to the southeast. This is the highest region, topographically, in the State, the maximum elevation being at the extreme northwest portion of Cimarron County. The drainage is through the branches of North Canadian River. Springs are abundant in the Tertiary rocks and the ground water is of excellent quality.

The soils are of sufficient thickness and fertility to be excellent farming land, but the rainfall is too light to permit of extensive farming. The greater part of the region is in pasture. Milo maize is the principal forage and feed crop. Wheat is grown extensively, especially in the eastern portion of the region. Broom corn is one of the leading crops and this section is one of the important producers of this product in the United States. There are no mineral or manufacturing industries in the region.

The region is thinly settled. Transportation facilities are poor. The Atchison, Topeka & Santa Fe Railway crosses the southeastern portion of the area, the Wichita Falls & Northwestern penetrates it to Forgan, and the Chicago, Rock Island & Pacific crosses Texas County. The country roads are mostly on section lines, but many of the section lines have not been opened as highways. The sandy clay soil makes a fairly good natural roadbed and with very little work the country roads can be kept in good, passable condition. In fact, this region is noted for its excellent natural roads.

CHAPTER IV.

MINERAL RESOURCES OF OKLAHOMA.

GENERAL STATEMENT.

The principal mineral resources of Oklahoma are non-metallic. Lead and zinc are the only metals which are produced in quantities sufficient to make them of great value, although iron ore occurs in some quantity, and small amounts of manganese, copper, silver, and gold have been found. Petroleum, natural gas, and coal are very abundant and make by far the greater part of Oklahoma's mineral production. Other non-metallic products are clay and shale, building stone, crushed stone for concrete and road materials, gravel and sand, Portland cement materials, gypsum, salt, asphalt, and mineral waters. The value of the mineral production from 1901 to 1916 is shown by the accompanying chart.

In this section these resources will be considered in turn, in the order of their importance.

PETROLEUM.

Petroleum is found principally in the northeastern part of the State, in the region of Pennsylvanian rocks. The source of the oil is almost undoubtedly plant or animal matter, or both, which was buried with the rocks as they accumulated at the bottom of the sea. As the muds and sands were hardened by pressure, and finally elevated to their present position, the organic matter in them, being shut off from the air, was subjected to a process of decay and the series of compounds forming natural gas and petroleum resulted.

At first these compounds were distributed throughout the rocks in extremely small particles. Later the folding of the rocks created places in the arches of the folds where the gas and petroleum could collect. The collection into large bodies is due probably to the difference in the specific gravity (weight) of the gas and oil particles and that of the salt water with which they were associated. The gas and oil, being lighter than water, collect in the highest places they can reach. These are the crests of arches of the gentle folds which are present in the rocks of almost all regions. To accomplish this accumulation, there must be above the porous rock containing the gas and petroleum a tight-grained

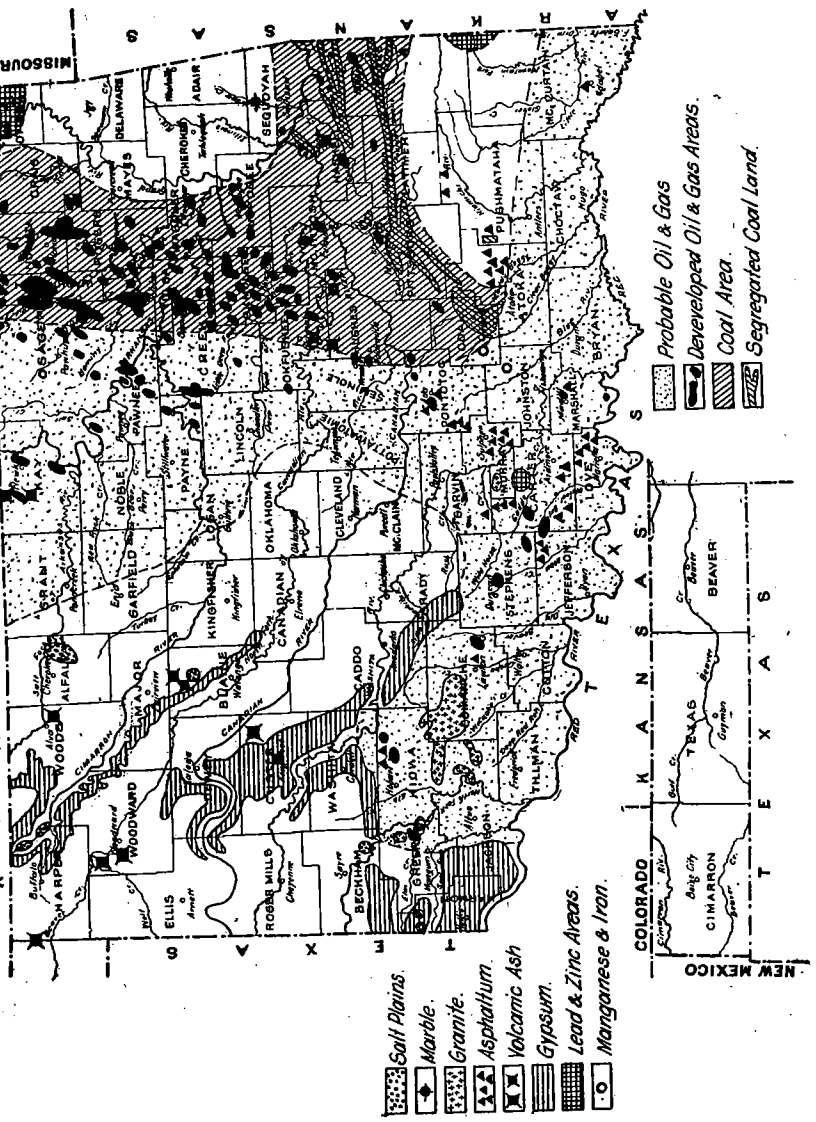


Figure 6.—Map of Oklahoma showing distribution of mineral resources.

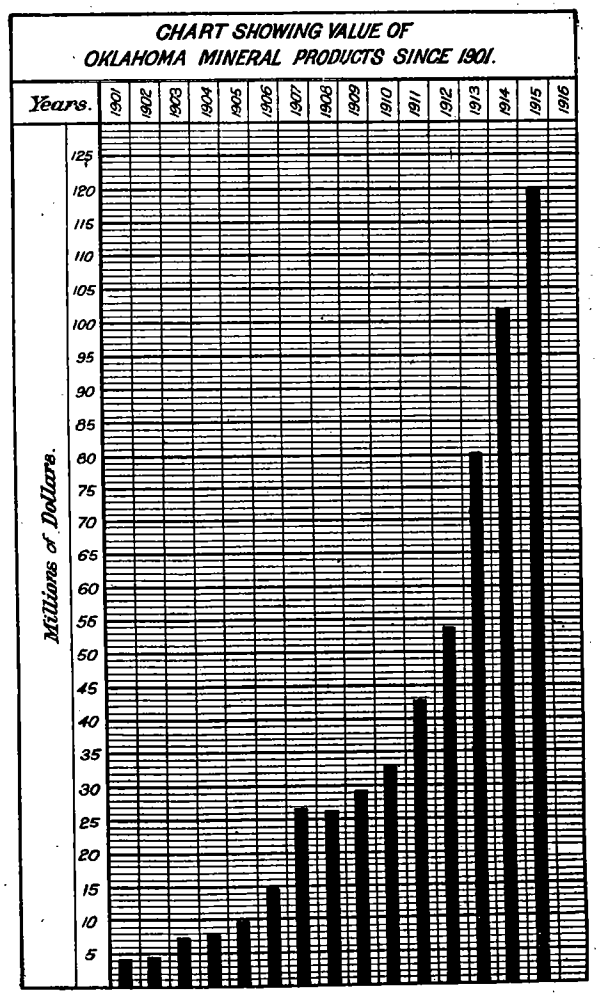


Figure 7.

rock through which they cannot pass. This rock is in most places a shale and is called a *cap rock*. The arches or crests of the folds in which gas and petroleum may be collected are called *anticlines*, and the troughs between the anticlines are called *synclines*. The porous rock in which the gas and petroleum collect is the *reservoir rock* or *oil sand*. All these features are shown in the accompanying figure. In general, the gas accumulates in the tops of the folds, that is, along the crests of the anticlines; the petroleum is found farther down the slope; and the salt

water still farther down the slope, and in the synclines. This regular arrangement may be greatly complicated by the difference in thickness and porosity of the oil sand, and other factors.

Petroleum and natural gas are obtained by drilling wells. The outfit used in drilling in Oklahoma is called the standard or "churn drill" rig. It consists of a derrick about 80 feet high, with pulleys at the top, and large windlasses at the base to handle the wire or rope cable. The *tools* consists of a long *drill stem,* at the lower end of which is fastened the *bit.* This is sharpened so that as the stem is raised and lowered a short distance in the hole the rock at the bottom of the hole is chipped or ground away. The ground rock or "drillings" is removed by a *baler,* which is a long cylindrical bucket with a valve at the bottom. Besides the derrick there is an engine and boiler to furnish power and gearing, and beams to raise and lower the tools and baler, and to give an up and down motion to the tools when drilling. Water is kept from entering the hole and the walls kept from caving by "strings" of cast iron pipe or *casing.* Wells in Oklahoma are started with casing 12 to 16 inches in diameter. As the well is deepened, the difficulties of drilling increase and strings of smaller casing are placed inside the larger one. There are usually three or four strings of casing in a well when it is finished.

When petroleum is encountered it may flow from the well with great force, making a gusher or flowing well. (Pl. XXIII.). Other wells may not flow and may have to be pumped by pumps especially built for this purpose. From the wells the petroleum flows or is pumped into 2-inch pipes which conduct it to large storage tanks or to loading racks along a nearby railroad. From the larger storage tanks it is pumped into large pipe-lines, through which it is conducted to refineries which may be hundreds of miles distant.

The principal petroleum fields of Oklahoma are in the northeastern part of the State, in the region of Pennsylvanian rocks. These rocks consist of shales, sandstones, and limestones, which have a general westward dip away from the Ozark uplift in the northeastern corner of the State. The general dip is interrupted in many places by gentle folds, in the anticlinal parts of which the petroleum accumulates. Some of the sandstones and limestones are porous and form the reservoir rocks of oil sands. The shales are fine-grained and tight and form the cap rocks. Some of the oil sands are of considerable extent. For instance, the Bartlesville sand is known to extend over hundreds of square miles, while others are relatively small, lenticular masses, which are productive only in a single locality.

The productive petroleum and natural gas pools are shown on the accompanying map. (Map showing location of oil and gas fields).

All the important petroleum producing pools, except one, lie in what may be called the main oil and gas field, which includes the following counties: Nowata, Rogers, Wagoner, Muskogee, Okmulgee, Creek, Tulsa, Washington, Osage, Pawnee, and Kay. The one important pool outside

FLOWING WELL IN THE CLEVELAND FIELD. THE INITIAL CAPACITY OF THIS WELL WAS ABOUT 12,000 BARRELS PER DAY.

this area is the Healdton pool in Carter County, south of the Arbuckle Mountains. Minor pools are those near Madill in Marshall County, Ada in Pontotoc County, and Lawton in Comanche County.

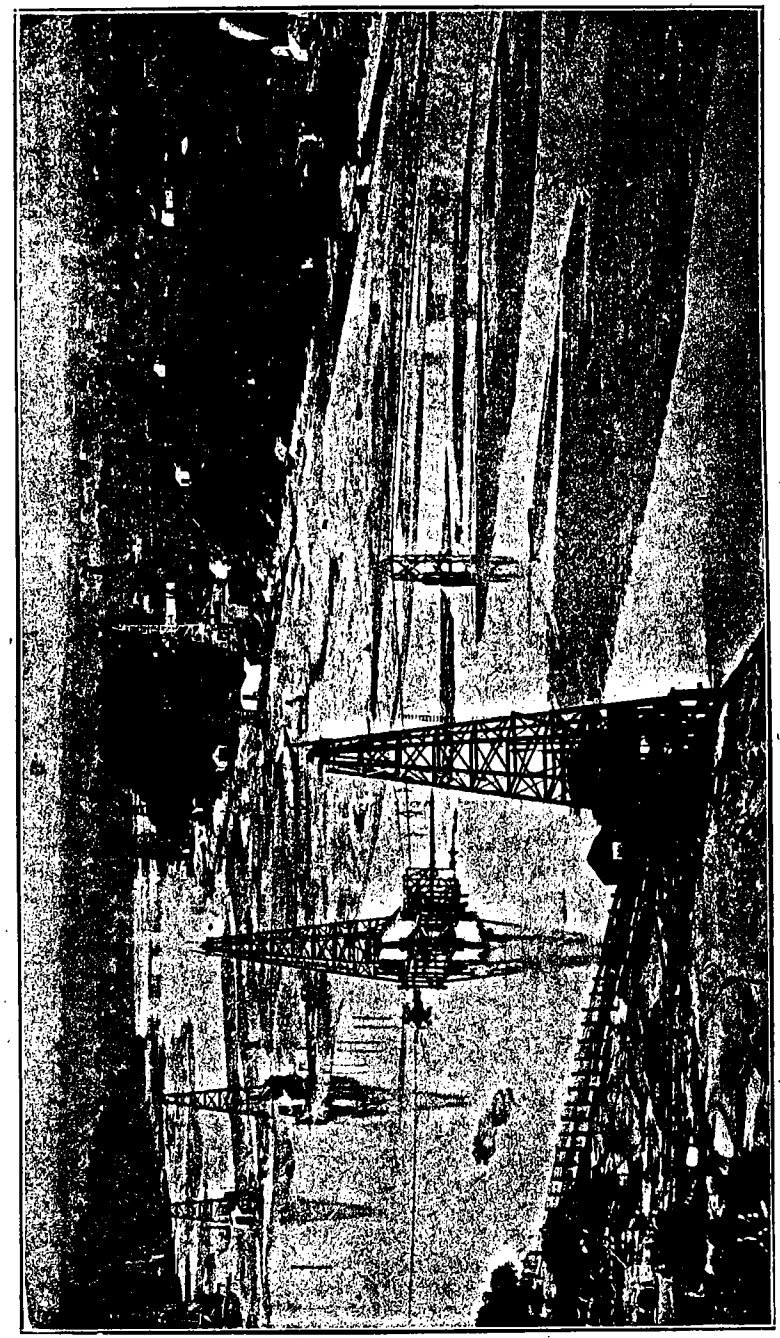
Some of the important pools are: Coody's Bluff-Alluwe and Delaware-Childers in Nowata County, Dewey-Bartlesville in Washington County. Bird Creek in Tulsa County, Glenn and Cushing in Creek County, Morris and Bald Hill in Okmulgee County, Cleveland in Pawnee County, and the Newkirk and Blackwell in Kay County. Minor pools are near Billings in Noble County, and Garber in Garfield County.

The Glenn and Cushing pools in Creek County have been the most important of all, both in amount of petroleum produced and the effect on the markets. The Glenn pool was discovered in 1906, and the production was soon greater than could be handled by the markets. The price fell to 41 cents per barrel and remained at nearly that figure for over three years. From 1907 to 1914, inclusive, the Glenn pool produced a grand total of over 120 million barrels. The Cushing pool was discovered in 1912, but it was the close of 1913 before the deep sand (Bartlesville) was discovered, and a rush of development started that soon eclipsed the Glenn pool at its maximum. The production rose to about 300,000 barrels per day, and the market was so flooded that the price of petroleum dropped from $1.05 per barrel to 40 cents per barrel within a few months. The pool then declined greatly in production, and as a result of this, together with unusual market conditions and increased demand, the price of oil has risen to $1.70 per barrel.

The specific gravity of Oklahoma oils varies from 22° to 48° Baume. The heavier oils are found in the southwestern producing areas of the State. While the amount of oil produced in the Madill region is small, its quality is the highest of any produced in the State. The price of oil is dependent to a large degree upon the specific gravity and the base of the oil, that is, whether the base is asphalt or paraffin, the latter being the more valuable for refining purposes. The oil from the Wheeler and Healdton districts have an asphaltic base, while those of the northeastern part of the State are chiefly of paraffin base. This accounts for the difference in price of crude oil from the two sections. At the present time the oil of northeastern Oklahoma is selling for $1.70 per barrel, while that from the Healdton district is listed at 90 cents per barrel.

The Oklahoma petroleums are in general fairly light oils of good refining quality. A large part of the production is refined at plants located within the State. There are about 25 refineries in the State with a capacity of over 50,000 barrels of crude petroleum per day. By far the greater part of the production is carried through large pipe-lines to refineries in Texas, Kansas, Missouri, Indiana, and New Jersey. For several years Oklahoma ranked second to California in the production of petroleum, but, on account of the greater value of the Oklahoma oil, has stood first in the value of production. However, during the past three years Oklahoma

PLATE XXIV.



OIL AND GAS DEVELOPMENT IN BED OF CIMARRON RIVER, NORTH END OF CUSHING FIELD.

has ranked first in production as well as in value.

The following table shows the production value and average price per barrel of petroleum in Oklahoma from 1901 to 1916.

The future of the petroleum industry in Oklahoma cannot be foretold at present. The main field has been pretty well tested, and it is improbable that any new pools of the magnitude of the Glenn or Cushing will be discovered, although such an event is within the range of possibility. It is entirely possible that other pools resembling the Healdton pool may be found in the region south of the Arbuckle Mountains, and there is also a possibility of the extension of the main field to the west.

There are certain areas in the State where there is no probability of petroleum being found. These are the Ozark, Ouachita, Arbuckle, and Wichita mountains; a large area in the east-central part of the State; and a considerable part of the Redbeds area in western Oklahoma.

The probable producing territory for both petroleum and natural gas is shown on the accompanying map.

NATURAL GAS.

Natural gas occurs closely associated with petroleum. Many wells produce both substances, and all the petroleum pools mentioned above produce great quantities of gas from wells producing no petroleum. In a considerable area in eastern Oklahoma gas is produced in several localities where petroleum has not been found, as at Spiro, Poteau, Red Oak, Stigler, and Quinton.

In the early days of the petroleum industry in the State, there was little or no market for the gas and enormous quantities were wasted.

More recently the market for gas has greatly increased and, although the waste is still considerable, it is much less than it formerly was. Some 130 towns and villages in Oklahoma are supplied with natural gas and millions of cubic feet are piped daily to towns and cities in Kansas and Missouri. The rapid drawing of the gas from the wells causes them to decline very rapidly and some of the older fields are nearing exhaustion. However, recent developments, especially the finding of enormous quantities of gas in the shallower sands of the Blackwell field, make it certain that it will be several years before the field as a whole is exhausted.

COAL.

The coal fields of Oklahoma lie in the east-central and northeastern parts of the State. In the east-central part there are seven workable veins of coal, the two Hartshorne coals, the two McAlester coals, the Cavanal coal, and the two Witteville coals. The lower Hartshorne coal lies above the Hartshorne sandstone, and is separated from the upper vein by 50 feet of shale. The McAlester coals lie about 2,000 feet higher

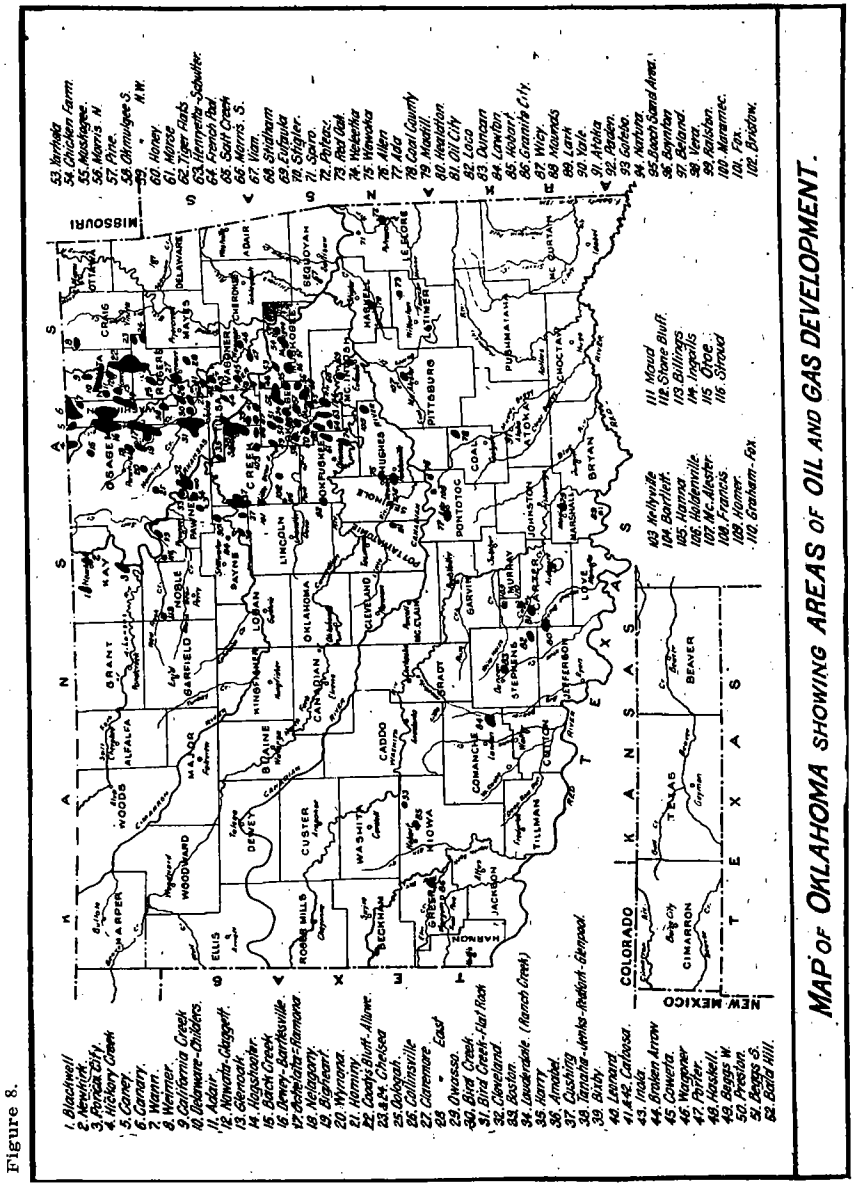


Figure 8.

stratigraphically, and are separated from each other by shale. These found beds extend southwest to the vicinity of the Arbuckle Mountains, where, from the towns of the same names, they are known as the Atoka and Lehigh coals. They are high-grade bituminous coals, locally altered to a semi-anthracite. The Hartshorne coals are each from 2½ to 7 feet in thickness, and the McAlester coals are each from 2 to 4½ feet thick. The Cavanal coal, 2 to 3 feet thick, occurs only in the eastern part of the district, and is mined at Poteau. The Witteville coals are 2½ to 4 feet thick, but contain partings of bone coal. They have been worked very little.

The rocks of this area have been strongly folded and there are many faults. Owing to the steep dip of the rocks the McAlester and Hartshorne coals, although separated by 2,000 feet stratigraphically, often outcrop within a short distance of each other, and both are mined at several towns, such as McAlester, Hartshorne, Wilburton, and Lehigh.

These beds extend to the north of the Canadian River, but become thinner and lie nearly level. In this region there are two higher veins of coal; one, a rather soft, bituminous coal, 3 feet thick, is mined at Dustin, Henryetta, Morris, Broken Arrow, Catoosa, and other places. The highest coal occurs in Tulsa and Creek counties. It is a bituminous coal 2½ to 3½ feet thick. It is mined at Collinsville, Dawson, Tulsa, and Red Fork. The greater part of this coal is worked by strip-pits rather than shaft mines.

The coal in east-central Oklahoma is in the territory formerly owned by the Choctaw and Chickasaw Indians, and before the land was opened to settlement the coal lands were surveyed and segregated. It was planned to sell the lands to the highest bidder, but the Secretary of the Interior rejected all bids, so that the title remains in the Indian tribes. The lands are leased to the operating companies on a royalty basis. Some of the thinner outcrops, and the coals to the north were not segregated, and are owned principally by the operating companies.

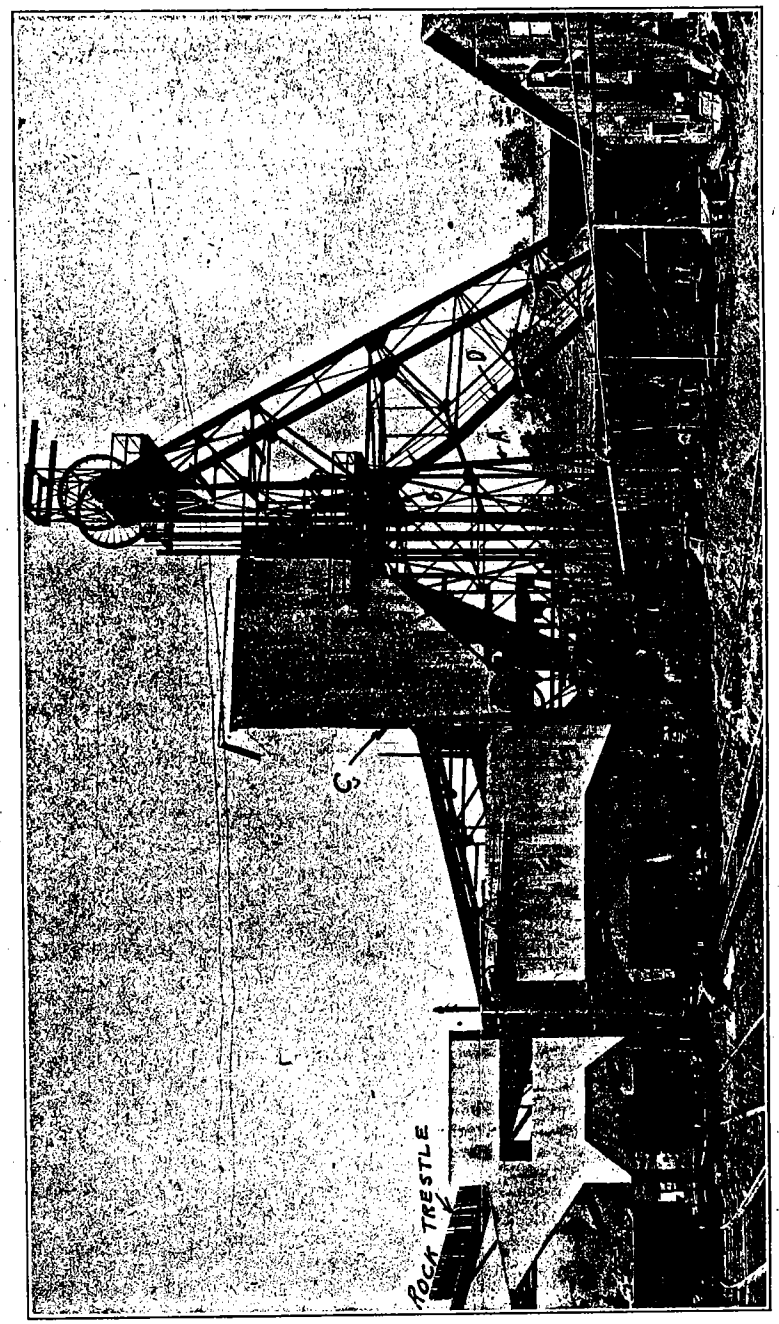
The production of coal in Oklahoma began in 1872, and reached a maximum in 1907, when 3,642,658 tons were produced. The production in 1915 was 2,990,450 tons.

There has been very little progress in the coal mining industry in the State for several years. Several causes contribute to produce this condition, the principal ones being the high cost of mining the steeply inclined beds; the great competition of coal from Arkansas, Colorado, and New Mexico; labor conditions; and high freight rates.

ASPHALT.

Asphalt is the residuum left by the escape and evaporation of bodies of asphaltic base petroleums. It is made commercially when asphaltic base petroleums are refined, and it seems fair to presume that the natural deposits are made in a similar manner. That is, a bed of rock containing oil is brought so near the surface or is cut by a fault so that

PLATE XXV.



SHOWING STEEL TIPPLE, SCREENS, AND LOADING CHUTES AT ROCK ISLAND MINE NO. 8, NEAR ALDERSON.

the oil can escape to the surface. The gases and lighter oils escape into the atmosphere leaving the residual deposit of heavier, more viscous components of oil. These form what we know as asphalt. Asphalt occurs widely distributed in southern Oklahoma in rocks of different ages. In the Arbuckle Mountains the deposits are found in the Simpson and Viola formations of Ordovician age. In these deposits the asphalt is found impregnating sandstones, limestones, and shales. Southwest of the Arbuckle Mountains, near Woodford, and south of Ardmore, are some important deposits in which the asphalt impregnates the sandstones standing almost perpendicular. Other important deposits are in southeastern Stephens and northeastern Jefferson counties, near Loco. Around the Wichita Mountains several deposits are known, there being large quantities near Lawton, Hobart, and Gotebo. Many deposits of commercial value are known at various localities in the Trinity sand area of the Red River region. Two deposits of pure asphalt are known in the Ouachita Mountain region. One deposit known as the Jumbo mine is northwest of Antlers, another is near Tuskahoma and a third not far fro Page. In these deposits the asphalt occurs as a vein which was formed probably along a fault plane. It is presumed that the fault cut petroleum bearing beds beneath and that the escape to the surface gave rise to the residuum of asphalt now forming the vein. These asphalts have undergone considerable metamorphism and stand in the same relation to other asphalts that anthrancite does to coal, that is, most of the volatile matter has escaped and the substance remaining is very high in fixed carbon. Material from the Jumbo deposit has the appearance of a soft, bituminous coal, while that from the deposit near Tuskahoma has a glassy lustre and conchoidal fracture. In general appearance it greatly resembles hard coal, but has a greenish lustre and a much less specific gravity.

The rock asphalts, that is, limestone and sandstone, impregnated with asphalt have been used on a considerable scale for paving. The streets of many of the towns of Oklahoma and northern Texas, as well as some towns in Missouri and southeastern Kansas are paved wholly or in part with this material. For use the materials are assorted so as to give the proper proportion of asphalt. The sandstone asphalt and limestone asphalts are ground, mixed together in the right proportions, heated and rolled on to a proper base, as is done with the Trinidad or Artificial asphalt. In general the pavements have given excellent satisfaction, although in some cases the percentage of asphalt carried by the rocks seems to have been too small to give long life to the pavement. The natural variation in the texture of the rock which the asphalt imparts and the variation in percentage of asphalt carried by the rocks makes it difficult to secure a uniform composition in the finished product. The pure asphalts from the Ouachita Mountain region are not fit for use as paving materials, being too low in volatile constituents and consequently too brittle. They are used principally in the manufacture of asphalt varnishes, paints, waterproofing, and insulating materials.

Value of asphalt in Oklahoma, 1903-1914.

Year.	Value.	Year.	Value.
1903	$28,150	1909	$48,130
1904	37,516	1910	65,244
1905	27,790	1911	.....
1906	18,461	1912	.....
1907	20,770	1913	91,416
1908	23,820	1914	73,535

LEAD AND ZINC.

Ores of lead and zinc have been found in several localities in Oklahoma, but in only two places have there been sufficient amounts discovered to make it profitable to mine them. The most important locality is in Ottawa County, the northeasternmost county of the State, where the lead and zinc mining has become an important industry. The other district, which produces only zinc, is in the Arbuckle Mountains, west of Davis in Murray County. Small quantities of lead have been found near Lawton in Comanche County, near Ada in Pontotoc County, and in some of the counties in the Ouachita Mountain region.

Lead and zinc do not occur in nature as the metals themselves, but as ores or compounds with other substances. The principal lead ore is *galena,* a compound of lead and sulphur which has the color of lead, but which is brittle, breaking readily into small cubical blocks instead of being soft and malleable as the metal is. The principal zinc ore is a compound of zinc and sulphur known to geologists as sphalerite, or zinc-blende, and to the miners as "jack." It is a substance having a resemblance to resin, and no resemblance to either zinc or sulphur.

Lead and zinc ores are not generally evenly distributed throughout very large bodies of rock, but are found in veins or "runs." These are bodies of rock in which the cracks and crevices are filled with ore, while the rock around the run contains little or no ore. The runs may be almost any shape or size, but those in Oklahoma are generally nearly straight. The thickness varies from 4 or 5 to 30 feet, or even more, and the width from a few feet to 100 yards or more. The longest run known in Oklahoma, the principal run of the Miami camp in Ottawa County, is over 2 miles long, but most of them are much shorter than this.

The runs of ore sometimes occur at the surface and are found there by prospectors. This is the case with the Arbuckle Mountain zinc ore. In Ottawa County, however, the ore bodies are at considerable depths, 100 to 400 feet, beneath the surface. The first step in developing a mine in a region which is supposed to contain lead and zinc is to prospect or determine whether any runs of ore are present and, if so, their thickness and extent. Prospecting is usually done by drilling a large number of holes with a well-drilling machine. The rock cuttings removed from

PLATE XXVI.

SHOWING UNDERGROUND WORKING IN LEAD AND ZINC MINE, OTTAWA COUNTY.

the well are observed closely, and in this way the thickness of the ore body and nature of the ore can be told. A large number of holes will show whether the ore body is wide enough and long enough to make mining of it profitable.

After an ore body has been located a shaft is sunk to it. This shaft is merely a large dug well, 8 or 10 feet square. Then from the bottom of the shaft the rock with its ore is lifted out of the top of the shaft in large buckets fastened to a wire rope which is wound up on a winding

drum stationed in a building several feet above the top of the shaft. Large entries or rooms are made in the ore body, beginning at the bottom of the shaft, by drilling holes into the rock, filling them with dynamite and blasting the rock to pieces. The broken rock is shovelled into the large buckets and hauled to the foot of the shaft on small cars and steel tracks, and elevated.

At the top of the shaft is a large building equipped with crushing, grinding, and screening machinery. The rock is crushed and ground until the largest pieces are less than an inch in diameter. This breaks out the small bodies of ore which are scattered through the rock. The small pieces of ore are then separated from the pieces of rock by washing both together over screens with a strong stream of water. The ore is heavier than the rock and works down and falls through the screens, while the rock pieces are carried on faster by the water, washed over the screens and into an elevator, which carries them on to a place outside of the mill.

If mining conditions are favorable, rocks containing only a small percentage of ore can be worked with a profit. Some of the mines produce only 2 or three tons of ore from 100 tons of mined rock, and 10 tons of ore from 100 tons of rock is a very good yield.

The great mining region known as the Joplin district, from its principal town, includes the southwestern portion of Missouri, southeastern Kansas, and northeastern Oklahoma.

The Oklahoma portion of the Joplin district lies in the northern part of Ottawa County, in the extreme northeastern part of the State. Miami is the principal town of the county and the region is often called the Miami district, although other towns have been built in the fields. Carden, Pitcher, and Century are three towns which have sprung up in that region on account of the ore deposits. Commerce is connected with Miami by a short independent railroad.

The oldest mining camp in Ottawa County is at Peoria, where mining operations took place as early as 1890. At that time the distance from market and the transportation facilities so hindered the operation that little work was done. Later, when the railroad passed nearer Peoria, operations were renewed. Some good lead ore and one kind of zinc ore were found in shallow diggings. However, operations here are not as extensive as they are a few miles to the west.

The camp at Lincolnville was opened in 1903 and was strongly "boomed" prior to 1907. However, about that time the main deposits were worked out and the town dwindled away from 1,200 to 200. Since the beginning of the European war the price of both zinc and lead has been so high that prospecting has been very active, and renewed prospecting by drilling has taken place. Many new and promising ore bodies have been opened and six large mills are now operating.

The Miami camp was opened in 1907 and very rapidly became the most important camp in the county, and for some years past has been one

of the leaders in the whole Joplin district. The ore occurs in a series of runs extending in a general north-south direction from about 4 miles north of Miami to the Kansas line. The grade of the ore, i. e., the percentage of concentrates, is the highest of any large camp in the Joplin district, but the concentrates themselves are of rather low grade, containing considerable iron. The history of the camp since its opening has been one of steady progress northward from the original shafts at the south end of the camp.

Besides the Ottawa County deposits lead has been reported from various localities in southeastern Oklahoma, from Ada, and from near Lawton. Some shipments of zinc ore have been made from mines in the Arbuckle Mountains west of Davis. None of these localities have proved to be commercially important.

BUILDING STONES.

GENERAL STATEMENTS.

Oklahoma is well supplied with building stones of several varieties, but the distribution is somewhat irregular. Practically all of the better materials which may be used for building stone are confined to the eastern half of the State. The Wichita Mountain region is the only territory in the western part of the State which has any great supply of building material.

The qualities desired in a building stone vary greatly with the use which is to be made of the stone. For such work as foundations, bridge piers, and abuttments, the color is of little importance, but for exterior work in large buildings the color may be the deciding factor in the choice of the stone. Naturally, pleasing color must be associated with other qualities which fit the stone for use, but it does not matter how durable, nor what other good qualities the stone may possess, if it does not have a pleasing color it will not be considered a very valuable building stone. Besides the color, other important qualities are: hardness, which greatly affects the cost of quarrying and dressing the stone; and porosity, which influences the durability or life of the stone in buildings. The greatest cause of deterioration of stone in buildings is the freezing of water in the pores of the rock. A rock may be quite porous and yet be durable if the pores are large, so that when the water freezes the ice may easily push out from the pores. Thirdly, the crushing and tensile strength must be sufficient for any use which may be made of the stone. Very few stones fail in this respect.

The different varieties of building stone which occur in Oklahoma are the granites, limestones, marble, and sandstones.

A. GRANITE QUARRY AT TROY, JOHNSTON COUNTY. THE GRANITE USED IN THE STATE CAPITOL BUILDING IS FROM THIS QUARRY.

B. LARGE GRANITE BOULDERS OF TISHOMINGO GRANITE ON BENNINGTON CREEK, NEAR TISHOMINGO.

GRANITE.

Granites* occur in enormous quantities in the Arbuckle and Wichita mountains. The granites of the Arbuckle Mountains occur in the portion of the mountains east of Washita River. The commercial granites of the region are chiefly in Johnston County, but an area of a few square miles occurs in Atoka County. There are two distinct types of granite in this district. In the central portion, bounded roughly by Blue River on the east and Rock Creek on the west, there is a coarse-grained, pinkish-gray, biotite granite. The remainder of the main area is composed of a fine-grained, pinkish-gray, biotite granite. The granite is generally fresh within a short distance of the surface, and quarrying conditions are favorable. Only a small portion of the granite area is near transportation. Little use has been made of this granite so far, although quarrying has been conducted on a small scale at Tishomingo and Troy. The Capitol Quarry from which stone was quarried for the State Caiptal near Troy.

The granites of the Wichita Mountains vary greatly in color and texture. In the main portion of the mountains extending northwest from Lawton the granite is a medium-grained pink granite. No use has been made of the granite from the Wichita range proper up to the present time. In the vicinity of Cold Springs the granite is light to dark gray in color. Some of the rock is really gabbro and diabase rather than granite. This stone has been quarried at Cold Springs and near Roosevelt. A bright rose-red granite has been quarried to a limited extent near Mountain Park. The largest granite quarries in the Wichita Mountains are at Granite on Headquarters Mountain. The granite here is a very uniform, medium-grained, brownish-red granite. It occurs under conditions very favorable for quarrying, and has been used in the State to a considerable extent for building and monumental purposes.

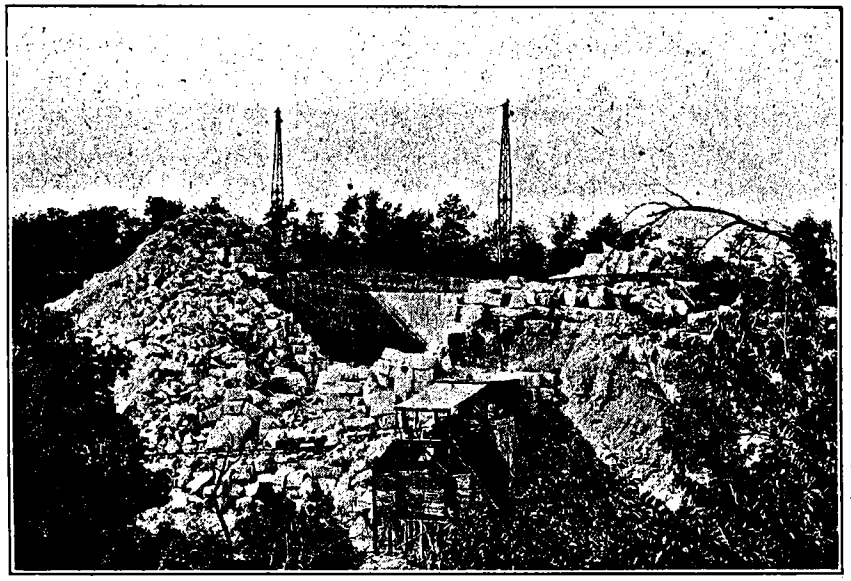
Plans have been made at different times to quarry the granite from a small dike near Spavinaw in Mayes County, but the stone is so far removed from a railroad that it is almost impossible to utilize it under present conditions.

LIMESTONE.

Limestones occur in five distinct areas: (1), in the northeastern portion of the State, a large, irregular area; (2), the Red River or Cretaceous limestone area in the southeastern part; (3), the Arbuckle Mountain region; (4), the Wichita Mountain region; and (5), a single formation extending north and east from the Arbuckle Mountains to the Arkansas state line.

Almost any of the limestones in the northeastern region are suitable

*For full discussion of the granites of Oklahoma See Bull. No. 20 Okla. Geol. Survey, by C. H. Taylor.



A. VIEW OF WAPANUCKA LIMESTONE QUARRY AT BROMIDE.

B. VIEW OF MARBLE QUARRY NEAR MARBLE CITY.

for use in local structure, but none of them possess any striking qualities of appearance or workability which render them of any great importance.

The limestone of the Arbuckle and Wichita mountains are of great thickness but in general are so badly cracked and checked by the forces which folded the mountains that they are of value only for crushed stone, or possibly Portland cement.

The limestones in the Red River area are rather irregular in bedding and most of them contain a considerable percentage of clay which lessens their durability. It is not probable that any important industry can develop in this limestone area, although the stones are and will be used considerably for local purposes.

The Wapanucka limestone, which extends from the Arbuckle Mountains northeast to the State line, is one of the most important limestones, economically, in the State. It is the subject of Bulletin No. 23 of the Oklahoma Geological Survey, by B. F. Wallis. Locally, near the town of Wapanucka this limestone resembles very closely in appearance, texture, and hardness, the Bedford limestone of Indiana and Kentucky. This has been quarried on considerable scale between Bromide and Wapanucka.

MARBLE.

Marble has been quarried near Marble City in Sequoyah County. The marble occurs here in a very thick bed from which it may be quarried in blocks as large as may be desired. The material is a gray to pinkish crystalline limestone of very pleasing effect when polished. When left with a rough surface it makes an excellent building stone for exterior work, but is too soft to retain a polish when used this way. When polished it is a very excellent material for interior work.

SANDSTONE.

The sandstones of the eastern portion of the State are generally uniformly grained, fairly well cemented, and of a neutral brown color. They have been used for a good many buildings locally, and also for bridges and foundations. None of them possess any striking features of texture or color which render them of especial importance. No large quarries have been opened and it is very improbable that the sandstone industry will attain much importance in the State, although the value of the sandstone for local use is very great. The sandstones of the western half of the State are generally brick to deep red in color and very fine-grained and quite soft. Although they have been used to some extent locally they are not to be recommended when better material is available, as it generally is.

SANDSTONE QUARRY AT COALGATE.

BUILDING SAND AND GRAVEL.

Building sand is widely distributed in Oklahoma. All of the streams of the western part of the State have their channels choked with sand. Rows of sand hills also occur along these streams.

In eastern Oklahoma and in the mountain regions the sand has been derived from the decay of the sandstone in those regions. Some of the sandstone ledges are so soft that sand may be dug directly from the ledge. There is enough good sand throughout the State to furnish an abundant supply for all mortar, cement, and plaster.

Gravel consists of pieces of broken stone. Much gravel is found in the State cemented together into masses. This form of material is called conglomerate. Large quantities of gravel occur along the streams from the Ozark, Wichita, and Arbuckle mountains, and the Flint Hills in Osage County. Much of the gravel from these regions is being used over the State. It is excellent material for concrete work, railroad ballast, and road materials.

LIME.

One of the uses of limestone is for the manufacture of lime. The process is accomplished by burning limestone in furnaces or kilns. Water

and carbon dioxide (CO_2) are expelled. Lime is used for making mortar, plaster, cement, bleaching powders, sandlime brick, and many other products. The use of lime as a fertilizer has become of considerable importance. Agricultural chemists have shown that there are 5 or 6 different functions which lime may perform for the benefit of soil. The question whether lime should be applied to the soil as quicklime, hydrated lime, air-slacked lime, or ground limestone is still the subject of a great deal of controversy. In each case, however, the local conditions must be considered carefully before a final conclusion can be reached. The limestone from which lime is made should be fairly pure in order to obtain the best results.

The first record of lime production on a commercial scale in the State was in 1902 when an output of about 25 barrels was reported. The industry gradually developed until 1910 when there were 8 plants in the State, one in each of the following counties: Atoka, Coal, Comanche, Delaware, Dewey, Johnston, Nowata, and Pawnee. Since 1911 not more than 4 of the plants have been in operation; those reporting production for 1911 to 1916 being in Coal, Comanche, Delaware, and Johnston counties. During the first half of 1916, only two were in operation, one at Grove, Delaware County, and the other near Bromide, in Coal County.

There are several limestone formations in the State which are admirably suited for the burning of lime. In the south and southeastern parts, the Arbuckle, Hunton, Viola, Wapanucka, and Goodland limestones have been used. In the north-central and northeastern part, the Mississippi lime or Boone chert is of value. In the Pennsylvanian area of the State from 8 to 10 limestones would prove suitable, and in the Permian of Kay County 2 or 3 would be of value.

CLAY PRODUCTS.

Clays and shales occur abundantly in nearly all parts of the State. In general the shales in the eastern half of the State are clay shales of dark gray to greenish or black in color. Many of these shales are of good working properties and will burn at comparatively low temperatures to some shade of red. No high grade fire clays or pottery clays have been found. Some of the shales associated with the coals in the east-central part of the State are of sufficiently high grade for the manufacture of sewer pipe or terra cotta. This section of the State is well supplied with railroads and with abundant and cheap fuel. Several brick plants have been established and have met with a fair degree of success, but the clay industry has not attained the importance that the advantages of the section in transportation and fuel seem to warrant. The principal plants are at Cleveland, Collinsville, Boynton, Muskogee, Tulsa, Bartlesville, Okmulgee, and McAlester. Smaller plants are located at several towns and villages. The shales in the western part of the State are all fine-grained clay shales of a red color. These possess

good working properties, although the plasticity and drying shrinkage are rather high. The region is so far removed from fuel and from the building centers that the shales are utilized only in small plants for local use.

The only clay products produced in the State are common building and paving brick. At the present time, there are 35 clay plants in the State. The following table shows the value of the clay products since 1900:

Value of clay products in Oklahoma, 1901-1914.

Year.	Value.	Year.	Value.
1901	$ 322,284	1908	$ 562,929
1902	403,649	1909	1,032,314
1903	534,977	1910	920,921
1904	531,024	1911	756,639
1905	596,299	1912	535,318
1906	540,901	1913	573,371
1907	664,512	1914	786,314

PORTLAND CEMENT MATERIALS.

Portland cement is a mixture of mineral substances, which, on the addition of water, hardens to an artificial stone. It is seldom used pure but is added to sand, gravel, or crushed stone, when it forms a bond uniting the larger particles into a solid mass. Portland cement has the advantage over other cements of hardening or "setting" under water. It was first made in England and the name came from the resemblance of the hardened cement to the famous building stone from Portland in that country.

Portland cement is made essentially of a calcareous material, generally limestone, and clay or shale. Any fairly pure limestone and shale or clay will make Portland cement, but, naturally, the quality of the product is dependent on that of the materials. To make the best Portland cement the raw materials must be low in silica, magnesia, and sulphur, must contain some iron, but not enough to make the iron content in the finished cement over 4 per cent. Too much iron gives the cement a dark color. In addition to the proper chemical composition, the materials should be physically suitable, for the expense of preparing the materials depends on their physical characters. For instance, a hard, crystalline limestone and a slaty shale would be much harder to grind, and, consequently, much more expensive to prepare than a soft limestone or marl and a soft clay.

The process of making Portland cement is quite simple, but when conducted on a large scale requires a very expensive equipment of machinery. The limestone from the quarry and the clay from the pit are carefully dried, then ground separately to extreme fineness, mixed in the proper proportions—determined by their composition—and burned

in large rotary kilns to a semi-vetrified mass or "clinker." The clinker is cooled and ground to extreme fineness, then packed in barrels or sacks ready for the market.

Portland cement is manufactured at three localities, Dewey in Washington County, Ada in Pontotoc County, and Hartshorne in Pittsburg County. The value of the production is over $1,000,000 annually.

GYPSUM.

Gypsum is used principally in the manufacture of wall plasters. Chemically gypsum is hydrous calcium sulphate ($CaSO_4 \cdot 2H_2O$). When heated it loses part of the water and becomes ($CaSO_4 \cdot H_2O$). That is, it loses one-half of its water of crystallization. The resulting substance is a white powder which is known as plaster of Paris. This has the property, when mixed with water, of taking up again the same amount of water as it lost when heated and recrystallizing to form gypsum. It is thus very valuable for the formation of casts and models. Gypsum in nature is generally impure and the plaster made from it has usually a greenish or pinkish tinge. When mixed with sand and hair it makes the ordinary wall plaster of commerce.

Gypsum occurs in nature in three distinct forms: a non-crystalline or very finely crystalline form, rock-gypsum; a crystalline form with the crystals platy, selenite; and a crystalline form in which the crystals are needle-shaped, satinspar. Gypsum is a very soft mineral, usually white or slightly colored by impurities to gray, blue, red, or green. It may easily be distinguished from other common minerals by softness, being easily scratched by the thumb nail.

The manufacture of gypsum products is quite simple. The material is quarried or mined, crushed and ground to a fine powder, fed into large iron kettles, and heated until the proper amount of water is driven off. The material must be constantly stirred while being heated. If heated to too high a temperature all the water is driven off and the resulting plaster is said to be "dead burned." It then takes up water with extreme slowness and is of no value as plaster.

All the forms of gypsum occur in abundance in western Oklahoma. The distribution has already been noted in the section on physiographic provinces under Gypsum Hills region. Persistent ledges of gypsum form pronounced escarpments along the south side of Cimarron River from north of El Reno northwest to the Kansas line with a considerable area north of the Cimarron in Woods County. The amount of gypsum in this region is inexhaustible, although much of it is unavailable at the present time on account of lack of transportation. In the south and southwest gypsum regions there is also an enormous amount of gypsum, but in most cases it is not so well situated in regard to transportation and quarrying as several localities in the north along the main line of gypsum hills. Associated with the Gypsum Hills are considerable deposits of a gypsiferous clay which is known as gypsite. This usually

lies in valleys or flats below the gypsum ledges. It is probably formed by the water which percolates through the gypsum coming down to the floor of the valley and evaporating from the surface leaving its gypsum in a very fine crystalline form mixed with the clay of the valley floor. This gypsite is of great value in the manufacture of plaster, since it is very easily obtained and requires no grinding before it is heated. Large gypsite deposits are in Blaine, Custer, and Jackson counties. Plaster mills for the manufacture of plaster are located at Eldorado in Jackson County, at Rush Springs in Grady County, at Watonga, Okeene, Bickford, Southard, and Darrow in Blaine County, and at Alva in Woods County.

While the deposits of gypsum in Oklahoma are inexhaustible and the raw materials can be very easily obtained, the high cost of fuel in the region and the distance from important building centers makes competition with more favorably located deposits very difficult. None of the plants in Oklahoma have been running to capacity for considerable time and some of them have not been operated for the last four or five years.

The following table gives the value of the production of gypsum plasters in Oklahoma since 1900.

Value of gypsum products in Oklahoma, 1901-1914.

Year.	Value	Year.	Value
1901	$ 66,031	1908	$288,000(e)
1902	111,215	1909	370,000(e)
1903	234,521	1910	451,000(e)
1904	190,245	1911	293,203
1905	200,000(e)	1912	268,618
1906	356,000(e)	1913	330,416
1907	404,000(e)	1914	312,856

(e) Estimated.

SALT.

Salt may be obtained commercially from the salt plains in the western part of the State. A large area on Salt Fork of Arkansas River east of Cherokee in Alfalfa County is known as the Cherokee Salt Plain. It is a flat plain about 30 square miles in area. Except at very wet times the entire surface of the plain is covered by a thin crust of salt. Brine is encountered in the plain at depths ranging from a few inches to two feet. The amount of salt which could be obtained from this plain is very difficult to estimate, since no tests have been made in the way of sinking wells to determine the amount of brine which could be pumped from them. However, there is no question that vast amounts of salt could be obtained here.

A short distance south of the Kansas line there are two important

salt plains, one on the Woods County and one on the Harper County side of Cimarron River. These are known as the Little and Big Salt plains. Both are fed by brine springs. The Big Salt Plain on the Harper County side is more important and is fed by springs of large volume. One spring flows thousands of gallons per minute, and there are several smaller ones. On this plain, especially during dry weather a crust of pure salt sometimes forms in the vicinity of the springs to the depth of six inches or even more. The quantity of salt available here is undoubtedly sufficient to supply a large plant but it is so far removed from transportation that it is impossible to utilize it at present.

The Ferguson Salt Plain is on Salt Creek west of Ferguson in Blaine County. This is fed by springs coming from the Redbeds beneath the heavy gypsums of the Blaine formation. The brine is not so thoroughly saturated as is that at the Big Salt Plain and the crust of salt over the surface of the plain is much thinner. However, a very large amount of salt is going to waste at this locality. A few years ago a small plant was built at Ferguson to utilize this brine. Water was carried to Ferguson in pipes and a small but complete plant was arranged. However, it was abandoned after a short time and the machinery was removed. Another similar, though smaller plant is near Carter in Beckham County. The springs come from Redbeds beneath gypsum ledges. There are two large salt plains on Elm Fork of Red River in the extreme northwestern part of Harmon County. The conditions here are similar to those of Carter Salt Plain, that is, the salt plains issue from the Redbeds below the lowest Greer gypsums. Each of these plains, which are known as the Chaney and Kiser could supply a very large quantity of salt, but like the plains on Cimarron River they are too far from transportation to permit them to be used. Salt is manufactured in a small way for local use by solar evaporation.

Value of Salt in Oklahoma, 1901-1914.

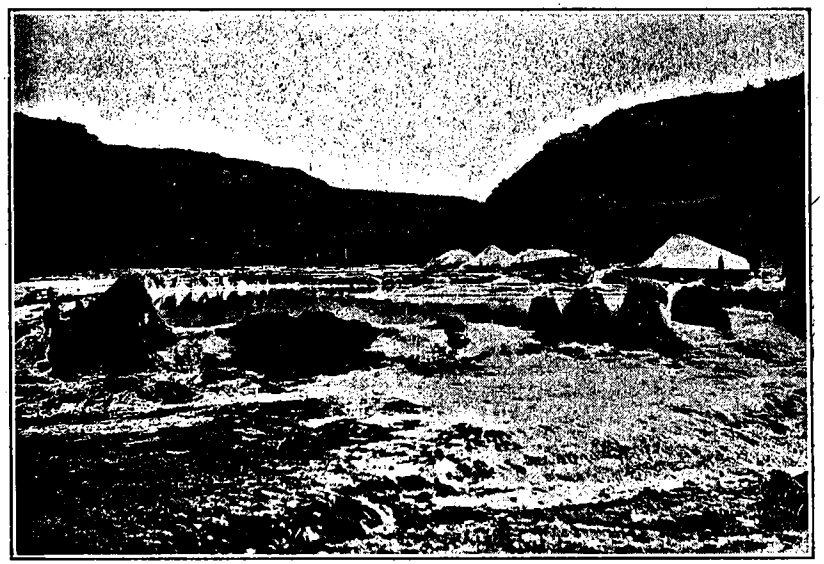
Year.	Value.	Year.	Value.
1901	$ 5,986	1908	$ 900
1902	7,562	1909	900
1903	2,070	1910	881
1904	1,961	1911	431
1905	2,145	1912	325
1906	4,965	1913	259
1907	910	1914	250(e)

°Estimate.

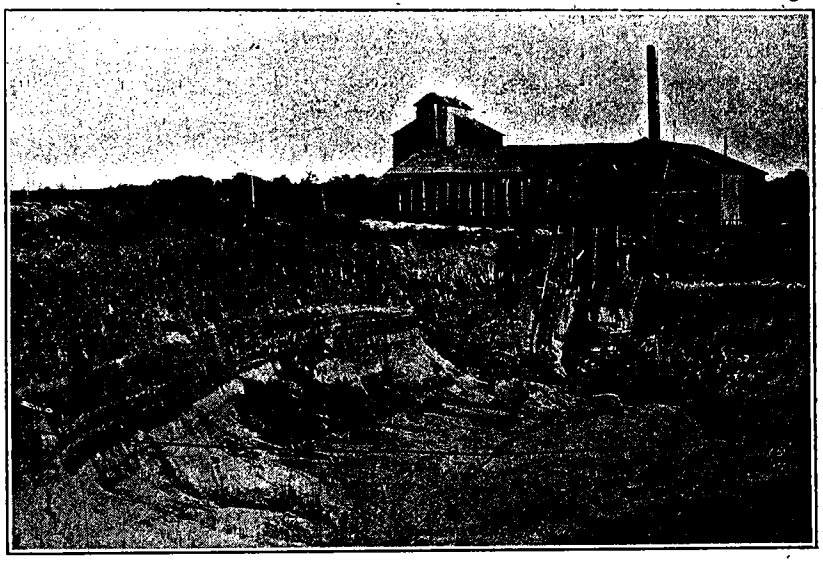
GLASS SAND.

Almost any sand may be used for the manufacture of glass, but sand containing very much impurity produces cloudy or colored glass. For a clear glass a pure siliceous sand is required. Such sand occurs in great abundance in the Arbuckle Mountains. Locally three ledges

PLATE XXX.



A. KISER SALT PLAINS, HARMON COUNTY.



B. GLASS SAND QUARRY AND MILL NEAR ROFF.

of sandstone in the Simpson formation are composed of practically pure sand which is so loosely cemented that the rock is very easily crushed. The only quarries utilizing this sand are at Roff and Hickory where the sand is washed and shipped to glass plants in the gas fields. The sand is reported to be very good grade. There is no doubt that increasing use of this sand will be made as long as the supply of cheap fuel can be secured in the State. The sands in many other localities in the State could be used for colored glass, but in general no industry of importance can be built up except with the pure sand. A ledge of sand northeast of Tahlequah is of sufficient purity for the manufacture of glass, but is too far removed from transportation to make it available. Some beds in the Trinity sands in the southeastern part of the State may also be suitable for glass sand.

The glass sand industry is in its infancy in Oklahoma, although with a little more than three years the number of glass plants has grown from 6 to 20. Ten or more of these plants use Oklahoma glass sand with marked success.

ROAD MATERIALS.

The term road material includes clay, sand, gravel, sandstone, limestone, asphalt, clinker from burned culm heaps of coal mines, and that produced when coal dust is burned with clay and cinders from factories. Material for macadam roads may be obtained from igneous, sedimentary, and metamorphic rocks. The best test for a good road is actual use, hence some of the materials just mentioned have been found to be more satisfactory than others.

The various building stones which have been mentioned with the exception of the sandstones, may be utilized for material for macadam roads. So far, however, practically no macadam roads have been built in the State and it is doubtful whether this type of road, unless treated with some form of bituminous binder, is well adapted for our conditions and climate. The native asphalts might possibly be used as a binder for the metal in macadam roads, but this should be tested thoroughly on a small scale before it is used extensively for building roads of this kind.

The eastern part of the State is fairly well supplied with road materials. In all localities stone could be secured by means of a short railroad haul, and an additional wagon haul of a very short distance not more than 10 or 15 miles. The western part of the State with the exception of the Wichita Mountain region and various local deposits of gravel has little material for permanently improved roads. Fortunately, however, the sandy clay soil of this part of the State forms an excellent roadway almost the entire year. If properly graded and if dragged occasionally the country roads in the western half of the State can be classed as good roads. The only exceptions are the sand hills area along the streams, but in most of these localities clay can easily be secured and a fairly good road may be made by the claying of the sand.

IRON.

Iron is the most useful, and next to aluminum, the most abundant of metals and is mined and reduced in almost every country in the world. There is a general impression that the world's supply of iron ore is approaching exhaustion. The principal argument against this is that improved methods of smelting will enable the lower grade ores to be successfully used as a source of iron. The enormous deposits of iron ore in certain localities have held in check the discovery and development of smaller areas and leaner ores.

The iron present in rocks gives rise to the various colors which occur in rock.

Oklahoma has no large deposits of iron ore, but some good ore occurs in the State, and there are reasons to believe that further investigations may reveal considerable quantities of impure ore. Iron is widely diffused through the Redbeds shales and sandstones in the central and western part of the State, and some of them contain as much as 20 per cent iron. Some iron occurs throughout the Coal Measures area; chiefly in concretionary or kidney ore. These two sources are not likely to produce any ore of value. Some good ore occurs in the Ouachita and Arbuckle mountains, and in the region of Roff, Mill Creek, Davis, and Hunton, are found large boulders of low grade iron. In the vicinity of Sulphur and Bromide, blocks of ore weighing several hundred pounds are found. This is chiefly a manganese iron ore. The analysis of a sample of this ore shows 10 per cent iron and 40 per cent manganese. Shipments of ore have been made from near Hunton and Mill Creek.

In the Wichitas considerable iron ore is found scattered over the surface. Some of this iron ore is magnetite. Some pyrites are shipped each year from the lead and zinc region.

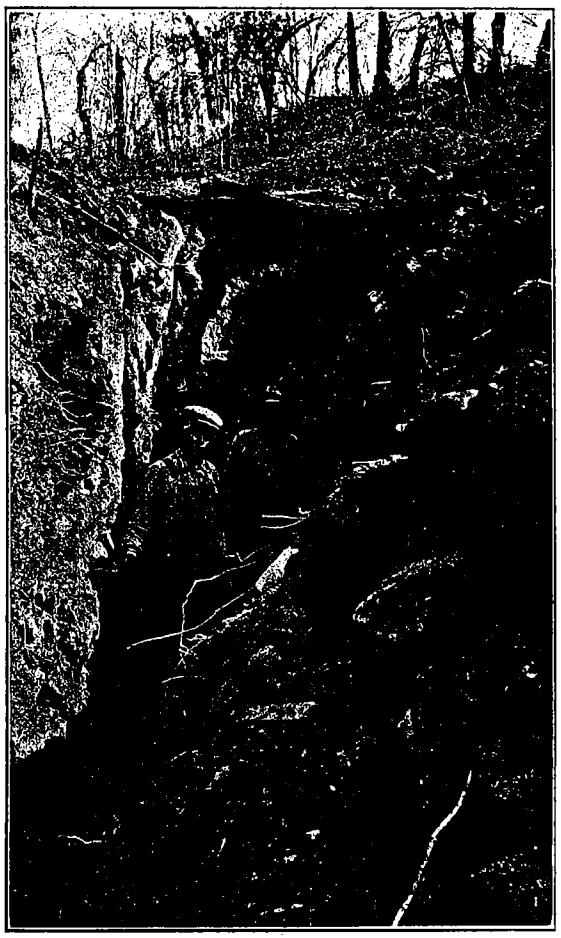
Deposits of iron ore have been reported from many localities, but the Survey has not made any systematic investigation of the iron ore deposits and their true value cannot now be stated.

MANGANESE.

Explorations are now going on in Oklahoma to determine the extent of some maganese ore deposits. Investigations are being carried on about 3 miles north of Bromide and near Springbrook, about 5 miles southwest of Bromide.

The exploration near Springbrook was examined in considerable detail by a member of the Survey. Chemical analyses show this ore to run as high as 40 per cent manganese. This ore occurs in irregular masses in an east-west fault zone which dips south at an angle of 80°. These irregular masses of ore vary in size from quite small to very large, one mass having been taken out which was 50 feet long, averaging 5 feet wide and 5 feet deep. The fault has brought in contact the Viola limestone and the Arbuckle limestone which are normally 1,400 feet apart

PLATE XXXI.



MANGANESE DEPOSIT NEAR SPRING BROOK, JOHNSON COUNTY.

on the geologic section. The vertical displacement is therefore more than 1400 feet. The downthrow is on the north side of the fault. The strata on both sides dip towards the fault zone. About a mile southwest of the ore deposits is the Arbuckle-Granite contact. The Arbuckle limestone dips away from the granite and towards the fault zone. The fault may be of sufficient magnitude to penetrate the granite which underlies the Arbuckle limestone. The Viola strata dipping steeply towards the fault zone acts as a barrier to the northward movement of the ground water that moves along the top slope of the Arbuckle limestone. Consequently there is movement of water upward in the fault zone. This idea is checked up by the fact that a spring is located on the fault zone.

The ore in the fault zone is a secondary concentration, the original source of which is the Arbuckle limestone, probably the Reagan sandstone which may underlie the Arbuckle limestone, and the granite which underlies both the Arbuckle limestone and the Reagan sandstone, if it be present.

The structure here is such as to cause the ground water to flow through the Arbuckle limestone and possibly on the contact of the granite with either the Reagan sandstone or the Arbuckle limestone or both. These formations may contain manganese which could be taken up by the ground water, carried to the fault zone and deposited. The ore occurs in irregular masses because the fault zone is irregular in its composition, some parts of it permitting better circulation of the ground water.

It is quite probable that there is a deposit of ore extending to considerable depth.

The fact that manganese ore is found in the Arbuckle region and on a fault zone opens up the possibility of other deposits in this region. There are, no doubt, other localities where faulting has brought about similar conditions to those that prevail near Springbrook, Oklahoma.

COPPER.

Copper is widely distributed among the rocks. It has been reported from many places in Oklahoma, but in all these localities it has been found in such small quantities that it is of no commercial importance. Copper stain is frequently found in rocks, and even pieces of metallic copper may be included in small fragments, but such are no indication of ore of value. The principal places from which copper is reported is from the Redbeds region, and from the mountain regions. Much prospecting has been done in a number of localities. In some places hundreds of shafts have been sunk, but in no case has the amount of copper justified the expense.

NOVACULITE.

Novaculite is an even grained, gritty stone which is really a sandstone with the appearance of chert or flint. It has not been found in commercial quantities in Oklahoma, but since fine deposits occur in Arkansas in the Ouachita Mountains it is highly probable that the same material may be found in the extension of these same mountains on the Oklahoma side of the line. The most likely localities would be along the hills east of Stringtown and Atoka, about Talihina and to the eastward. The workable stone is obtained usually in rather small pieces. The size of the block as quarried ranges from 1 to 1,500 pounds. The stone is used for whetstones, razor hones, and jewelers' stones. In fact, it may be used by all workmen who use small-pointed or fine-edged tools.

VOLCANIC ASH.

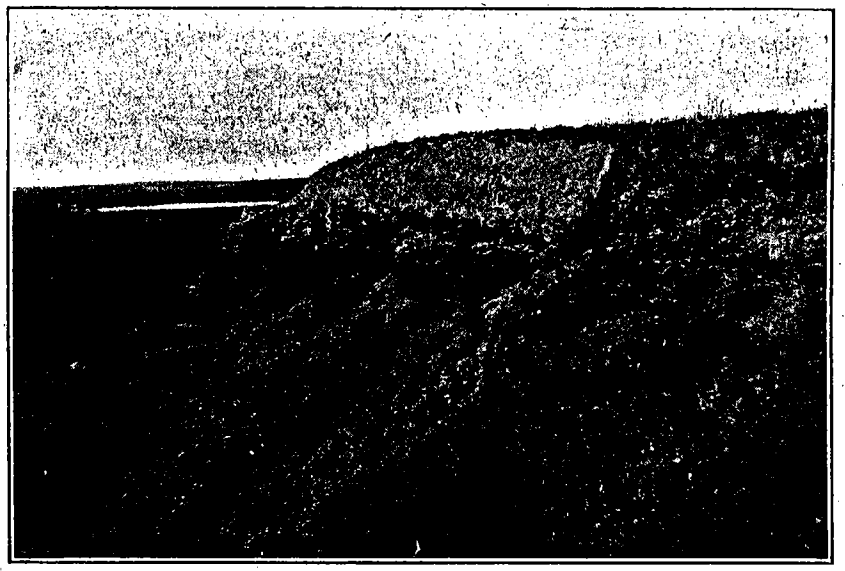
Volcanic ash is composed of fine dust and powdered lava blown from volcanoes. There are several localities in Oklahoma where considerable deposits of volcanic ash are known to exist. Only a few deposits are of great size. It is only recently that volcanic dust has been considered of commercial value. It has been discovered that volcanic ash in greater or less quantities exists over a large part of the State, and when not found in distinct deposits it is found disseminated through the surface soil over large areas.

The principal volcanic dust deposit in Oklahoma occurs in the northwestern and east central parts of the State. One of the principal occurrences is about 8½miles northwest of Gate, near the boundary line between Harper and Beaver counties. Here a deposit 9 feet in thickness outcrops for a distance of 1,800 feet or more and about 1¼ miles east of this location another deposit showing 10 feet in thickness has a considerable outcrop. Other small deposits occur in the same general locality. Another important deposit is about 8 miles northwest of Woodward, where there is an outcrop of about 600 feet, showing a thickness of 6 feet, and a little farther to the south the outcrop continues for some distance with a thickness of about 8 feet. The deposit considered most accessible and perhaps most important in the State is in section 15, just northeast of Custer City. A deposit of much value and considerably removed from the ones above described is found 8 miles northwest of Wetumka. This deposit is being developed to some extent and the material shipped from Okemah to Oklahoma City, where it is being used for various purposes. Another small deposit occurs 6 miles west of Okemah and another near Dustin. Near the north edge of the town of Stigler is a small deposit of impure ash 4 to 5 feet thick. Other deposits are known to occur over the general region from about Alva east to Newkirk and south to Watonga and Kingfisher. It is very probable that further investigations will lead to the discovery of many other deposits of greater or less extent over the northwest and central parts of the State.

Volcanic ash is used for abrasive purposes, chiefly in the form of polishing powders, scouring soaps, and cleansing powder. It is also used in the manufacture of dynamite as a holder of nitro-glycerin. It is a good non-conductor of heat and is used for packng material for safes, steam pipes and boilers, and as fireproof building material. It is of value as a fertilizer in the natural state, and in addition is used as an absorbent of liquid manure in the preparation of artificial fertilizers. It is also used in the manufacture of cements, artificial stone, paper, sealing wax, fire works, and many other materials.

TRIPOLI.

Tripoli is a light, soft, porous, siliceous rock supposed to have resulted from the leaching of calcareous material from a siliceous limestone. It is usually white or cream colored, but often there is sufficient iron oxide present to give a decided pink to red color. It is of value for a number of purposes. The chief products are manufactured from



A. VOLCANIC ASH DEPOSIT NORTHEAST OF GATE, NEAR BEAVER, HARPER COUNTY LINE.

B. TRIPOLI QUARRY NORTHEASTERN OKLAHOMA.

the flour which is prepared from the tripoli as quarried, in essentially the same manner as ordinary wheat flour is made. The rock is ground and sieved through silk wire bolting, is packed in barrels and sold in the market. Various grades of flour are made, depending on the purity of the material, and the fineness of the grinding. The chief use of the flour is as an abrasive or polisher in metal-working trades. The finer grades are used in jewelry polishing, and the coarse as brass and steel polishes. It is also used as an adulterant in the manufacture of gunpowder, as the body in dynamite, bagging for boilers, for making cement, water filters, wood filler, and wood polishes.

Illinois, Missouri, Arkansas, and Oklahoma are the states which produce tripoli. The principal seat of the industry is at Seneca, Missouri. Two mills owned by the same company are operating there. Much of the raw material comes from the Oklahoma side of the line. In 1912 a large deposit of value was found near Peoria, Okla., about 8 miles from Seneca, and a railroad spur was constructed and a mill site selected. A company has considered developing the deposit and furnishing ground tripoli for abrasive purposes. It is difficult to obtain large pieces of the Oklahoma tripoli, such as are desired for filter manufacture, because of the cracks and bedding planes in the rock.

The rocks exposed in the northeastern part of the State, where the tripoli occurs, is the Boone chert, or Mississippi limestone. This formation consists of layers of pure limestone, limestone interbedded with layers of pure chert or flint. The deposits of tripoli owe their origin to the solvent action of water on this limestone or chert. The region is rough and hilly. The tripoli is found chiefly in the tops of the hills and along the sides of ravines. The extent of the deposit in Oklahoma is not known. Several small deposits of tripoli have been reported from various sections of the State. The source of the Missouri tripoli is probably the same as that of Oklahoma. The deposit in Arkansas consists of weathered, calareous, siliceous rock. The calcareous material has been leached out, leaving a pure, fine-grained siliceous material. At various places novaculite beds have been altered to tripoli.

GOLD AND SILVER.

There is always a desire on the part of the prospector to search for the precious metals. Much prospecting has been done in Oklahoma for gold and silver. This search has been carried on for years, and up till the present time not enough has been found to be of any economic value. Some analyses of selected samples show high mineral content, but in quantity the ore-bearing rock proves to be practically worthless. Throughout the Arbuckle and Wichita mountain region numerous prospect holes have been sunk to depths varying from a few feet to 100 feet. In some cases material containing a very small percentage of gold, silver, and other precious metals has been found. An investigation of a large number of these prospects by the United States Geological Survey a few years ago showed that nothing of value had been discovered. Many people

have been induced to invest in stockselling schemes and fake prospects without any returns for their money.

In August, 1913, 29 tons of ore were shipped from a surface working 5 miles west of Byars in McClain County. The smelter returns show that 1,300 ounces of silver were recovered, having a value of $785. The material is silver chloride in a soft, reddish sandstone. Several samples were collected from this locality by a representative of the Geological Survey and were assayed, but did not show much of value.

Whether future prospecting may reveal valuable deposits cannot be said, but it is believed that representative places have been prospected over the State and these do not offer encouragement for additional investigations.

WATER RESOURCES.

RIVERS.

Oklahoma has many streams of considerable size. Ten rivers cross the State. The two largest are the Arkansas, which with its tributaries drains the northern two-thirds of the State; and Red River, which receives the water from the southern third of the State. The Arkansas, which rises in the Rocky Mountains, flows a distance of 200 miles across the northeastern part of the State. The channel contains much sand. In Colorado and western Kansas much of the water is used for irrigation, so that in northern Oklahoma there is little water in the stream. In this State it is fed by many tributaries. From near Muskogee, where Verdigris and Grand rivers enter, the Arkansas is navigable for small boats part of the year. The principal tributaries from the south are Poteau, Canadian, Cimarron, and Salt Fork. South Fork of Canadian River rises in New Mexico, and the North Fork has many tributaries rising in eastern New Mexico, and one in the Panhandle of Texas. Salt Fork flows through the salt plains of Alfalfa County and below that point the water is salty. The principal tributaries of the stream are Medicine, Mule, Sand, Chickasha, Deer, Cottonwood, and Bois d'Arc creeks.

Red River forms the southern boundary of Oklahoma. The stream has a broad sand-choked channel. The principal streams which empty into this river are the Washita, the only stream in western Oklahoma which has steep banks and little sand in the channel; Little and Kiamichi rivers which drain the Ouachita Mountains; Boggy Creek which drains the area between the Ouachitas and Arbuckles; Blue River in the eastern part of the Arbuckles; Mud and Beaver creeks which drain the area between the Arbuckles and Wichitas; and Cache Creek from the eastern part of the Wichita Mountains. North Fork of Red River rises in the Panhandle of Texas. All of these streams have extensive fertile valleys.

DOMESTIC WATER SUPPLY.

The water supply for household and domestic use in Oklahoma is good. There is no part of the State in which good water cannot be

obtained. Springs are found in all parts of the State. In the northeastern part of the State springs are abundant and furnish the chief water supply. In the Ouachita, Arbuckle, and Wichita mountains are a great many good springs of pure water. Some springs are found in the sandstone regions of the eastern half of the State, and in the Flint Hills in the northern part there are many excellent springs. In the Redbeds region springs are common but usually contain gypsum or salt.

The purest spring water in western Oklahoma comes from springs in the sand hills and the high uplands. Some of the most noted of these springs are Cleo Springs, Elm Springs at Alva, Caddo Springs, north of El Reno, and several large springs near Moscow, Aline, Grand, and Woodward.

Good well water can be obtained in all parts of the State. In the mountain region but few wells have been put down. In the eastern and central parts of the State wells are common, and a good supply of water is usually found at 50 feet or less. In the Redbeds and Gypsum Hills region the wells are from 50 to 100 feet deep. In some of these wells the water is pure while in others there is a considerable quantity of gypsum and salt. In the sand hills and high plains of the western part of the State, good pure water is obtained. The wells are often 300 feet or more in depth, and windmills are used to pump the water. In many parts of the State surface water is ponded for stock use.

Lawton's dam and reservoir impound 5,000,000,000 gallons of water. The height of the dam is 50 feet and the area of the reservoir is 1,082 acres.

For city water supplies the water is obtained either from deep wells, strong springs, mountain streams, or rivers.

WATER POWER.

The water power resources of the State are very great. There are a number of swiftly flowing streams, carrying constant volumes of water. In these areas the question of utilization is not a difficult one. There are many other streams which have irregular flows. Water power has long been successfully used for practical purposes. Water power is inexpensive and perpetual, and requires little additional expense after once it has been put to use.

A proper development of the water power of the State would bring about several important results. Much cheap power would be secured, navigation facilities increased, less damage done by floods, and purer water supplied from large storage basins. Much of the water power of the State is not readily accessible under present conditions except by transmission in the form of electricity. Electricity can be successfully transmitted 150 to 200 miles. Artificial light and heat are of special importance. When our ordinary fuels have been exhausted water must be the chief agent for supplying the needs. The water power might well be utilized as a means of conservation of other resources.

Power plants are now in operation in only a few places in the State.

Many others are being considered. Along the Washita several projects have been investigated and in the eastern part of the State it is proposed to construct a dam across Grand River near Muskogee. The amount of power here generated would be enormous. Extensive reservoirs may also be formed from mountain streams. To say the least, there are all the good water power sites in Oklahoma that can ever be utilized for all purposes—water power, irrigation, and domestic uses. The reservoir constructed on Medicine Creek near Lawton, impounding an enormous supply of water, shows what may be accomplished by the utilization of natural storage basins.

MINERAL WATERS.

There are many mineral wells and springs in Oklahoma. Water is one of the essentials of life. The use of mineral water in the treatment of disease is an important one. As ordinarily understood, "mineral water" is applied to water which is used in the treatment of disease and differs from ordinary water in that it holds in solution certain solids or gases. The quantity of mineral matter contained varies greatly and many waters sold for medicinal or table use as mineral waters often contain smaller quantities of inorganic substances than that contained in many domestic and city water supplies. Mineral waters of commerce are both natural and artificial, that is, some water is put on the market in the natural state, while others are treated by concentration on the addition of organic or inorganic substances for certain results.

Rain water as it falls upon the surface of the earth is practically pure. In passing through the soil and rocks it comes in contact with many mineral substances from which its mineral content may be obtained. The kind of mineral and the quantity contained in the water depends upon several features and the classification of water on the basis of mineral contained is a very arbitrary one.

Platt National Park, a Government reservation, includes the mineral wells and springs in the vicinity of Sulphur.

There are several good sulphur and bromide springs near the town of Bromide, and the town was founded chiefly for the purpose of utilizing these waters for medicinal and bathing purposes. Several mineral springs of importance occur in the region of the Arbuckle and Wichita mountains. Others occur in the Ouachita and Ozark mountains.

In northeastern Oklahoma there are a great number of artesian wells which produce strong mineral waters, and at many places over the State in general mineral waters have been found either in springs or in deep well borings. The term "artesian" was formerly applied only to wells which flowed, but in common use the term is now applied to any deep well. In prospecting for oil and gas in Oklahoma the drill often encounters mineral water. Some very important wells have been found in this manner. The utilization of both the pure and mineral waters which issue from the springs over the State will be given much fuller consideration in the future than they have in the past. The chief purpose

is to find waters which are pure from the standpoint of not being contaminated with substances which would be detrimental to health. While waters which contain minerals are often of special benefit, it is also true that the greatest value is derived from the amount of water used, and as good results may be obtained from the use of pure water as from medicinal waters.

There was a decided advance in the mineral water trade of Oklahoma during 1911, the total output increasing from 150,000 gallons, valued at $4,950.00 in 1910, to 497,074 gallons with a value of $14,290.00 in 1911. In 1912 the output showed an additional gain both in quantity and value, amounting to 1,015,512 gallons sold, with a value of $32,971.00, an increase of 518,438 in gallons and in value of $18.681.00. The year 1913 showed a decline of more than one-half from the amount sold in 1912, but the value per gallon increased. The total amount sold was 502,439 gallons, valued at $26,231.00.

The waters sold in the State are used for table, medicinal, and general commercial purposes. Several thousand gallons are used in the preparation of soft drinks and some for the manufacture of distilled water. Four of the firms reporting sales have bathing houses in connection with their springs or wells and a considerable amount is used at these places. Some of the resorts at the various springs have accommodation for several hundred guests. There are many excellent springs in the State from which the water is not sold and the real value of this mineral output would thus be much increased.

SCENERY.

The natural scenery of Oklahoma is unexcelled. The mountain streams, waterfalls, timbered hills, granite peaks, and bald surfaces give a wild and rugged appearance. Several Government Reservations and National Parks and many other public and private parks have been located in the regions of beautiful scenery. There is scarcely a part of the State that does not have many features of interest. The erosion features in the sandstone hills and gypsum hills are produced on a grand scale. The river valleys with their abundant crops and wooded hillsides present a pleasant sight.

In the limestone and gypsum regions occur many caves. None of these are of very large size, but are very beautiful. In the caves occur stalactites which hang icicle-like from the roof and the stalagmites which are formed on the floor from the material in the drip, and rise as columns from the floor.

Travertine (Tiber Stone) occurs in large deposits in the Arbuckle Mountains and gives rise to many picturesque water falls and rugged scenery. Travertine is formed in running streams or springs by the deposition of lime on the sides where it encrusts and binds together shells, fragments of wood, leaves, and stone.

CHAPTER V.

AGRICULTURE IN OKLAHOMA.

GENERAL STATEMENT.

Oklahoma is primarily an agricultural State, and agriculture in its various phases is, and will remain, by far the most important industry in its borders. The great range in elevation, temperature, and rainfall, and the variation of soil make possible a great diversity of crops. Practically all the important crops of the United States may be grown successfully in some portions of the State.

SOILS.

Topographically the State is divided into 11 regions as described in Chapter III. These divisions in a general way indicate the principal soil groups of the State.

There is no sharp line of division between these various regions. The general boundaries are shown in the physiographic map (Pl. XI). These divisions coincide closely with the geologic divisions of the State. (See Plate VII).

The great varieties of rock materials found in these regions produce soils differing much in character. The granites, limestones, sandstones, shales, and clays, each make different types of soil.

Soil is termed the loose mantle of material covering the surface of the earth. It consists of the disintegrated material of the earth's crust mixed with varying amounts of decayed organic matter. The earth's crust is composed of more than 70 elements, most of which are present in very small proportions, but, with the exception of 4 or 5, all have some important function in plant growth.

Immediately beneath the soil or stratum of earth which affords nourishment to plants is a mass of earth or rock unmixed with the decayed matter to which the term subsoil is applied.

The soils of the State would be grouped under the following heads: (1) Residual soils, (2) Transported soils. Under the second division are (a) colluvial soils, (b) alluvial soils, and (c) aeolian soils.

Residual soils are those which have been formed in the place where they are now found. The parent rock underlies the soil or subsoil at a greater or less distance, and the soil bears some of the characteristics

of this rock. The upper part of the rock's surface is generally somewhat broken and decayed with fragments scattered throughout the subsoil. A very large percentage of the upland soils of the State belong to this class.

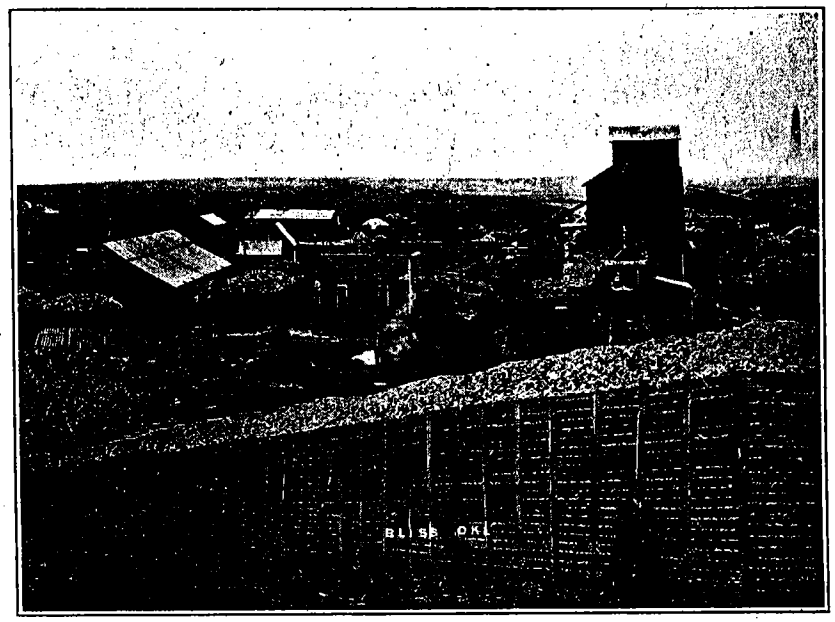
Transported soils are those which have been moved by the action of water, wind, and ice. Very few residual soils remain undisturbed for any great length of time. The term colluvial soil indicates hillside soils, or those soils which have been removed only a little distance from the place of origin. They form a large part of the rolling and hilly uplands. The alluvial soils include those of the river valleys and the smaller stream bottoms. Many of the soils of this type in the State are of the very highest importance and are adapted to the growing of all sorts of crops. The aeolian soils are those which have been influenced by the action of the wind. The region of sand hills along our rivers are examples of this type. These regions are suited only to special crops. The greater part of these areas are stable, but in a few cases areas of shifting dunes are found.

Large areas in the State are not to be considered as agricultural regions. In the 5 mountainous districts there is little land of value except in the highlands of the Ozark Plateau. This region while indicating a mountainous locality, is only the remnant of a worn down table land and is one of the important agricultural regions of the State, especially in the growing of hay and general forage crops. About the boundaries of the Arbuckle and Wichita mountains some very fertile soils are found. The constituents derived from the granite and limestone make up good soils.

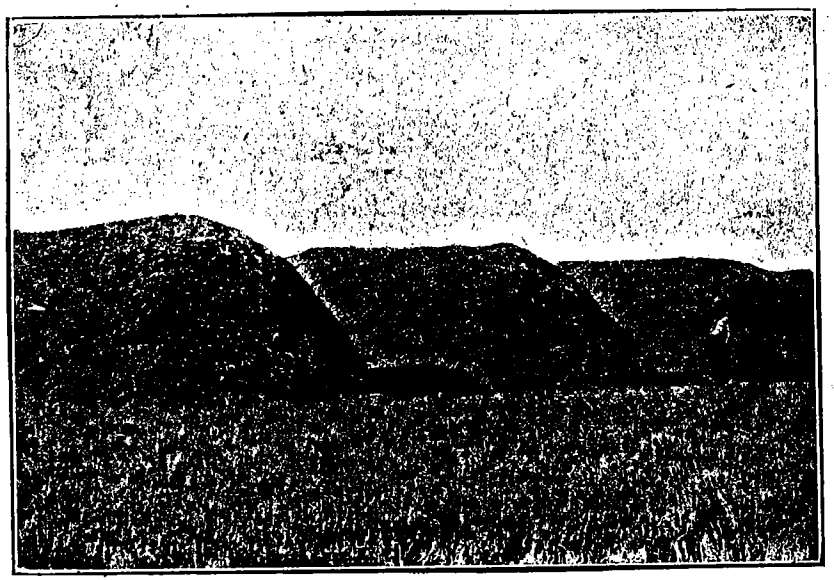
Only a small percentage of the agriclutural lands of the State are now being utilized. The State is new and farming conditions have not reached the highest standard in any part. Hundreds of thousands of acres of Indian lands, segregated lands, and other tracts which are not open for settlement, have prevented growth from an agricultural standpoint. With proper care and cultivation the fertile soils should become the prinicpal producing resource of the State. The soils are adapted to many crops. At the present time cotton, wheat, oats, corn, kafir, prairie grass, and alfalfa are the principal crops.

The rainfall varies from place to place, from year to year, and from season to season. The highest rainfall is in the eastern part of the State, where the average for a period of 20 years was about 40 inches; in the central part of the State, 30 to 35 inches; and in the western one-third it decreases from 30 inches to about 15 inches in the western part of the Panhandle. With rainfall properly distributed throughout the growing season the soils show their high degree of fertility by the enormous crops which are produced.

The Geological Survey had made practically no investigation of soil conditions until during the field season of 1914. A bulletin will be prepared in the near future which will give considerable information



A. CORN CRIBS AT BLISS, NOBLE COUNTY.



B. WHEAT STACKS, BEAVER COUNTY.

concerning the origin, distribution, character, and fertility of the various soils of the State.

PRINCIPAL CROPS.

CORN.

Although Oklahoma is not generally considered one of the important corn growing states, the acreage devoted to this crop exceeds that of any other crop.

Corn is grown in all parts of the State except the extreme northwestern portion; however, the greater portion of acreage is in the eastern and southern parts. On account of the low average rainfall it is unsafe to depend on corn as a leading crop in the western part of the State, but good crops can be produced in the years of best crop conditions, with the result that a considerable acreage is usually planted. The introduction of the silo tends to increase the acreage of corn, because in case of drouth before the corn is matured, the partially matured crop can be utilized as silage and not be a total loss.

The acreage planted to corn annually is between 4,000,000 and 5,000,000. The average yield is subject to great variation on account of variation in rainfall. In ordinary years it is about 15 bushels per acre, but some of the better yields will give 75 to 80 bushels per acre.

WHEAT.

The distribution of wheat-growing in Oklahoma is directly opposite to that of corn. While grown to a greater or less extent in all parts of the State, the important wheat-raising belt lies in the western and northwestern parts of the State, coinciding approximately with the Gypsum Hills and High Plains physiographic provinces. In the northwestern part of this region, in Woods, Alfalfa, Grant, Garfield, Dewey, and Kingfisher counties, wheat is the principal crop and is depended upon almost entirely by many farmers. Farther south cotton becomes important and wheat is not planted so exclusively. In general, the counties in the eastern half of the State are small wheat producers, only one or two having an acreage in excess of 10,000, and many of them having less than 1,000.

COTTON.

Cotton is the chief crop of Oklahoma in point of value, and has about the same acreage as wheat. It is grown extensively in the southern half of the State and to a less degree north almost to the Kansas line. On account of rainfall and temperature the cotton area extends farther north in the eastern portion than in the western portion of the State. Considerable cotton is grown in Mayes and Delaware counties, in the northeast corner of the State—while the crop is relatively of less importance in Dewey, Blaine, and Kingfisher counties, which lie farther to the south, but in the western part of the State. In the southeastern part of the

PLATE XXXIV.

COTTON FIELD IN OKLAHOMA COUNTY.

State, cotton is the leading or staple crop. The average yield of cotton for the State is usually considerably less than half a bale per acre, but in favorable localities yields of a bale or more per acre are not uncommon. The cotton boll-weevil has caused much damage to the cotton crop for some years. However, the insect does not seem to be able to secure so firm a hold in Oklahoma as it has farther south. In some seasons nearly the whole cotton-growing area in Oklahoma is affected by the pest, while in others it is confined to the Red River Valley region. In general, the crop is much less seriously injured by the weevil in Oklahoma than it is in Texas.

OATS.

Oats are grown throughout the State, although in no section can they be considered the principal crop. The central part of the State grows more oats than either the eastern or western parts. In favorable seasons the yield is good. When on account of dry weather or other conditions the crop does not fully mature the oats are often cut and used as hay.

BARLEY AND RYE.

Barley and rye are grown only in a small way in Oklahoma. The combined acreage for both crops is usually less than 15,000 annually, and combined production between 200,000 and 300,000 bushels. According to the report of the State Board of Agriculture the total value of the production of both crops for the past 5 years has been very nearly $1,000,000.

HAY.

The native wild grasses are utilized extensively for hay in the eastern part of the State. The principal producing counties are those of the Prairie Plains region, particularly Ottawa, Craig, and Mayes. In these counties the conservation and marketing of prairie hay is one of the leading industries. In the western part of the State the coarse grass known as blue stem is used for hay to some extent. Johnson grass is utilized in the southern counties. Alfalfa is grown extensively throughout the State and the acreage is increasing rapidly. The central and western parts of the State lead in alfalfa, especially the counties of the wheat belt to the northwest of the center of the State. The principal hay crops of the eastern and northern states, red clover and timothy, cannot be grown successfully in Oklahoma.

SORGHUMS.

The sorghums are extremely important in Oklahoma on account of their drouth-resisting properties. Kafir corn is grown most extensively, but in the western part of the State it is largely replaced by milo maise. Feterita is of recent introduction and promises to be very valuable, but its importance is somewhat doubtful as yet. Broom-corn is grown extensively in the northwestern part of the State. Cane (sorghum) is used for pasture and for hay. It is sown very thickly and makes a very large yield of forage per acre. The values of the grain of kafir corn and milo maize and of the straw of broom-corn are given below. The value of these crops as given is increased greatly by the fodder from the kafir corn and milo maize, and the sorghum cane grown for pasture and fodder.

POTATOES.

Both Irish and sweet potatoes are grown in gardens and truck patches for home consumption, in all except the extreme western portion of the State. The production of both is less than the consumption, and many carloads of both are shipped into the State each year. Sweet potatoes are not shipped extensively and Irish potatoes from only one locality, the valley of Arkansas River near Muskogee and Ft. Gibson. Both these crops deserve much more attention than they receive, especially in the eastern half of the State.

PLATE XXXV.

MARKETING BROOM CORN AT WOODWARD, WOODWARD COUNTY.

MINOR CROPS.

BROOM CORN.

Broom corn is an important crop in several counties of the central-western part of the State. The crop amounts in value from $1,000,000 to $3,000,000 per year.

PEANUTS.

Peanuts do well in nearly all parts of the State and have been grown in a small way for forage for many years. The growing of the nuts for market is of recent origin, but is spreading rapidly. So far the industry is centered southwest of the center of the State, principally in Stephens County. The importance of the crop in 1915 is shown below.

Crop Returns of Peanuts, 1915.

Acres	Price per lb.	Total yield, lbs.	Total value.
17,820	$ .041	14,098,000	$578,018

MELONS.

Melons are grown in all parts of the State except the extreme western portion. Several carloads are shipped to northern and eastern markets each year but only a small number in comparison to what can be raised.

TOMATOES.

Tomatoes are grown only for local use, although several localities in the eastern part of the State give opportunity for their cultivation on a larger scale, and the establishment of canning plants.

FRUITS.

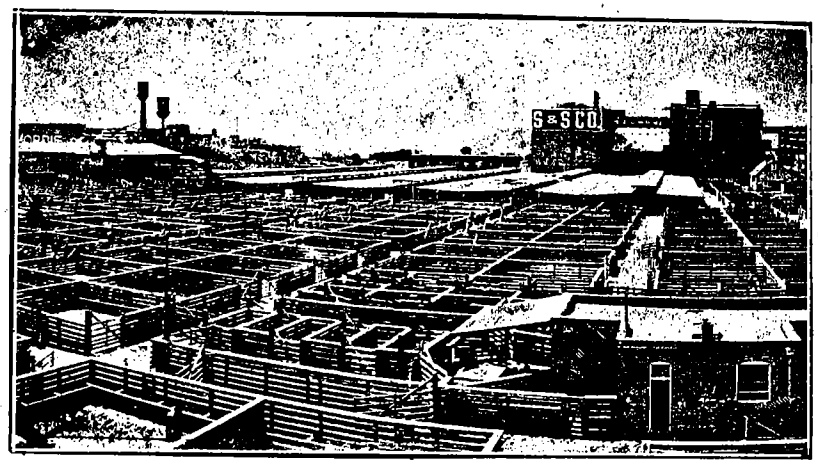
The larger fruits, apples, peaches, and pears are grown in all parts of the State, but much more extensively in the central and eastern portions than in the western. Many carloads of peaches are shipped to the northern markets each year. The apple crop is insufficient to supply the local demand.

The smaller fruits, berries, cherries, plums, and grapes, are grown for home consumption in the central and eastern parts of the State. The production falls far short of supplying the local demand and large quantities of all the small fruits are imported.

The whole eastern half of the State offers excellent opportunities for the growing of small fruits on a much larger scale than has been attempted so far.

The San Jose scale has damaged the orchards of the State but is under fairly good control. The pear blight is present in most sections of the State. All nursery stocks are inspected annually and no stock is permitted to be sold until a certificate has been granted by the state inspector that the nursery is free from injurious insects or plant diseases. Stock shipped from outside the State must have been inspected and passed under the laws of the state from which it came.

PLATE XXXVI.



A. STOCK YARDS, OKLAHOMA CITY.

B. PRIZE-WINNING CATTLE ON FARM NEAR CHICKASHA.

LIVE STOCK.

GENERAL STATEMENT.

Originally Oklahoma was primarily a cattle growing region and almost the whole area was given over to the pasturing of cattle. With the opening of the State to white settlement the range was closed and cattle have decreased in importance both relatively and absolutely.

Considerable areas of the State, however, are not suitable for farming and in these the production of range cattle is still the important industry. With the closing of the range and the division of the territory into farms, the growing of better grade cattle and of horses and hogs on a smaller scale became important. Although there are still many "long horn" range cattle and also "razorback" hogs in the State, the percentage of pure-bred stock is increasing rapidly.

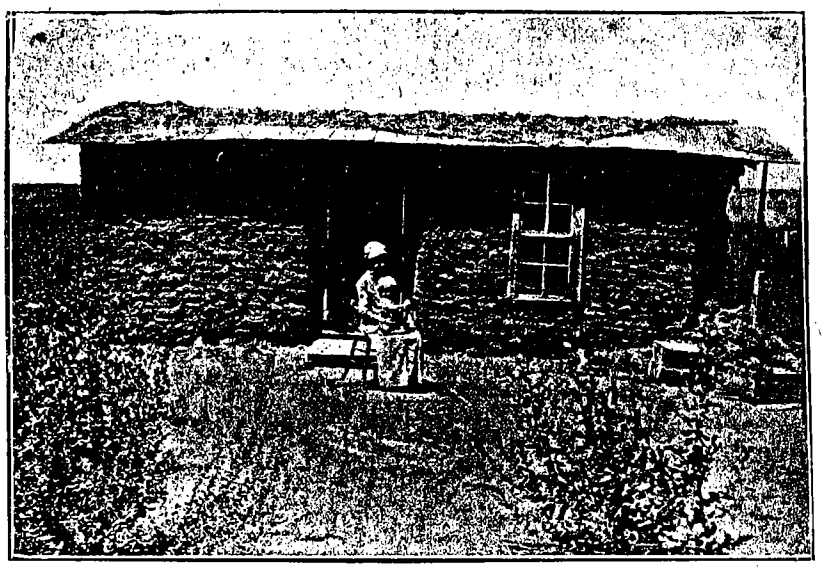
HORSES AND MULES.

The value of horses in the State is greater than that of any other class of live stock. However, the grade of the animals is generally low and the value per head is considerably less than in most other states. The number of mules is about one-third that of horses, but the average value per head is considerably greater than that of the horses. There is much room for improvement, by proper selection and breeding, in the character of both horses and mules in the State.

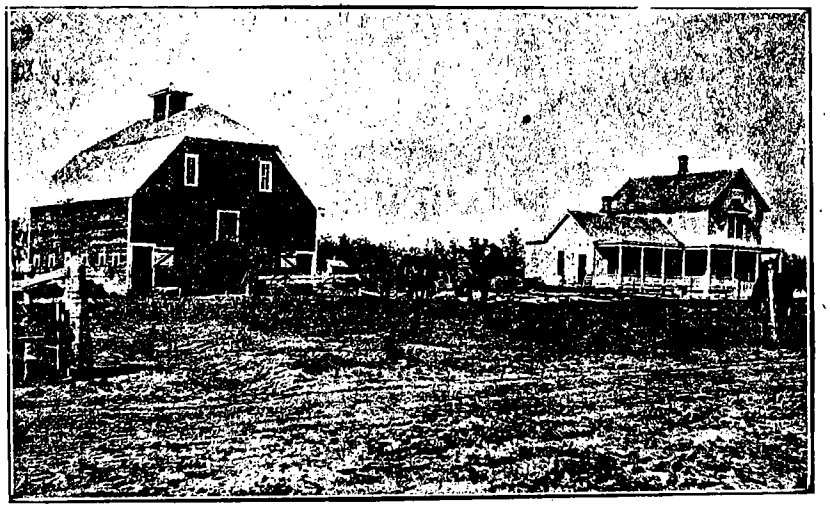
CATTLE.

Cattle are raised extensively in all parts of the State. Range and beef cattle greatly predominate but the dairy cattle are receiving more attention recently. A considerable dairy industry is being developed, especially in the central part of the State. Of the pure-bred beef cattle the Herefords, Shorthorns, and Aberdeen-Angus are bred most extensively, and of the dairy cattle, Jerseys, Holsteins, and Guernseys. The scrub and range cattle still greatly outnumber the pure-bred stock but this condition is improving rapidly. The greatest hindrance to cattle-growing has been the Texas fever tick. This pest has been eradicated from a large section of the State, and the work is being continued. At the present rate of progress, the whole State will be free from the tick in a comparatively few years. The eradication is carried on by dipping the cattle in an arsenical solution in specially constructed dipping vats. The work is conducted under Federal and State supervision. The average cost of dipping is usually less than $1.00 per head per year. The increased value due to freeing the cattle from ticks is estimated at $7.00 per head. In addition, there must be considered the advantage of the introduction of foreign pure-bred stock, which readily succumb to the fever in tick-infested localities. In 1915 nearly $150,000 was expended on tick eradication in Oklahoma. There are about 600 dipping vats in the State.

In addition to the campaign against the tick, the State Board of



A. SOD-HOUSE NEAR PUTNAM, DEWEY COUNTY.



B. MODERN FARM HOME, KAY COUNTY.

Agriculture assists in the fight against blackleg in young cattle, by distributing vaccine through the State Agricultural and Mechanical College. A rigid quarantine is being maintained against the foot and mouth disease. Dairy inspection and inspection of dairy cattle for tuberculosis is also carried on by the State Board of Agriculture.

HOGS.

Hogs are grown in all parts of the State. In the extreme eastern portion they are allowed free range and are mostly "scrubs." In other parts of the State hogs are confined, and are generally pure-bred varieties, although there is still much room for improvement in this regard.

Hog cholera is present in nearly all counties but, so far, is not so prevalent as in the north-central states. Fairly good success has followed the use of vaccine in the treatment of the disease, but there is no organized fight being made against the spread of cholera.

The packing plants and stock yards at Oklahoma City, Wichita, Kan., and Ft. Worth, Tex., provide convenient markets and most of the stock is shipped to these three markets.

SHEEP.

Sheep-raising has received very little attention in Oklahoma, although considerable of the area of the State is very well suited to the industry.

CHAPTER VI.

HISTORY OF OKLAHOMA.

BOUNDARIES.

In 1803, by the provisions of the Louisiana Purchase, the United States acquired control of all of what is now Oklahoma, except the part which lies west of the one hundredth meridian. Previous to this purchase, trappers and hunters in French employ had explored the region along Red and Arkansas rivers, where at that time different tribes of uncivilized Indians lived. The only permanent result of the French occupancy prior to the Louisiana Purchase is shown in the French names by which streams and mountains in eastern Oklahoma are designated, such as Poteau, Verdigris, Sansbois, Fourche Maline, and Cavanal.

The question of disposing of the Indians in the United States had already caused considerable trouble before the Louisiana Purchase. After this transaction Jefferson and his associates decided to solve the problem by making permanent provisions for them in the newly acquired territory.

The boundaries of the State of Oklahoma were decided by conditions and circumstances outside the limits of the territory. States and territories, one after another, were carved out of the vast western domain and what was left when these states and tetritories were formed, being already the home of the Indians and generally known as the Indian Country, was given the name of Indian Territory. The Territory occupied the southwestern part of the land acquired by the Louisiana Purchase and was bounded by Red River on the south—its only natural boundary—which separated it from Texas. The eastern boundary was determined by three straight lines. At the time of the formation of Missouri the boundary of this State was termined by a line drawn from the mouth of the Kansas River at Kansas City south to the parallel of 36° 30′. In 1819 the Territory of Arkansas was organized, extending westward to the edge of the Louisiana Purchase. Five years later this boundary was moved eastward and the Territory terminated at a line drawn north from the present site of Muskogee. In 1828 the line was moved still farther east and the boundary was finally established by a line drawn from a point on Arkansas River, 100 paces west of old Fort Smith, south to Red River. The rest of the eastern boundary was determined by a straight line drawn diagonally west of north from Fort Smith to the

southwest corner of Missouri. The western boundary was determined by the Louisiana Purchase treaty, the Territory extending to the Spanish possession in Texas, or to the 100th meridian.

By the terms of the treaty of 1828 the Government ceded to the Cherokee Indians a grant of land whose northern boundary should be the 37th parallel. When Kansas was made a territory the southern boundary was established at this parallel instead of the Missouri Compromise line of 36° 30′, which would otherwise have formed the southern limit of this free territory. This line was chosen in order not to divide the Cherokee reservation into free and slave portions, and thus the northern boundary of the State of Oklahoma was determined.

TREATIES AND REMOVAL OF INDIAN TRIBES.

The first movement of Indians beyond the Mississippi with which the Government was concerned was the Cherokee migration of 1890. In 1817, in consequence of an exploring expedition which crossed the Mississippi to reconnoitre the country along Arkansas and Red Rivers, a grant of land was given this tribe to recompense them for the land they were giving up in the east. This land granted to the Cherokee was in the present state of Arkansas. In 1828 the Cherokee reservation was moved westward so that the eastern boundary was the same as the present boundary of Oklahoma. This tribe received the grant of 7,000,000 acres of land in the northeastern part of the territory with the northern boundary the 37th parallel. Here stipulations were reaffirmed by the treaty of 1833. By the terms of this treaty the United States guaranteed to the Cherokee nation "a perpetual outlet west, and a free and unmolested use of all the country lying west of the western boundary of the said seven million acres, as far west as the sovereignty of the United States and right of soil extend."

The movement of the Choctaws to the Arkansas River country had begun about 1800 and in 1820 a treaty was effected by which the government promised to give them a grant of land larger than all their holdings east of the Mississippi. This reservation comprised all that part of the present State of Oklahoma south of the Canadian River and a large portion of southern Arkansas. By treaty of 1825 the Choctaws ceded to the Government that portion of their reservation which extended over into Arkansas and established the western boundary of Arkansas south of Fort Smith.

These two nations—the Cherokees and Choctaws—accepted their assigned grants west of the Mississippi with the most solemn guarantee of the Government that no state or territorial lines ever should be extended around them after the western line of Arkansas had been fixed. The history of the events by which these two Indian nations were segregated is the history of the principal events in the formation of Indian Territory.

The first tribe to invade the territory after the settlement of the

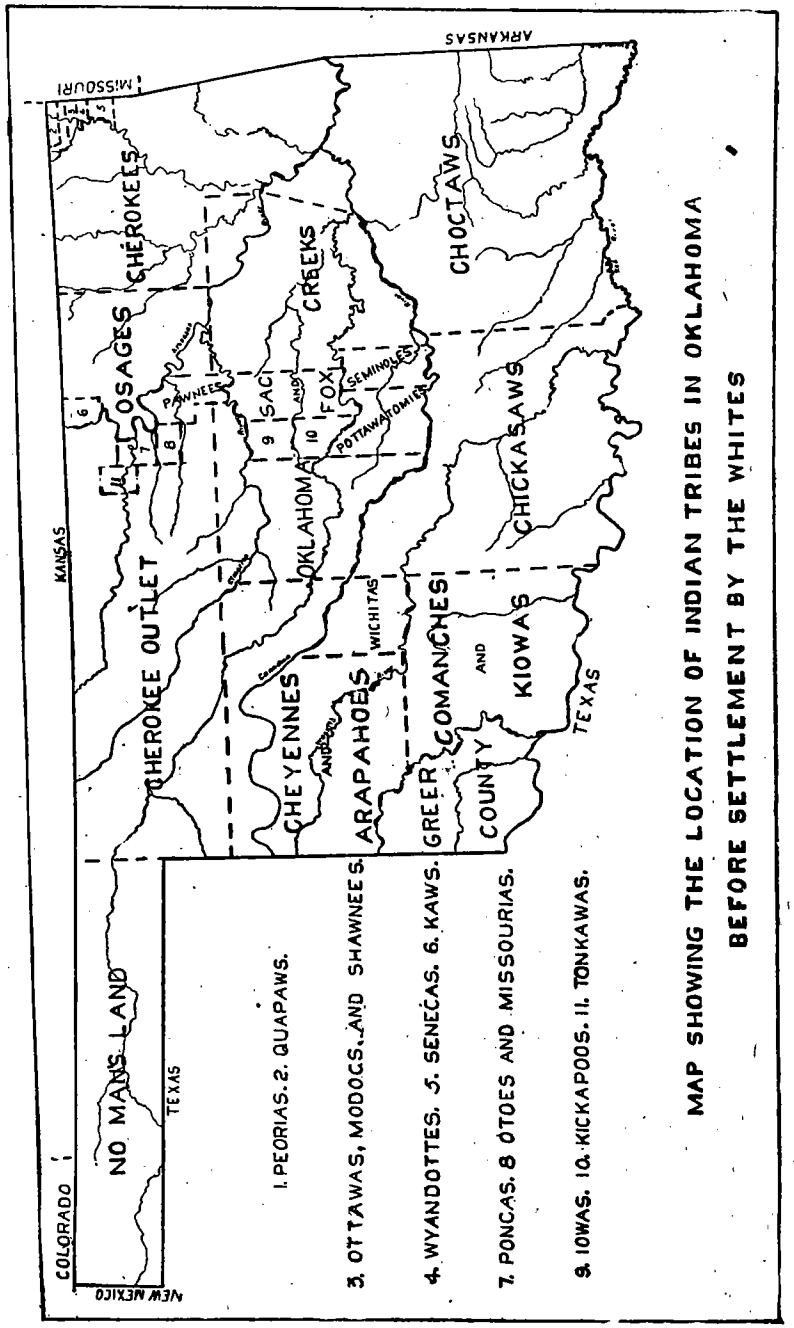


Figure 9.

Cherokees and Choctaws was the Creeks, or in their own language, the Muskogees. After several years of parleying with the Government the Creeks finally accepted a grant of land west of the Mississippi in exchange for their homes in the East. But it was soon found that this grant of land overlapped the reservation of the Cherokees. The result was a gathering of the representatives of the two tribes and the making of agreements by which the boundaries of each were defined. The northern boundary of the Creeks was the line which, running through Tulsa near its eastern end, extended west clear to the Mexican line (or the Texas Panhandle) and in the original Oklahoma was the northern line of Payne, Logan, Kingfisher, and Blaine counties. The southern boundary of the Creek country was Canadian River. All the area between these north and south lines, from near the city of Muskogee on the east, to the Texas line on the west, embracing the greater part of twenty of the present Oklahoma counties, was guaranteed as the perpetual home of the Creeks. By the terms of this treaty it was provided that the Seminoles, a tribe related to the Creeks, should have a place in the Creek reservation, and that this tribe should be considered "a constituent part of said nation." By a subsequent treaty made in 1833 the Seminoles were given a home between the north and south forks of Canadian River extending west of the Creek lands above the mouth of Little River and including parts of the present counties of McIntosh, Hughes, and Seminole.

By the terms of these treaties above discussed all the land lying west of the Arkansas line on the east and the Mexican line on the west and from Red River north to the 37th parallel was assigned. Boundaries to the Indian Country were thus somewhat definitely arranged. The Choctaws received all the present State of Oklahoma south of Canadian River. Part of this country was later given to the Chickasaws. The Creeks and Seminoles received all the land lying north of Canadian River as far as that line that runs about the latitude of Tulsa and marks the dividing boundary between nine or ten modern counties and extends from the Mexican possessions on the west to an eastern line that followed approximately the line of the Missouri, Kansas & Texas Railroad from Eufaula north through Muskogee and Wagoner. All the remainder of the present State belonged, either as an actual home or as an outlet to the western hunting grounds, to the Cherokees. The strip lying west of the 100th meridian had not yet been ceded to the United States. Therefore by the year 1835 the Five Civilized Tribes possessed all the land of the present State of Oklahoma with the exception of the old public land strip—the Texas Panhandle—and Greer County. Greer County was claimed by Texas.

The policy of removing the Indians from the east and concentrating them in some western location embraced the following objects: (1) The removal of the tribes beyond the limits of white settlement and the jurisdiction of state and territorial governments; (2) assignment of lands in perpetuity; (3) seclusion from the whites; (4) government by tribal organization and Indian customs, under the supervision of the United States, and to the end that the Indians might eventually be prepared for participation in the privileges and responsibilities of full citizenship.

To effect the removal, various methods were resorted to. Some of the Indians migrated peaceably and in some cases the Government was compelled to resort to force to effect the removal. Besides receiving large grants of land in the west the Indians were paid by the Government immense sums of money to induce them to consent to the removal. The aggregate sum paid for this purpose up to 1850 was about ninety million dollars—three times as much as was paid for the entire Louisiana purchase, Florida, and California. Besides this the Government maintained a special department to look after the interests of the Indians and by numerous regulations and by a large body of superintendents, agents, and other officials exercised extreme care for the welfare of these wards.

In 1837 the Choctaws and Chickasaws made a treaty near Fort Towson by which the Chickasaws purchased a joint interest in the granted Choctaw reservation. The Chickasaws received the western portion of the reservation. In 1866, in consideration of the sum of $300,000, by a new treaty these tribes ceded to the United States the territory west of the 98th degree, west longitude, known as the Leased District.

During the fifteen years preceding the outbreak of the Civil War the Five Civilized Tribes made great progress in several lines. Besides improving their farms and accumulating greater wealth in the way of flocks and birds and more comfortable homes, the people of these tribes gave other evidences of substantial development. They no longer depended upon the missionary stations to furnish their only educational facilities, but began establishing tribal schools, acadamies, and seminaries. Educational organizations were begun. Many of the Indians had neat, well-kept homes. The women were industrious as a class, and many of them were skillful in spinning, weaving, and sewing.

During the Civil War the Five Civilized Tribes allied themselves with the Confederate States while some of the many Indians from the different tribes fought in the Union armies. Thus the country was divided. This resulted in raids and hostilities among the different tribes, and these, with the ravages of the war itself, left the country in a very pathetic condition. Homes and belongings were destroyed, farms laid waste, stock driven away, and owners compelled to flee for refuge. Dissensions in the tribes kept the dawn of peace farther away. Even after peace conditions were agreed upon with the Government, it was a long time before the friendly relations were reestablished among the tribes and among the people in the tribes. By the terms of the peace treaties with the Government all the tribes agreed to abolish slavery. All consented to the construction of railway lines across their respective tribal reservations. Each treaty made provision for the federation of the tribes of the Indian Territory with a general legislative council, the

membership of which was to be apportioned among the several tribes according to population. Each treaty contained provisions for the settlement of other Indian tribes in the Indian Territory. It was the treaty with Choctaws and Chickasaws that contained the provision that "the Superintendent of Indian Affairs shall be the executive of the proposed territory with the title of Governor of the Territory of Oklahoma." This seems to be the first time that the name "Oklahoma" was suggested for the great State which now bears the title. However, the name was generally used to designate Indian Territory, but was applied to the unassigned lands in the middle of the State from 1879 until the passage of the bill which provided that it should be open to settlement. This region was called "The Oklahoma Country."

Since the whole extent of the Indian Country had been assigned to the Five Civilized Tribes, the Government, in order to make provision for the many other smaller tribes, had to enter into a series of new treaties with these tribes and persuade them to give up some of their holdings to the United States. The Creeks gave up the western half of their domain. The Seminoles ceded their whole reservation to the Government and received in exchange a part of the land which the Creeks had ceded to the Government. The territory which they received is the present Seminole County. The Cherokees by the terms of the treaty of 1866 agreed to allow the Government to settle civilized Indians in their reservation west of the 96th meridian.

The leased district was divided among the Plains Indians as follows: The Cheyenne and Arapahoes received the northern part of the district; the Wichita Caddos were assigned the territory south of the Cheyenne-Arapahoe district; the country south of this reservation was given to the Kiowa, Comanche, and Apache tribes. The eastern part of the land ceded by the Creek Indians was divided among the following tribes: Iowa, Kickapoo, Sac and Fox, Pottawatomie, and Shawnee.

Under the terms of this treaty the Osage Nation was given the land directly joining the Cherokee reservation, or the present Osage country; the Kansas, Nes Perce, Ponca, Oto-Missouri, and Pawnee were assigned the territory on west of the Osage reservation. On agreement with the provisions of a treaty with the Cherokees the northeastern corner of their domain was assigned in small areas to the Quapaw, Peoria, Ottawa, Shawnee, Modac, Wyandotte and Seneca tribes. The small portion of unassigned land in the middle of the territory comprised the original Oklahoma. The State has grown from this little nucleus by the addition of the reservations around it until it now includes all the different Indian assignments and contains over seventy thousand square miles or more than forty-five million acres of land.

The distribution of the present State of Oklahoma among the Indian tribes is shown on figure 9.

The Plains Indians had not enjoyed the advantages of the eastern country and were entirely different from the people of the Five Civilized

Tribes. They were a wild, roving people, and instead of settling on their allotments they roamed at will over the western region. They fought among themselves and made many bloody forays upon the border settlements of Texas on the south and Kansas on the north. One of the first tasks of the General Government after the end of the Civil War was the pacification of the Indian tribes of the Great Plains. Vigorous campaigns were begun against the Comanche, Kiowa, Apache, and the southern divisions of the Cheyenne and Arapahoe. These tribes were persuaded to sign treaties of peace and hostilities were at an end for some time. But for several years the treaties endured only through the winter and spring and when government supplies were not needed for help during the winter these tribes were on the war-path again. In the spring of 1877 several of the tribes joined together in a general outbreak. The hostilities engaged in raiding ranches and running off stock during the early part of the summer. Under the leadership of Quanah Parker they attacked a party of hunters at Adobe Wells on the South Canadian, but were repulsed with heavy loss and had to retire in defeat. A party of hostile Kiowas and Comanches attacked the Wichita agency in the fall and killed several people and burned buildings. When winter came these tribes were again ready to sign treaties of peace but when they wanted to quit the war-path and go to the agencies to draw rations and annuity goods, they found the tables turned. During the exceptionally severe winter which followed, the hostile tribes were kept constantly on the move. They were pursued by Colonel Nelson A. Miles and given no time to rest. The terms which were dictated by the military authorities were those of unconditional surrender. Their arms, their horses and mules were given up. Many of the men were put into prison. These prisoners, except the leaders were released in the following spring. But the punishment inflicted was severe enough to prevent another outbreak. This ended the last general Indian uprising in western Oklahoma.

The railways did their share in the development of Oklahoma. The first railway to enter the Indian Territory (the Missouri, Kansas & Texas) began laying its track southward from the Kansas boundary in June 1870. Its construction was rapidly pushed southward and southwest across the Cherokee, Creek, and Choctaw Nations and thence across Red River into Texas. In 1872 the Atlantic & Pacific Railway (now the St. Louis & San Francisco) built its line across the Shawnee and Wyandotte reservations, entering the Cherokee Nation and effecting a junction with the Missouri, Kansas & Texas at Vinita. In 1880 the Atchison, Topeka & Santa Fe built its line to the Indian Territory boundary, at Caldwell, Kansas, which became a great cattle shipping center.

OPENING OF THE OKLAHOMA COUNTRY.

Settlers in the adjoining states and territories made repeated efforts to enter and colonize the Oklahoma Country but the Government continually interfered and drove them out. Captain David L. Payne led a colony across the Kansas border into the Indian Territory in the summer of 1880, but the leader and followers were arrested and escorted by troops across the border again. In 1881 Captain Payne brought suit in the United States Court at Topeka, Kansas, for damages on account of his forcible removal from the territory. He was frustrated by repeated postponements and in the fall he went to Texas where he organized his second colony. They came to Oklahoma and encamped on Cache Creek, but were expelled by the troops. In the next few years Payne made repeated attempts to settle a colony within the boundaries of the Territory but was not successful. In 1884 Oklahoma "boomers" began to settle the country singly instead of coming in a body. As fast as the settlers were removed others followed. After the death of Payne in 1884, one of his lieutenants, W. L. Couch, was chosen as the leader of the movement to colonize the Oklahoma country but his efforts were as fruitless as those of Payne. Shortly after Payne's death a bill was introduced into Congress for the opening of the unassigned district to settlement by homestead entry. The construction of a new railway line in 1884 led the "boomers" to decide that the lands would soon be open for settlement and no other organized attempt for invasion was made but the "boomers" were still active in agitating the opening of the country. The scene of the contest was shifted to Washington. At last a bill providing for the opening of the Oklahoma country was passed and became a law Nov. 3, 1889. March 23, 1889, President Benjamin Harrison issued a proclamation setting the date for the opening of the unsettled lands to settlement as April 22, 1889. The press of the President's proclamation for the formal opening of the land was eagerly awaited by the prospectives or settlers in many places through the west, and especially along the border of the adjoining state where many of the former "boomers" were residing. Great multitudes on the borders assembled from practically every state in the Union and from all classes and conditions of life. There were many in Arkansas and Texas but the greatest part was in the southern part of Kansas and in addition to the accommodation which could be secured in close-by towns thousands of people lived in camps or in wagons. Peace and good order generally prevailed and the greatest amount of those who came were seeking land on which to build homes. At that time there was but one run of railway in the Oklahoma country, that of the Atchison, Topeka & Santa Fe, which passed through the central part of the tract from north to south. Thousands of persons were in southern Kansas in the district of Kansas City, waiting for the opening day. On the opening day fifteen passenger trains left Kansas City between daylight and 11 o'clock A. M. and it is said that fully ten thousand

people wanted to board the first train out, the larger part of them having been without lodging the night before. People also came to the border in wagons, buggies, on horseback, and on foot. At 12 o'clock everything was in readiness for the rush to the new country and as bugles were sounded along the line the thousands of people passed into the new land to secure possessions of their own. In many cases it happened that the land selected proved to be already in possession of the "sooners" who would sneak out of their hiding places in the bushes in time to beat those who had fully kept the rules prescribed. It is estimated that more than one hundred thousand people came to Oklahoma on the day of the opening, 15,000 of whom are said to have spent the first night in Guthrie, and fully 10,000 in Oklahoma City and many others of the new cities and towns cared for very large numbers.

On the morning of April 23, 1889 the race for claims was over and the serious business of establishing homes and institutions was begun.

NO MAN'S LAND.

In 1845 Texas, which had heretofore been independent was annexed to the United States. It wished to enter the Union as a slave state and in order to do so agreed in 1850 to relinquish all claims to the land north of the Missouri Compromise Line—36 degrees and 30 minutes. The establishment of the bounds of New Mexico left the so-called "No Man's Land" unattached to any state, territory or Indian reservation. This strip of land included the present counties of Beaver, Texas, and Cimarron and was bounded on the north by Kansas and Colorado, on the east by the Cherokee Outlet, on the south by the Texas Panhandle, and on the west by New Mexico. For a number of years this strip was not a part of any state or territory. It was settled however, and the citizens for their own protection met and organized a government and named the country Cimarron Territory. This small territory maintained its separate government until 1890, when it became a part of Oklahoma. The area was for a while known as "Beaver County," but has been divided into Cimarron, Texas, and Beaver counties.

GREER COUNTY.

In 1896 Greer County, a strip of land bounded on the north and east by the North Fork of Red River, on the south by Red River proper, and on the west by the 100th meridian, was added to the Territory of Oklahoma. The title to this land has been in dispute owing to a difference in opinion as to the main body of Red River. Texas had always claimed North Fork of Red River as part of the boundary between that State and the Indian Territory and so claimed Greer County. The question was finally settled in the United States Supreme Court and Greer County was added to the Indian Territory. This area now includes part of Beckham, and all of Greer, Harmon, and Jackson counties.

*Thoburn, T. B., History of Oklahoma, 1916.

STATEHOOD.

After the affairs of the two territories—that of Oklahoma and Indian Territory—were properly adjusted, the Enabling Act was passed by Congress, permitting the people of the two territories to frame a state government. Delegates were elected and a constitutional convention held. A constitution was adopted by the people and on November 16, 1907, the State of Oklahoma was admitted as the 46th state of the Union.

The first settlers of Oklahoma came from all parts of the Union. Rapid development of the State's resources and the building of cities soon followed. At the present time (1917) the population of Oklahoma is about 2,000.000 people.

CHAPTER VII.

EDUCATION IN OKLAHOMA.

GENERAL STATEMENT.

The public schools of Oklahoma are open to all persons between the ages of 6 and 21 years of age. The higher institutions of the State offer educational advantages without tuition. When the lands of the Territory of Oklahoma were open for settlement, sections 16 and 36 in each township were reserved by the government for the benefit of the schools. In certain parts section 13 was also set aside. These school lands have been the source of much money for the schools of the State.

A comprehensive review of the public school system of Oklahoma is given in the Fifth Biennial Report (1914) of the State Superintendent of Public Instruction, as follows:

PUBLIC SCHOOL SYSTEM.

The general scheme of education in Oklahoma includes public, private, and sectarian schools. The public schools are supported by taxation, and it is with this class that we have to deal in this report. Other educational forces at work in the state are the Oklahoma Educational Association, a chartered organization maintained by the teachers, which holds annual meetings; the County Superintendents' Association, maintained by the seventy-seven county superintendents in the state, and which holds an annual meeting each year; the City Superintendents and High School Conference, which meets during the spring at the time of the regular Interscholastic Track Meet held at the State University; the District Teachers' Associations among which should be mentioned the Southwestern, Northwestern, and Northeastern as notable examples; the County Teachers' Associations; the School District Officers' Associations; the Teachers' Reading Circles; and the County Normal Institutes and Training Courses.

The Public Schools may be classified as common schools, high schools, county separate schools, and state schools or colleges. With respect to organization these schools are controlled by boards of directors, in common school and consolidated school districts; by boards of education in independent districts; by the county authorities in county separate school districts; and state boards have supervision over the state schools. There are twenty-five state institutions included in our educational system, viz.:

The University of Oklahoma, two University Preparatory Schools, the Agricultural and Mechanical College, six State Normal Schools, the School of Mines, the Oklahoma College for Women, the Colored Agricultural and Normal University, six district Agricultural Schools and six eleemosynary institutions. The official supervision of all these public schools lies with the State Superintendent, elected by the people; the State Board of Education, appointed by the Governor; a State Board of Agriculture; a State High School Inspector; a Supervisor in every county elected by the people of the county; and local school boards in each district elected by the people of the district. Our state constitution places the Agricultural and Mechanical College together with the six District Agricultural Schools under the control of the State Board of Agriculture. The other state institutions named are under the control of the State Board of Education with the State Superintendent as chairman thereof.

For the purpose of local taxation and administration the state is divided into counties which are subdivided into school districts. These districts may be classified as common school districts, independent districts, consolidated districts, union graded districts, joint districts, and county separate districts. Each common school district, consolidated district, union graded district, and joint district is served by three officers, a director, a clerk and a member. An independent district is served by a board of education composed of three or more members.

The school board in each common school district employs the teachers, has general oversight of the school and school property, conducts the elections held for the purpose of issuing school district bonds and electing school district officers, makes an estimate of the needs of the district for the guidance of the county excise board, issues warrants for payment of claims against the district, and makes certain reports to the county superintendent. The board in a consolidated district, in addition to the powers and duties named above, must provide transportation to and from school for all pupils living two miles and more from the school house. A union graded district is organized by uniting two or more common school districts for the purpose of maintaining a high school for the pupils who have completed the common school course in the districts combining; and the board in such district has control of the union school only, the several common school districts retaining their characters as such and being governed by their respective boards. The board in a union graded district has the same duties and powers with respect to the union graded district that are performed and exercised by common school district officers with the exception of the power to hold elections for the purpose of voting bonds. No provision is made for transporting pupils in union graded districts. A joint district is a common school district which includes territory situated in two or more counties. "Each city of the first class, and each incorporated town maintaining a four years' high school fully accredited with the State University," is an independent district. The board of education in an independent district has all of the powers and duties heretofore mentioned in connection with other school districts with the exception of providing

for the transportation of pupils to and from school. In addition to these powers and duties the board may by a three-fourths vote, elect a superintendent for a term not to exceed three years. This board, also, through its examining committee, issues teachers' certificates valid in the schools of the district, and is custodian of the school district funds.

Our law provides that the public schools of the state shall be organized and maintained upon a complete plan of separation between the white and colored races with impartial facilities for both races; that no person, corporation or association of persons shall maintain or operate any college, school, or institution in this state where persons of both white and colored races are received as pupils for instruction; and that it shall be unlawful for any white person to attend any school, college, or institution where colored persons are received as pupils for instruction. Under the provisions of this statute, we have what is termed "county separate schools." The separate school in each district is defined by the statute as "that school in said school district of the race having the fewest number of children in said school district," and the county superintendent is given "authority to designate what school or schools in each school district shall be the separate school and which class of children, either white or colored, shall have the privilege of attending such separate school or schools in said school district." It is also provided that members of the school district board shall be of the same race as the children who are entitled to attend the school of the district not the separate school.

Although the separate school is called the "county separate school," it will be noted that it is organized on a basis of the district as a unit.

The separate schools are supported by a tax levy made by the county commissioners on all taxable property in the county; the county clerk issues warrants for salaries of teachers employed in all separate schools and for the other expenses of said schools, which warrants must be countersigned by the county superintendent of public instruction, and the county superintendent of public instruction employs all teachers for the county separate schools except for those county separate schools located in independent districts. Thus for purposes of maintenance and administration the county separate schools become county schools in fact.

It is a matter of regret that we have no data available relating to the cost of our separate schools as compared with the cost of the majority schools. In some districts the white school is the county separate school, while in other districts the colored school is the county separate school.

The state schools are maintained with public funds appropriated by the Legislature for that purpose.

We have in Oklahoma, as shown by special reports made by each county superintendent, 110 private, parochial, and denominational schools. These schools consist of elementary schools, academies, business schools, and colleges. Elsewhere in this report will be found such data as it was possible for the State Department of Education to secure concerning these

schools. They are supported by endowments, contributions, and tuition fees. While these schools are not under the supervision of the State Superintendent or the State Board of Education, many of them do educational work of a high order and it is a matter of regret that we cannot submit in this report detailed information concerning them. In addition to these the federal government maintains several schools for children of Indian descent.

Substantial educational progress has been made during the past two years. Sixty new districts have been organized during that time and approximately 100 new buildings have been erected. In 1912 the county superintendents reported 6,647 school buildings, while in 1914 their reports showed 6,609, a net decrease of 38 buildings. The decrease is due to several causes, among which may be mentioned the consolidation of rural school districts which led to the abandonment of the little one-room country school houses, the building of large buildings in some of the cities and the concentration of the pupils at these larger buildings. Some of the new buildings replaced older school houses that had been destroyed or had become dilapidated. In 1912 there were 541,828 persons of school age enumerated in the state, and 438,901 were enrolled in the public schools exclusive of state schools. In 1914 there were 575,021 persons enumerated and 496,908 enrolled. The increase in the enumeration during this time has been only 33,193, or 6.1 per cent, while the increase in the enrollment in the public schools was 68,007, or 15.4 per cent. During the same time the average daily attendance has increased 47,423, or 17.5 per cent.

Despite this growth in enrollment and average daily attendance, the teaching force remains about the same—numerically—consisting of 11,739 teachers in 1914, as compared with 11,740 in 1912, although the salaries of these teachers have been increased in proportion to the added work. The reports for 1912 show that the teachers received during that year the sum of $4,076,444.32, and the reports for 1914 show $5,257,046.34 paid for teachers' salaries during that year, same being an increase of more than 28 per cent.

Considerable improvement has been made in the schools with respect to the number of pupils who complete the common school course of study and later enroll in the high schools. The increase in the number of high schools has had a great deal of influence on this phase of our educational development. There were issued to eighth grade graduates by the State Department of Education during the spring of 1911, 3,725 common school diplomas, and during the spring of 1912, 4,436 such diplomas were issued. In 1913 the number of graduates of the common schools was 5,647, and in 1914 the number became 6,745, an increase of 81 per cent over the number graduated in 1911. Each year a larger number of eighth grade graduates enter our high schools. Unfortunately, reliable statistics are not available to show this growth in high school enrollment from year to year. There were 10,612 pupils doing high school work in the state in 1910, and 19,414 enrolled in the high schools in 1914. This represents an improvement of 82.9 per cent during four years, or an average of 20.7 per cent increase each year. The reports received from the high schools recently indicate that this percentage of increase will be maintained during the present year.

PUBLIC SCHOOL FUNDS.

The educating of the people is the largest business of the state. The public school touches the lives of all the people. It costs more dollars than any other business with which the state concerns itself. Yet the average man or woman, having become accustomed to free schools and accepting them as a matter of course, does not stop to inquire from whence comes the money with which these schools are maintained.

The organic act of Oklahoma Territory made provision for setting aside certain land as an endowment for public schools. Each act of Congress opening additional land to settlement in Oklahoma Territory reserved certain sections of this public land for educational purposes. The Enabling Act confirmed these reservations of the public domain and added thereto. Hence it is not necessary at this place to go back prior to the passage of this act in order to ascertain the extent and source of Oklahoma's permanent school endowment.

By the terms of the Enabling Act, sections sixteen and thirty-six in every township in Oklahoma Territory and all indemnity lands that had been selected in lieu thereof, were granted to the State for the use and benefit of the common schools. This common school grant consisted of 1,415,000 acres.

Also by the terms of this act "Section thirteen in the Cherokee Outlet, the Tonkawa Indian Reservation, and the Pawnee Indian Reservation, reserved by the President of the United States by proclamation issued August 19, 1893, opening to settlement the lands, and by any act or acts of Congress since said date, and section thirteen in all other lands which have been or may be opened to settlement in the Territory of Oklahoma, and all lands selected in lieu thereof," were granted to the institutions of higher learning. This grant consists of 350,000 acres. Land in Oklahoma under the control of the government and not filed on prior to the date of the Enabling Act was granted to the state for the use and benefit of the educational institutions. Under section 3, article 2, chapter 28, Session Laws of Oklahoma, 1909, these lands have been designated "New College Lands," and are so carried on the records of the land office. These "New College Lands," are located principally in Beaver, Cimarron, and Texas counties. This grant consists of 1,050,000 acres, which added to the section thirteen grant makes a total of 1,400,000 acres set aside for the state educational institutions of higher learning.

Section thirty-three was set aside for public buildings, penal and charitable institutions, etc., but in January, 1897, Congress reserved section thirty-three in Greer County to Oklahoma "for such purposes as the Legislature of the future state may prescribe." The Legislature of the state, by act passed in March, 1911, set aside section thirty-three in Greer County to be used to assist in promoting consolidated rural schools. This consists of 40,480 acres.

By an act of the Legislature approved March 13, 1913, the residue of the "Public Building Fund" in excess of the amounts required for the

payment of all outstanding bonds and interest thereon, issued against said fund, is set aside for the union graded or consolidated school fund. The number of acres available under this act cannot be determined until the lands are sold or the bonds liquidated.

Summarizing the above, the lands set aside for educational purposes in Oklahoma are as follows:

Common School, Sections 16 and 36	1,415,000 acres
State School, Sections 13 and Indemnity	350,000 acres
State School, "New College"	1,050,000 acres
Section 33, Greer County Consolidated School	40,480 acres
Total school land endowment of Oklahoma	2,855,480 acres

In lieu of sections sixteen and thirty-six and other lands of the Indian Territory, there was appropriated $5,000,000 by Congress at the time Oklahoma was admitted to statehood.

The 2,855,480 acres of land and the five million dollars appropriated by Congress constitute the basis of Oklahoma's permanent school fund. Part of the school land, 1,203,006 acres has been sold, and the net proceeds of the sale, $9,011,562.15, has been placed to the credit of the permanent school fund of the State.

The school lands remaining unsold are leased and the school funds are loaned on approved farm security. The income derived from the rentals of the land and the interest money loaned is apportioned to the school districts in the state each year. This apportionment is made on a per capita basis, and at the same time that other state money is apportioned to the schools During the school year 1912-13 this apportionment amounted to $1.95 per capita and during the school year 1913-14, $2.25 per capita was apportioned.

The State also levies taxes in support of the common schools. The rate of levy is one-fourth mill. There was collected during the fiscal year ending June 30, 1913, and apportioned to the school children of the state, $142,078.25. During the fiscal year ending June 30, 1914, there was collected and apportioned $140.737.17 in state taxes for the common schools.

All of the income tax levied by the State is turned into the common school fund. In addition to this one-half of the inheritance tax collected is paid into the state common school fund, the other half going to the general revenue fund. During the past fiscal year this income tax and one-half of the inheritance tax amounted to $9,342.49. All persons whose annual incomes are in excess of $3,500 are subject to this tax. School directors should report to the State Auditor the names of all persons residing in their district who are subject to this tax. In addition to the school tax levied by the State, each county makes a levy for the support of the common schools in the county. The rate varies in the counties.

The people in the districts, through their directors, make levies to supplement the above funds.

The directors may charge non-resident pupils tuition. This is done in a great many districts, especially where the pupils have finished the common schools and have entered the city high schools.

Buildings are provided by bond issues in the several districts or by warrants where the people of the districts choose to build by the rental plan.

Below is given the usual income of the common schools for one year as shown by the records of the land office, the State Auditor and reports of the county superintendents:

Income from common school lands	$ 624,034.83
Income from $5,000,000 fund (farm loans)	242,646.97
Income from Greer County, section 33	13,900.17
Income from state tax	140,737.17
Income from inheritance tax	9,342.49
Income from county tax	126,769.85
Income from district tax	5,702,052.81
Income from sale of bonds	933,574.57
Income from tuition and other sources	554,502.40
Total income for the year	$8,347,561.26

The above figures cover the income of the common schools for one year. The revenue derived from rentals of the state school, or college lands, amounted to $224,145.03 during the year considered.

From the above figures one can readily see the sources of school funds from the magnitude of the school business in Oklahoma. It is by far the largest business that the State conducts and should receive the most careful attention and consideration of every citizen of the State.

As the state school fund has increased it has been possible to reduce the percentage of money levied for the support of the schools by local authorities. From the accompanying table may be gained some idea of the manner in which the state school fund has grown during the past nine years.

State School Fund.

Year	Enumeration	Apportionment	Per Capita Distribution
1906	225,943	$ 343,931.00	$1.52
1907	218,817	306,343.80	1.40
1908	472,683	310,993.95	.65
1909	500,281	750,226.00	1.50
1910	515,478	770,010.50	1.50
1911	539,058	970,304.80	1.80
1912	556,818	1,085,795.10	1.95
1913	541,828	1,056,564.00	1.95
1914	557,004	1,271,246.00	2.25

There has been a steady increase in the enumeration of pupils and in the revenues derived from rentals of school lands. The enumeration in 1908 was more than twice as great as in 1907, because the children in the Indian Territory part of the State were enumerated for the first time that year; and, while the total apportionment for the year was $4,650.15 greater than for the preceding year, the per capita fell to 65 cents. In 1912 a new method of taking the enumeration was devised. Under this system the enumeration for 1913 fell below that of the previous year.

The enumeration for 1914 is larger than for any preceding year. The apportionment of the school funds for this year was also larger than ever before. The apportionment in January of 1914 was $1.25 per capita, or a total of $696,255.00. The July apportionment was $1.00 per capita, or a total of $575,021.00, making an aggregate apportionment of $1,271,246.00 for the year, and a per capita apportionment of $2.25. The apportionment for January, 1914, was made on the enumeration of 557,004 pupils reported in January, 1913. The apportionment in July was made in accordance with the terms of the amended law, on a basis of the enumeration as reported in January, 1914, and which showed a scholastic population of 575,021.

EDUCATIONAL AND CORRECTIVE INSTITUTIONS.

EDUCATIONAL INSTITUTIONS.

STATE INSTITUTIONS.

THE UNIVERSITY OF OKLAHOMA.

Location.

The University of Oklahoma, a co-educational institution, is located just a short distance south and west of the center of the State, at Norman, the county seat of Cleveland County. Norman has excellent railway facilities. There are four passenger trains north and four south daily over the Gulf Coast line of the Atchison, Topeka & Santa Fe Railway; and the Oklahoma Railway Company maintains a car every hour over its interurban lines to Oklahoma City, El Reno, Edmond, and Guthrie. Close connections with trains for all parts of the State can be made at Oklahoma City.

History.

The University of Oklahoma is founded upon the authority of an act of the legislature of the Territory of Oklahoma, entitled, "An act to locate and establish the University of Oklahoma." The act provided that when $10,000 and 40 acres of land should be given to the territory by the city of Norman the school should be located at that place. These requirements having been met, the University of Oklahoma was established at Norman in 1892.

The first legislature of the State, in 1907, adopted the territorial law, with such additions and changes in details as seemed necessary at the time.

The University accepted students for the first time in the fall of 1892. In the spring of 1893 work was begun on the first building, which was occupied in the following September. During the first years the institution was a university in name only; a very large majority of the students were members of the lower classes of the preparatory school.

Colleges and schools have developed in the following order:

The College of Arts and Sciences, 1893; the School of Pharmacy, two-year plan, 1893, four-year plan, 1908, three-year plan. 1914; graduate work, 1899, the Graduate School organized separately, 1909; the School of Medicine, first two years' work, 1900, third and fourth years, 1910; the School of Fine Arts, 1903; the School of Applied Science and the School of Mines, 1904, reorganized as the College of Engineering, 1909; the Summer Session, 1908; the School of Law, 1909; the School of Education, 1909; Training School for Nurses, 1912; School of Commerce and Industry, 1913; School of Journalism, 1913.

The first class was graduated from the School of Pharmacy in 1896; the first degrees were granted by the College of Arts and Sciences in 1898; the first master's degree was granted in 1900; the first degree was granted by the School of Fine Arts in 1905; the first in engineering in 1908; the first for the four-year course in pharmacy in 1910; the first by the School of Law in 1910; the first by the School of Medicine in 1910; the first nurse's diploma in 1913.

David Ross Boyd was president of the University from 1892 to 1908. Arthur Grant Evans was president of the University from 1908 to 1911. Julien Charles Monnet was acting president during the school year 1911-12. Stratton Duluth Brooks became president of the University on May 1, 1912.

Grounds and Buildings.

The University of Oklahoma occupies a campus of one hundred and twenty acres, on which are located seven large buildings—University Hall, Science Hall, Library, Engineering Building, Monnet Hall, Chemistry Building, and Gymnasium. In addition to these buildings there are several small wooden buildings, used temporarily until permanent buildings can be constructed. The last legislature (1917) appropriated money for the construction of four new buildings: an auditorium, a geology building, a wing for the library building, to be located on the campus at Norman, and a medical building to be located at Oklahoma City. These appropriations total $425,000.

Support.

The University of Oklahoma is supported from the general revenue of the State and from the income received from lands set aside by Congress out of the public domain as an endowment for the State Schools.

The revenue for the years ending June 30, 1918, and June 30, 1919, follows:

For Support and Maintenance.

	Year ending June 30, 1918	Year ending June 30, 1919
General appropriation	$ 91,400	$ 47,765
From Section 13	13,800	9,785
New College Lands	10,800	10,500
Total	$116,000	$68,050
For Salaries, General Appropriation	$185,600	$216,060
Section 13	55,200	38,940
New College Lands	43,200	42,000
Grand total	$400,000	$365,050

Administration.

The University of Oklahoma is a part of the public educational system of the State. The governing body of the institution is the State Board of Education, consisting of the Superintendent of Public Instruction and six members appointed by the Governor.

Departments.

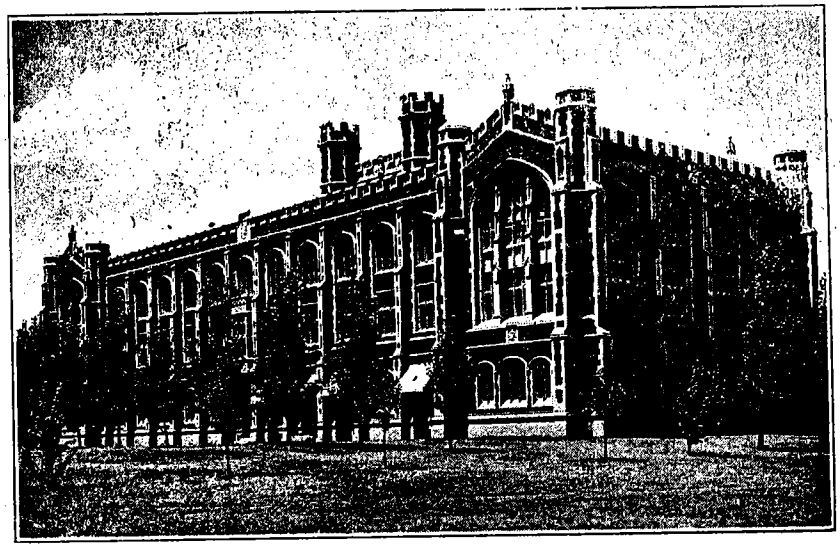
The University of Oklahoma comprises the following colleges and schools:

The Graduate School.
The College of Arts and Sciences, including
  The School of Commerce and Industry.
  The School of Education.
  The School of Journalism.
The School of Fine Arts.
The School of Law.
The School of Medicine, including
  The Training School for Nurses.
The School of Pharmacy.
The College of Engineering, including
  The School of Chemical Engineering.
  The School of Civil Engineering.
  The School of Electrical Engineering.
  The School of Mechanical Engineering.
  The School of Mining Geology.

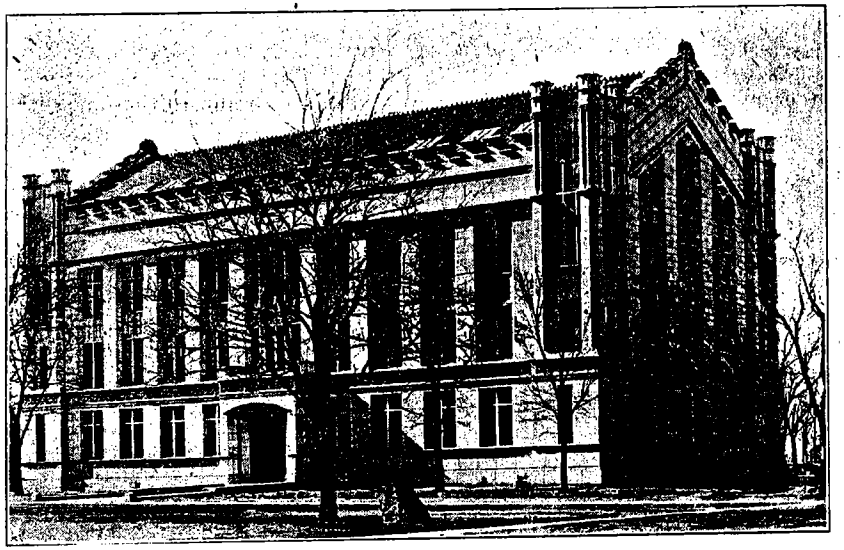
Purpose.

The purpose of the University is stated in the following laws enacted by the Legislature of the Territory of Oklahoma, and adopted by the first Legislature of the State:

(6787) Sec. 9. The object of the University of Oklahoma shall be to provide the means of acquiring a thorough knowledge of the various



A. ADMINISTRATION BUILDING, UNIVERSITY OF OKLAHOMA, NORMAN.



B. DEBARR HALL—CHEMISTRY BUILDING—OKLAHOMA UNIVERSITY. NORMAN.

branches of learning connected with scientific, industrial, and professional pursuits, in the instruction and training of persons in the theory and art of teaching, and also the fundamental laws of the United States and this territory in what regards the rights and duties of citizens.

(6788) Sec. 10. The college department of arts shall embrace the courses of instruction in mathematical, physical, and natural sciences with their applications to the industrial arts, such as agriculture, mechanics, engineering, mining, metallurgy, manufactures; architecture, and commerce, and such branches included in the college of letters as shall be necessary to proper fitness of pupils in the scientific and practical courses of their chosen pursuits, and in military tactics; and in the normal department the proper instruction and learning in the theory and art of teaching in the common schools; and as soon as the income of the University will allow, in such order as the wants of the public shall seem to require, the said courses in the sciences and their application to the practical arts shall be expanded into district colleges of arts, and shall embrace a liberal course of instruction in languages, literature, and philosophy, together with such courses or parts of courses in the college of arts as the regents of the University shall prescribe.

(6789) Sec. 11. The University shall be open to female as well as to male students, under such regulations and restrictions as the board of regents may deem proper, and all able-bodied male students of the University in whatever college may receive instruction and discipline in military tactics, the requisite arms for which shall be furnished by the territory.

The University of Oklahoma is a part of the public educational system of the State. In accordance with the laws of Oklahoma, the University provides an opportunity to continue the work that is begun in the public schools, and furnishes, without charge for tuition, facilities for academic training and for thorough professional study.

Apart from this close connection with the public schools, it is the purpose of the University of Oklahoma to reach general readers and investigators throughout Oklahoma. It is able to serve the general public chiefly through University Extension. So far as possible, however, all its equipment is made useful to the people of the State at large.

Beyond its directly educational work, the University of Oklahoma stands as the concrete expression of the intellectual activity of the State, engaged in doing its part in extending the field of knowledge, especially in such directions as may be of the greatest and most obvious benefit to mankind. Thus by the action of the legislature it is called upon to do such research work as will best aid the citizens of the State. Also, by locating the offices of the Geological Survey here, the legislature manifestly intended to use the facilities of the University for research in such a way as to aid in the development of the mineral resources of the State.

UNIVERSITY PREPARATORY SCHOOLS.

Oklahoma University Preparatory School.

The Oklahoma University Preparatory School was founded and located at Tonkawa by the following enactment of the Territorial Legislature, approved March 8, 1901:

There is hereby created and established a University Preparatory School for the Territory of Oklahoma, which shall be located within one mile of the corporate limits of the town of Tonkawa, in Kay County in the Territory of Oklahoma, to be known as the University Preparatory School.

The town of Tonkawa donated twenty acres of land adjoining the town to the east. A four-story building of limestone and pressed brick was built on this land, and school opened in September, 1902, with a faculty of 7 instructors and an enrollment of 227 students. The school grew in attendance and buildings were added as needed.

The city of Tonkawa is located in the southwestern part of Kay County, on the Hunnewell branch of the Santa Fe Route.

The support of the school was derived from the following sources:

1. Legislative appropriation.
2. "Section Thirteen Fund, State Educational Institutions."
3. A proportionate share of the New College Fund.

The main purpose of the school is stated in the Act of 1901, as follows:

The purpose of such school (University Preparatory School) shall be to provide instruction for students of Oklahoma, which will prepare such students for a university course of study. The school, however, has enlarged its course to take care of all classes of secondary students.

The Legislative appropriation for this school for the two years ending June 30, 1919, was vetoed by the Governor, and this school closed as a State institution June 30, 1917. The city of Tonkawa has taken over the property and will conduct its high school there.

Eastern University Preparatory School.

The State University School, at Claremore, Oklahoma, was established by act of the Legislature of 1909, on condition that the city of Claremore give to the school a tract of land of not less than thirty-five acres. This condition was met by the people of Claremore and the school was established.

Claremore, the seat of the school, is situated in Rogers County in the northeastern part of Oklahoma at the junction of the Iron Mountain and Frisco railroads.

The purpose of the school as stated in the act which created it, is to prepare young men and young women "for entrance to the State University or any other institution of higher learning." This course was, however, enlarged to include the practical subjects, thus taking care of students who were unable to attend a university after completing the preparatory course.

The legislative appropriations for this school for the two years ending June 30, 1919, were vetoed by the Governor. This school closed

as a State institution June 30, 1917. The city of Claremore has taken over the property and will incorporate it into its school system.

OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE.

Location.

Oklahoma Agricultural and Mechanical College, a co-educational institution, is located at Stillwater, in Payne County, somewhat north of the center of the State. Stillwater is on the Arkansas City-Pauls Valley branch of the Atchison, Topeka & Santa Fe Railway, which operates three passenger trains north and three passenger trains south daily.

History.

The Agricultural and Mechanical College owes its origin to a bill offered by United States Senator Morrill of Vermont, in 1862, which provided funds for one such institution of learning in every state of the Union, and set aside certain public lands from which endowments have come to each of these State and Federal colleges.

In 1887 Congress provided for an Agricultural Experiment Station in connection with the Land Grant colleges.

The First Legislature of the Territory of Oklahoma adopted a resolution assenting to and accepting the provisions of Congress and established the Oklahoma Agricultural and Mechanical College in Payne County at Stillwater, December 25, 1890.

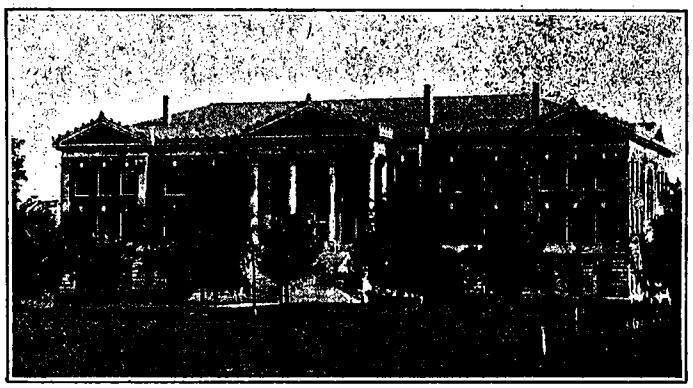
Grounds and Buildings.

The campus covers 80 acres and the farm 1,000 acres. Fourteen especially designed buildings of brick and stone comprise the main plant of Oklahoma Agricultural and Mechanical College. In addition there are ten minor buildings, including modern barns, pavilions, poultry plant, greenhouse, and dairy.

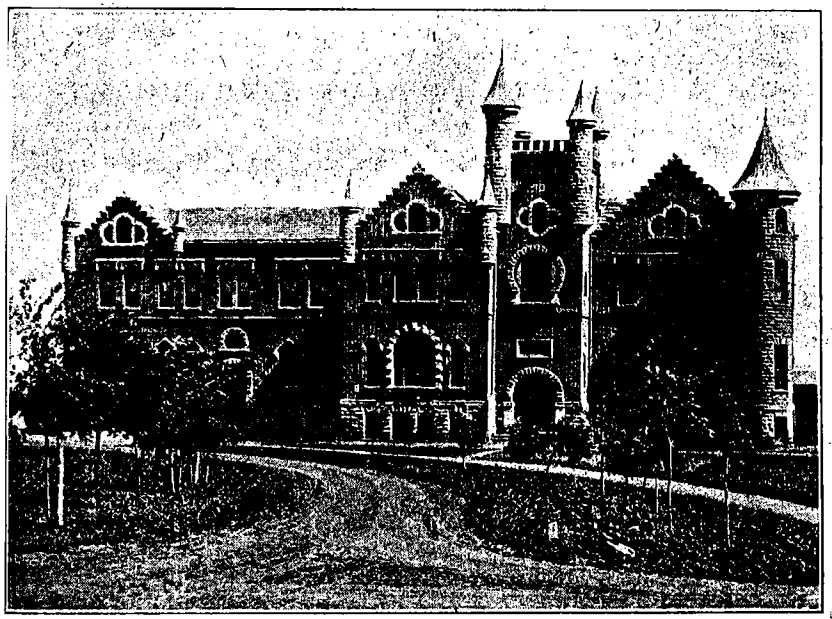
Support.

The College derives its support from both Federal and State governments. The Morrill fund from the Federal Government is used for instruction of students in literature, languages, the sciences, and for the preparation of school teachers in the principles of agriculture and home economics. The Hatch and Adams Federal funds support the Oklahoma Agricultural Experiment Station, and the Smith-Lever bill adopted by the Sixty-Third Congress provides increase in support from cooperative agricultural extension work for a period of ten years, when the permanent basis of this support is reached. This fund is dependent upon cooperative support by the State, and is available only for agricultural extension work. A fund derived from the rental of public lands donated by Congress to Oklahoma Agricultural and Mechanical College under the Enabling Act granting statehood to Oklahoma, known as the "Land Lease Fund," is used for operating expenses of the college proper. The State Legislature appropriates annually or biannually a fund for buildings, repairs, and extensions to permanent equipment.

PLATE XXXIX.



A. MORRILL HALL, AGRICULTURAL AND MECHANICAL COLLEGE, STILLWATER.



B. LIBRARY BUILDING, AGRICULTURAL AND MECHANICAL COLLEGE, STILLWATER.

Administration.

The Oklahoma State Board of Agriculture is the ex-officio Board of Regents of the institution, of which board Frank M. Gault is president. Since June, 1915, J. W. Cantwell has been president of the College.

Departments.

The studies of the College are grouped into the following schools:

The School of Agriculture.
The School of Engineering.
The School of Home Economics.
The School of Science and Literature.
The School of Education.
The School of Commerce and Marketing.
The School of Veterinary Medicine.

Purpose.

The service rendered by the Oklahoma Agricultural and Mechanical College to the State is three-fold:

(1) To educate and train in all that relates to applied science, the industries and citizenship, by affording both liberal and technical studies, laboratories, shops, and fields for the development of character. the mind, and industrial efficiency—the College proper.

(2) To carry forward investigations in agriculture of a research or experimental nature, to learn and demonstrate new facts of importance to farmers and the youth of the State—the Agricultural Experiment Station.

(3) To instruct school teachers, children, and citizens living in all parts of the State in the best proven practice of scientific agriculture. the industries, the sciences, and in the broad fields of home economics and home building—the Extension Division.

State Agricultural Schools.

Affiliated with Oklahoma Agricultural and Mechanical College are six State Agricultural schools: Cameron School of Agriculture, Lawton, Comanche County; Connell State School of Agriculture, Helena, Alfalfa County; Conners State School of Agriculture, Warner, Muskogee County; Haskell State School of Agriculture, Broken Arrow, Tulsa County; Murray State School of Agriculture, Tishomingo, Johnston County; and Panhandle Agricultural Institute, Goodwell, Texas County. These schools were established early in statehood.

The appropriations for the years ending June 30, 1918, and June 30, 1919, for the Connell State School of Agriculture and the Haskell State School of Agriculture were vetoed by the Governor. Preparations are now under way whereby the buildings at these places will be utilized for other State institutions.

NORMAL SCHOOLS.

General Statement.

Oklahoma has six Normal Schools, as follows: Central State Normal, Edmond, Oklahoma County; East Central State Normal, Ada, Pontotoc County; Northeastern State Normal, Tahlequah, Cherokee County; Northwestern State Normal, Alva, Woods County; Southeastern State Normal, Durant, Bryan County; and Southwestern State Normal, Weatherford, Custer County.

All these normal schools are supported by money available from the "Section Thirteen Fund" and by legislative appropriations.

The purpose of these institutes is to provide for the instruction of both men and women in the art of teaching, and in all branches of learning which pertain to a good common school education; also to give instructions in the theory and practice of teaching.

All these schools are parts of the public educational system of the State. The governing body is the State Board of Education, consisting of the Superintendent of Public Instruction and six members appointed by the Governor.

Central State Normal.

Location.

Central State Normal is located at Edmond, Oklahoma County, in the central part of the State. Edmond, a city of about 3,000, is served by the Atchison, Topeka & Santa Fe Railway, which operates four passenger trains north and four passenger trains south daily. The Oklahoma Railway Company maintains hourly service from Edmond to Guthrie, Oklahoma City, El Reno, and Norman.

History.

The Central Normal was created by the Territorial Legislature of 1890. The first Normal building, constructed of brick, was completed in 1893.

Grounds and Buildings.

For the purpose of locating the Central State Normal, forty acres were provided within one mile of Edmond. Ten acres of the land were reserved as a site for buildings, the remainder being platted into lots and blocks for sale, from which funds were received to aid the support of the institution. The school now has three buildings and a power house.

East Central State Normal.

Location.

The East Central State Normal is located at Ada, a city of approximately 7,000 in Pontotoc County, in the east-central part of the State. The city of Ada is supplied with three railroads: the St. Louis and San Francisco Railway Company, which operates two passenger trains south and two passenger trains north daily; Missouri, Kansas and Texas Lines,

on which operate two passenger trains southeast and two northwest daily; and the Atchison, Topeka & Santa Fe Railway Company, which operates two passenger trains west and two east daily.

History.

On the last day of the regular session of the Second Legislature a bill was passed, creating the sixth State Normal School. The bill carried an appropriation of $100,000 for the erection of a building. The general appropriation bill had already been passed and no provision was made for maintenance and equipment of the new school. The citizens of Ada advanced the money necessary for the conduct of the school until the legislature should meet and make an appropriation. School opened September 20, 1909, in the Ada high school building. The contract for the new building was let in October, 1909 and was completed July, 1910. The special session of the legislature which was convened in 1910 made an appropriation for maintenance and equipment.

Grounds and Buildings.

The campus comprises twenty acres donated by the citizens of Ada. The Main Building is a large, three-story structure of pressed brick, containing thirty-nine recitation rooms, and an auditorium with a seating capacity of 1,100. A gymnasium building has been erected.

Northeastern State Normal.

Location.

Northeastern State Normal is located at Tahlequah, Cherokee County, Oklahoma. Tahlequah has one railroad, the St. Louis and San Francisco Railway, on which operate two passenger trains east and two west daily.

History.

The Northeastern State Normal School was established at Tahlequah by an act of the State Legislature in March, 1909. The bill establishing the school carried an appropriation for the purchase of the Cherokee National Female Seminary and forty acres of land belonging thereto.

Grounds and Buildings.

The school has a splendid campus of forty acres, on which are numerous shade trees and springs of water. The building is a large three-story brick structure erected in 1889 to serve as a female seminary for the Cherokee people.

Northwestern State Normal.

Location.

The Northwestern State Normal is located at Alva, Woods County. Alva is served by two railroads: the Chicago, Rock Island and Pacific Railway, on which operate two trains daily—one north and one south; and the Santa Fe Railway, on which run two trains northeast and two southwest daily.

History.

The Northwestern State Normal was established in 1897 by an act of

the Territorial Governor, Cassius M. Barnes. The main building was erected in 1898. An act of the first Legislature of the State of Oklahoma confirmed the Northwestern State Normal as one of the permanent State educational institutions.

Grounds and Buildings.

The campus consists of forty acres, upon which is located the buildings—the Main Building, Science Building, and the Power House.

Southeastern State Normal.

Location.

Southeastern State Normal is located at Durant, Bryan County. Durant is supplied with three railroads: Missouri, Kansas and Texas Lines, on which operate four passenger trains north and fourth south daily; the St. Louis and San Francisco Railway which operates two trains east, and two west daily; and the Missouri, Oklahoma and Gulf Railway, which operates two trains north and two south daily.

History.

The Southeastern State Normal was established in 1909 by an act of the Second Legislature.

Grounds and Buildings.

The campus consists of twenty acres, in the center of which is located the one building. Part of the campus is naturally wooded and parts have been planted to trees.

Southwestern State Normal.

Location.

Southwestern State Normal is located at Weatherford, Custer County. Weatherford is supplied with one railroad, the Chicago, Rock Island and Pacific Railway, on which operate two trains east and two west daily.

Grounds and Buildings.

The campus has an abundance of shade trees. The school has the following buildings: Administration Building, Science Building, Power House, and Janitor's home.

OKLAHOMA COLLEGE FOR WOMEN.

Location.

The Oklahoma College for Women is located at Chickasha, Grady County. Chickasha is served by three railroads: the Chicago, Rock Island and Pacific Railway, on which operate four passenger trains south, four north, two each way between Chickasha and Mangum, and two each way between Chickasha and Lindsay; the St. Louis and San Francisco Railway, on which operate two passenger trains northeast and two southwest daily; and the Atchison, Topeka and Santa Fe Railway, on which are two outgoing passenger trains to the east and two incoming trains from the east.

History.

This institution was established by act of the State Legislature in 1908.

The first session of the school opened in five rooms of the Chickasha high school building, September 14, 1909. The second year's work was carried on in the First Baptist Church, in a nearby apartment house, and rooms of the Chickasha Business College.

The school's first building was dedicated May 16, 1911, and the third session of the school opened in its own home September 12, 1911.

Grounds and Buildings.

The city of Chickasha donated twenty acres just northwest of the city to the school for a campus, and another tract of 140 acres in the country. The college has two buildings; the Administration Building, and the Nellie Spanks Hall.

Support.

The College is supported by appropriations made by the Legislature and approved by the Governor.

Administration.

The College is governed by the State Board of Education, which consists of the State Superintendent of Public Instruction and six members appointed by the Governor.

Departments.

The school maintains a Department of Technical Arts, a Department of Academic Arts, a Department of Fine Arts, and a Secondary School.

Purpose.

The purpose of this institution is to provide for the moral and intellectual advancement of the girls of Oklahoma. The young ladies are trained along lines that will make them efficient home-makers, and at the same time the training is so practical that any young lady completing the course should be able to provide for herself should she so desire.

OKLAHOMA SCHOOL OF MINES AND METALLURGY.

Location.

The School of Mines is located at Wilburton, the county seat of Latimer County. The city of Wilburton is on the Memphis-Amarillo Division of the Rock Island Railroad and is also the terminus of the Missouri, Kansas and Texas Railway branch east from McAlester. The Rock Island maintains three passenger trains west and three east daily, and the Missouri, Kansas and Texas Railway maintains two trains each way daily between Wilburton and McAlester.

History.

The Oklahoma School of Mines and Metallurgy was created by the first State Legislature. The school was opened in temporary quarters in Wilburton, January 11, 1909. The appropriations for the support of this school for the years ending June 30, 1918, and June 30, 1919, were vetoed by the Governor. Arrangements are being made whereby the University of Oklahoma at Norman will take over the work of this school.

Grounds and Buildings.

The campus, consisting of sixty acres, was donated to the school by the citizens of Wilburton. The school has three large substantial buildings.

Support.

The school was supported by appropriations made by the Legislature and approved by the Governor.

Administration.

The school was governed by a board of three regents, appointed by the Governor.

Departments.

The following departments were maintained: Department of Mining, and Department of Metallurgy. In addition to these departments conducted for regular students a Night School was maintained for miners.

Purpose.

The purpose of the School of Mines and Metallurgy is to "teach such branches in mining and metallurgy as will give a thorough technical knowledge of mines and mining, and all subjects pertaining thereto, including physics and mining engineering, mathematics, chemistry, geology, minerology, metallurgy, the subjects of shop work and drawing, the technical knowledge of mine gases, assaying, surveying, drafting of maps and plans and such other subjects pertaining to mining engineering as may add to the safety and economical operation of mines within the State."

OKLAHOMA SCHOOL FOR THE BLIND.

The Oklahoma School for the Blind was originated by Miss Lura A. Rowland, now Mrs. Lura A. Lowrey. Miss Rowland, a graduate of the Arkansas School for the Blind, established in 1897 a school for the blind in Indian Territory. It was known as the International School for the Blind. The school being private was supported by public and private subscriptions until 1908, when the First Oklahoma Legislature appropriated $5,000 for the maintenance of the "Lura A. Lowrey School for the Blind" and at the same time placed the institution under the control of the State Board of Education. School was conducted in a building formerly occupied by U. S. Army officers when a fort was maintained at Fort Gibson. Later the school was located at Muskogee and permanent quarters provided.

At the present time the school owns 25 acres, 8 of which are used for a campus, on which are located the 7 buildings composing the school.

The school is open to "all persons over 6 and under 21 years of age, who are of such mental and physical ability as to enable them to do systematic study, whose vision is so impaired as to make it impossible for them to attend the schools for the sighted, are proper persons to be received into the School for the Blind."

The course of study is prescribed by the State Board of Education and is that of the common and high schools of the State.

OKLAHOMA SCHOOL FOR THE DEAF.

The Legislature of 1908-1909 permanently located the State School for the Deaf at Sulphur, Oklahoma. The State has given for this school 60 acres just outside the city limits of Sulphur. The land adjoins the Platt National Park. The school now has 74 acres of land, 14 of which are the campus with its seven buildings.

The school derives its support from appropriations made by the Legislature and approved by the Governor.

The purpose of the school is to educate the deaf children of the State. The school follows what is known as a combined system of education. There are 2 departments, the manual and the oral.

The oral department proposes to teach its students to talk and to educate them by speech; the manual department trains its students by finger spelling and by signs.

OKLAHOMA STATE HOME.

The Oklahoma State Home was made a State institution by the Legislature on May 18, 1908, and is intended as a "Temporary Home" for "white children of sound mind and body under sixteen years of age, who are dependent upon the public for support" and receives only such children as are committed by the juvenile courts of the State as dependent and neglected children; and when so committed it becomes the duty of the Superintendent and State Agent of the institution to find worthy private homes for them.

This institution is located at Pryor, Okla., the county seat of Mayes County, mid-way between Vinita and Muskogee, on the Missouri, Kansas & Texas Railway.

The school has a 40-acre campus on which is located the Administration Building. There are eight cottages, located in a circle around the campus. The children are housed in these cottages—4 for the boys and 4 for the girls.

The children in this institution are taught the common school course. In addition to the eight teachers who teach the common school course, a music teacher is employed who gives both vocal and instrumental music lessons to the children who are musically inclined.

The institution owns its own laundry, which is operated for the most part by the children. It also has a farm of 320 acres, practically adjoining the campus. A large number of the larger boys find work on this farm when not in school. A supply of good milk is obtained from a dairy herd of some 50 thoroughbred Holstein cows.

The management of the institution will, upon application being made and references given showing that the applicant is able to furnish a child a good home and send that child to school, permit such person to go to the institution and select a child and keep it so long as such conditions are met.

INSTITUTION FOR FEEBLE MINDED.

The Institution for Feeble Minded is located at Enid, Garfield County, Oklahoma.

This institution was created by the Legislature in 1910 and derives its support from appropriations made by the Legislature and approved by the Governor.

This institution now has a hospital, school building, main building, 2 large ward buildings, 2 large cottages, a laundry, and a power house. The institution has its own water system.

The Montessori system of teaching is used and all the children possible are taught. The children are also taught basketry, weaving, and all kinds of fancy work. Some of the girls work in the kitchens and some in the laundry. The boys work on the farm and make brooms.

STATE TRAINING SCHOOL FOR BOYS.

The State Training School for boys is located three miles south of Pauls Valley, Garvin County.

The Institution owns about 400 acres of broken upland. The campus is on the south part of the farm and consists of about 8 acres. There are 11 brick buildings on the campus; 2 frame buildings on the farm used as residences, and three frame buildings used as barns.

The school work in this Institution is similar to the work done in the public schools of the State. Work is done in all the grades up to and including the eighth grade. The State-adopted text books are used. When a pupil graduates from the eighth grade he is prepared to enter any of the affiliated high schools.

COLORED AGRICULTURAL AND NORMAL UNIVERSITY.

The Colored Agricultural and Normal University is located at Langston, Logan County. This Institution was established by act of the Territorial Legislature in 1897, for the purpose of giving the negroes of the State, normal, collegiate, industrial, and agricultural training. Forty acres of land for agricultural and building purposes were donated by the people of Langston and vicinity.

The Institution derives its support from the "Morrill Fund," "Section Thirteen Fund," and from appropriations made by the Legislature and approved by the Governor.

The Institution now owns 319 acres of land and has twelve buildings.

STATE INSTITUTE FOR DEAF, BLIND, AND COLORED ORPHANS.

This Institute is located at Taft, Muskogee County. It was established by the Second Legislature and it is intended for the education of the negro children in the grammar grades, including a thorough high school course, and in the primary industries which will fit them for usefulness.

This Institute consists of three departments—the Department for the Deaf Mute, the Department for the Blind, and the Department for Orphans.

This Institution owns in all 101 acres of land and has 5 buildings: Girls' Dormitory, Boys' Dormitory, Superintendent's residence, light and heating plant, and a barn.

DENOMINATIONAL UNIVERSITIES AND COLLEGES.

PHILLIPS UNIVERSITY.

Location.

Phillips University is located at Enid, Garfield County. Enid has three railroads: Atchison, Topeka & Santa Fe Railway; St. Louis & San Francisco Railroad; and the Chicago, Rock Island & Pacific Railway. The Chicago, Rock Island & Pacific Railway operates four passenger trains south and four north daily, one passenger train each way between Enid and Waurika, and one passenger train each way daily between Enid and Billings. The St. Louis & San Francisco Railroad operates three trains southwest and three northeast daily, and two passenger trains west and two east daily. The Atchison, Topeka & Santa Fe Railway operates two passenger trains northwest and two southeast daily.

History.

In August, 1906, E. V. Zollars, acting through an invitation extended to him by prominent men, visited 30 leading towns of the two territories that have since become the State of Oklahoma, setting forth the need of a school such as Phillips University. Eight different cities bidded for the location of the University, but Enid secured it on account of her splendid offer and her central location with reference to the area from which the University expected to draw most of her students. The University was established in 1907 and E. V. Zollars was the first president. At first the Institution was called the Oklahoma Christian University, but this name was considered to be too narrow for the field which it served, so after the death of T. W. Phillips, Mr. Zollar's chief backer in the foundation of the school, it was changed to Phillips University.

Grounds and Buildings.

The University owns a 20-acre campus, on which is located the following buildings—Administration Building, Music Hall, Library Building, Gymnasium, and Girls' Hall.

Support.

Phillips University is supported by small tuition fees collected from the students, by endowments, and donations.

Administration.

The University is governed by a board of 11 trustees.

Departments.

Phillips University embraces the following colleges and schools:

The College of Liberal Arts.
The College of the Bible.
The School of Education.
The High School.
The College of Fine Arts, including
Music, Oratory, and Art.
The University Hospital and Training School for Nurses.

Purpose.

Phillips University emphasizes the necessity of Christian influences upon the life of a student in the critical period of his preparation. Teachers and trustees are not limited by charter to any religious body. Christian character and fitness determine their selection.

OKLAHOMA METHODIST UNIVERSITY.

Location.

The Oklahoma Methodist University is located at Guthrie, Logan County. Guthrie is served by five railroads and one interurban line. The Atchison, Topeka and Santa Fe Railway Company operates five passenger trains north, five south daily, three trains daily each way between Guthrie and Ripley, one train each way daily between Guthrie and Cashion, two outgoing trains and two incoming daily to Kiowa, Kansas. The Chicago, Rock Island and Pacific Railway Company operates one train east, and one west daily. The Missouri, Kansas and Texas Railway Company maintains a service, making connections with its trains north, south, and east. The Fort Smith and Western Railway Company has one train each way daily between Guthrie and Fort Smith, Arkansas. The St. Louis, El Reno and Western Railway Company operates one train each way daily between Guthrie and El Reno.

History.

The Methodist University of Oklahoma is the result of the amalgamation of the Fort Worth University and Epworth University, brought about in 1911.

Fort Worth University, located at Fort Worth, Texas, was originally Texas Wesleyan College, chartered by the State of Texas, June 6, 1881. In 1889, the charter was amended and the name changed to Fort Worth University.

Epworth University was begun at Oklahoma City in 1901, but not

formally opened until September, 1914. It was launched as a joint institution of the Methodist Episcopal Church and the Methodist Episcopal Church, South. The joint relationship of the two denominations was dissolved in 1911 and the interest of the Methodist Episcopal Church was merged with Fort Worth University to create the present institution. the Methodist University of Oklahoma.

Grounds and Buildings.

The University now has the Convention Hall, once used as the State Capitol.

Support.

The institution is supported by receipts from tuition, interest on endowment, gifts from the Board of Education of the Methodist Episcopal Church, individual gifts of friends and education funds for the Methodist Episcopal Church in Oklahoma and Texas.

Administration.

This University is governed by a board of trustees.

Departments.

The University maintains the following departments: the College of Liberal Arts, the Graduate School, the Academy, the School of Fine Arts, the Kindergarten Training Department, and the Department of Home Economics.

Purpose.

The Methodist University is a denominational school in that it is under the fostering care of the Methodist Episcolpal Church, state and national. It is not sectarian in the sense of laying emphasis on its teaching of the tenets and peculiar doctrinal opinions of any sect. It aims to be broadly christian throughout, and emphasizes the importance of christian influence in education.

CATHOLIC UNIVERSITY OF OKLAHOMA.

Location.

The Catholic University of Oklahoma is located at Shawnee, Pottawatomie County. Shawnee is served by three railroads. The Chicago, Rock Island and Pacific Railway Company operates three passenger trains east, and three west daily. It also operates one outgoing and one incoming train daily to Asher. On the Atchison, Topeka and Santa Fe Railway, two trains arrive from the north, and two from the south, two trains depart for the south and two for the north daily. The Missouri, Kansas and Texas Railway Company operates two trains each way daily.

History.

This institution was established by the Benedictine Fathers with the cordial approval of the Catholic Bishop of Oklahoma. The University opened its doors for the first fall term on September 9, 1915. The first annual commencement was held June 1, 1916.

At present the University comprises the College of Arts and Sciences,

and the High School Department. Other departments are to be added in the future.

OKLAHOMA BAPTIST UNIVERSITY.

The Oklahoma Baptist University is located at Shawnee, Pottawtomie County, Oklahoma.

The institution was first opened in September, 1911. It was closed from 1912 to 1915 and opened again in the fall of 1915. The University is controlled by the Oklahoma Baptist General Convention, through a board of 24 trustees. Three departments are maintained by this institution—the College of Liberal Arts, the College of Fine Arts, and the High School Department.

The University has a campus of sixty acres in which is located two buildings—the main building and a dormitory for women.

The purpose of this school is, in general, to contribute to the strength and influence of the denomination which supports it; in particular, its aims are to train men for the ministry, so far as such training is to be had in a college; to give general culture to volunteers for missionary work in both home and foreign fields; to train teachers for places on the system of public education and thus aid the State in solving some of the problems of citizenship; to give pre-professional training to students of medicine and law; and to train for the proper use of leisure time.

KINGFISHER COLLEGE.

Kingfisher College is located at Kingfisher, Kingfisher County, Oklahoma. Kingfisher has one railroad, the Chicago, Rock Island and Pacific, which operates 4 passenger trains south and four north daily; also one train each way is operated between Kingfisher and Chandler.

The Association of Congregational Churches of Oklahoma, in session in El Reno, in May, 1894, voted to establish a college for Oklahoma. The committee on location selected Kingfisher as the place for building, July 26th, and the charter was issued to Kingfisher College on September 26, 1894. The first president of the college was Julius Temple House. He began work in the summer of 1895 and the institution formally opened its doors September 2nd of the same year. Colvin Blodgett Moody was elected president in October, 1909. He served actively from January 1st, 1916, to July 1st, 1915, when he resigned. George Benett Hatfield was elected president December 20, 1915.

The campus of the College consists of 120 acres on which are four buildings—Parker Hall, Gilbert Hall, Osgood Hall, and Seay Hall.

The College maintains the following departments: College Department, the Academy, and the Conservatory of Music. The college derives its support from endowments and contributions. It is governed by a board of trustees.

The purpose of the college is to be an institution of learning with

christian ideals and high literary standards for scholarship.

HENRY KENDALL COLLEGE.

Henry Kendall College is located at Tulsa, Tulsa County, Oklahoma. Tulsa has four railroads which operate trains in all directions over the State.

This college was founded by the early missionaries of the Presbyterian Church in 1818. It was set up in the wild western country for the purpose of bringing education and christianity to those who, led by the spirit of America, had set up homes along the very border of civilization. It had an equal desire to care for the Indian. Strictly speaking, the beginning of Henry Kendall College was a mission. Afterwards, it became a school for girls, and still later a co-educational institution. The College was first located at Muskogee, but about seven years ago was moved to its present location at Tulsa.

The College owns about 40 acres of ground upon which there are five buildings including the President's home. The other buildings are an administration building, a home for girls, a home for boys, and a gymnasium.

This College is managed by a board of trustees, members of which are selected from various parts of the state. It is supported by endowments and the Presbyterian church.

While in a certain sense of the word the school is denominational, it is also broad enough in its course of study, and in its management, to include all denominations. The members of the board of trustees are not all Presbyterians, neither are all the members of the faculty. It is, however, distinctly christian in character.

OKLAHOMA PRESBYTERIAN COLLEGE FOR GIRLS.

The Oklahoma Presbyterian College for Girls is located at Durant. Durant is supplied with three railroads which give good passenger service in all directions.

This college is the outgrowth of the former Durant Presbyterian College, which for a number of years did work at Durant. The co-educational feature of the old school was dropped and the new college is exclusively for the education of girls and young women.

The college has a campus of thirty acres, on which is located the college building.

This school is governed by a board of trustees, and derives its support from endowments and contributions. It is the purpose of this institution to give an education to girls and young women under the most ulifting religious and moral influences.

CHARITABLE INSTITUTIONS.

OKLAHOMA HOSPITAL FOR THE INSANE.

The Oklahoma Hospital for the Insane is located at Supply, Woodward County, Oklahoma.

In 1905, Congress offered to grant to the Territory of Oklahoma the use of the Fort Supply Military Reservation and the buildings thereon for the purpose of an insane hospital. The Territorial Legislature accepted the offer.

The site of this institution is of much interest from a historical standpoint. Fort Supply was used as a supply base for the United States regular army in its operations against the marauding bands of the so-called wild plains Indians. General Custer, the noted Indian fighter, was at one time stationed at this fort.

The hospital is managed and controlled by a board of trustees, composed of the Governor, who is ex-officio chairman, and two other persons of different political affiliations appointed by the Governor. The institution is supported by appropriations made by the Legislature and approved by the Governor.

EAST OKLAHOMA HOSPITAL FOR THE INSANE.

This institution is located at Vinita, Craig County, Oklahoma. In order to have this hospital located at Vinita, the city complied with the conditions imposed by the 1907-1908 Legislature by giving to the State one hundred and sixty acres of land for a site, and furnished the institution with flowing artesian water.

The institution is controlled by a board of three trustees, appointed by the Governor with the advice and consent of the Senate, and is supported by appropriations made by the Legislature and approved by the Governor.

OKLAHOMA SANITARIUM.

The Oklahoma Sanitarium is located at Norman, Cleveland County, Oklahoma. At first this hospital was a private institution. In 1901, contracts were entered into, and appropriations made, however, by the Territorial Legislature, for the care of state patients until the insane hospital at Fort Supply should be constructed. These contracts were for four years, but in 1903, they were extended indefinitely. On July 1, 1914, the institution became a State institution. The sanitarium covers a tract of land consisting of 600 acres, and has 22 buildings. The institution is controlled by a board of trustees and is supported by appropriations made by the Legislature and approved by the Governor.

OKLAHOMA STATE CONFEDERATE HOME.

The Oklahoma State Confederate Home is located at Ardmore, Carter County, Oklahoma. At first, this institution was operated by the Confederate Veteran Home Association, but in 1910, by an act of the State Legislature, it was made a charitable institution of the State, the State agreeing to maintain the Home for a period of 25 years.

The purpose of the institution is to care for the indigent and disabled soldiers and sailors who enlisted, served, or participated as a soldier or sailor of the Confederate States during the Civil War, also for the aged wives and widows of such soldiers and sailors. The State received 20 acres of land from the Association. This institution is con-

trolled by a Board of Control composed of 7 members. It obtains its support from appropriations made by the Legislature and approved by the Governor.

CORNISH ORPHANS' HOME.

This institution is located at Cornish, Jefferson County, Oklahoma. It is a private institution supported by charity. The Legislature at times has appropriated money to aid in its support. The institution owns 7 acres of land and one building.

STATE PENAL INSTITUTIONS.

STATE PENITENTIARY.

The State Penitentiary is located at McAlester, Pittsburg County, Oklahoma.

In January, 1909, before the penitentiary buildings were completed, 643 men were brought to McAlester from Kansas State Penitentiary, and were held in a temporary wooden cell house, without protection of any kind of walls, except a guard line of armed men. It was a risky way to hold these men, and it seems a miracle now that these desperate criminals were held by only a few men. However, as soon as arrangements could be made, a temporary wire fence, 14 feet high, of barbed wire four inches apart, was thrown around the buildings. This fence was charged with electricty.

The new penitentiary building was begun in June, 1909. The prison walls enclosed a little less than 10 acres. It is of concrete piers and slabs 18 feet above the grade line on the inside and 24 feet on the outside, and goes 8 feet below the surface.

The first buildings were let to contract, but the later buildings have been erected by the State with convict labor independent of contract.

The Penitentiary has a farm of approximately 1680 acres. This farm is worked by the convicts. The institution has a shoe factory and a tailor shop where all clothing worn by the convicts is made.

This institution is supported by appropriations made by the Legislature with the approval of the Governor, and by the labor of the convicts.

OKLAHOMA STATE REFORMATORY.

The Oklahoma Reformatory is located at Granite, Greer County, Oklahoma.

The Second Legislature, in 1908, created the institution and made appropriations for buildings and equipment. Temporary buildings were erected in 1910 and the first installments of prisoners were received by transfer from the McAlester Penitentiary in April, 1910.

First term prisoners, 16 to 25 years of age, inclusive, and not to exceed 5 year sentences, are eligible to admission to this institution either by direct commitment of the courts or by order of the Board of Prison Control. This institution is supported by legislative appropriations and the labor of the inmates.

CHAPTER VIII.

ANIMAL LIFE IN OKLAHOMA.*

INTRODUCTION.

Oklahoma at one time had a wealth of animal life that seemed almost impossible of exhaustion. Not only were birds and animals found here in unbelievable numbers, but the range in species was perhaps greater than in any other area of like size in the western part of the United States. Many of the animals characteristic of the mountainous regions of the west extended to the foot hills of the Rockies and often occurred in the western part of this State. Animals commonly found in the rough and timbered regions of the east came as far westward as the Ozark Mountains and remained in Oklahoma in considerable numbers, while the roving herds of the vast open plains of the northwest found ample pasturage and shelter here during the winter months and sometimes grazed beyond the southern boundaries of the State. To this immense throng must be added the myriads of semi-migratory birds and animals of the south that were found during a part or all of the year within the present limits of Oklahoma. The location of the State makes it a sort of meeting place, or focal point, for a variety and abundance of animal life that would not be possible under any other conditions.

The multiplicity of habitats existing in Oklahoma also makes possible a range in animal life that few states enjoy. The arid regions of the western part of Oklahoma have, or had, a large representation of all the varied fauna characteristic of the great semi-desert region to the north and west, while the mountains within the State offer range and protection to a vast assemblage of animals that our rapidly advancing civilization has not yet been able to destroy. Our broad streams and lakes have furnished shelter and food to water and shore animals that may still be found in abundance in regions not frequented by man, and the timbered regions of the south and east support a wealth of woodland forms that could not exist in localities where forests do not abound.

The changes incident to the settlement of a new country by man unavoidably cause the destruction of the feeding grounds and shelter of the wild animals, and as the improvement is pushed farther and farther

*This chapter was prepared by Howard Cross, Department of Zoology, Oklahoma University.

into the wild retreats, the native animals become less and less abundant and finally must perish altogether unless given some measure of protection. The advent of man into Oklahoma has, of course, very materially lessened many kinds of wild life, but fortunately only a few species have been lost entirely, and the location of a National Game Preserve within the State, and the provision recently made for the establishing of State game preserve, give assurance that no species now living in Oklahoma will ever be reduced to the point of extinction. We shall always have at least a remnant or sample of the faunal wealth that once abounded in this State.

HOOFED ANIMALS.

BUFFALOES.

The buffalo is the largest wild animal that has lived in Oklahoma in modern times. Within the memory of men now living, this noble animal roamed over the prairies in countless numbers, and at times whole valleys were covered with vast, unbroken herds. Great as this throng was, it went so quickly after the coming of the railroads that men could not believe it gone. In the fall of 1884 the hunters came to kill the buffaloes for their hides, which they sold for one dollar and a half apiece. but none could be found. "They are gone north," the gunners said, but they had not gone north; they had all but gone to utter extinction! At one time there were only twelve buffaloes in the State, but now there are eighty-four head in the Wichita National Game Preserve in Comanche County, and a small herd at the 101 Ranch in Kay County. The splendor and vigor of this remnant, however, are gone and they trail after a wagon to be fed, as broken and fearless as domesticated cattle.

ANTELOPE.

Antelope, while never so abundant as the buffalo, were very numerous in this State before the coming of the cowboy and his civilization. They often grazed in herds of several hundred and were well adapted to live in rough country. They remained somewhat longer than the buffalo, for the last antelope in Oklahoma, which lived in the southern part of Ellis County, were not killed until 1910. Since that time not a free antelope has lived within the State, and only a single specimen is held in captivity. This is a male and is on the Government Preserve in the Wichita Mountains.

DEER.

Deer were one time very abundant in the timbered sections of this State, and on account of their wonderful speed and cunning they have evaded the destructive forces of man and may yet be found running wild. Their range is now restricted to the mountainous regions, and it is doubtful if there are more than one hundred and fifty wild deer in the State today. Most of these are in the Kiamichi Mountains, where the persistent and criminal efforts of hunters to kill them will no doubt soon be successful in securing the last specimen.

FLESH-EATING ANIMALS.

ROCKY MOUNTAIN LIONS.

The larger flesh-eating animals were never numerous here, but there were enough during the time of early settlement to cause considerable damage to stock and to instill a constant fear in the lonely traveler. The Rocky Mountain lion was known in this State as late as 1900, and it is possible that a few stragglers are yet in some of the mountain districts, but they are difficult to find and are not often seen. One came as far east as Grant County in 1895. This animal followed Pond Creek with its sheltering timber, and left the protection of the woods at Jefferson long enough to spring into a man's yard and devour a pig. A few nights after the occurrence just narrated, a farmer living west of Jefferson was annoyed by the low, frightened growl of the family dog. When the door was opened the dog shot out into the darkness and a sharp yelp was heard. The next morning the hind leg of this courageous but imprudent dog was found about one hundred yards from the house. This is the last record of the misdeeds of this Rocky Mountain lion before it was finally hunted down and killed.

BEARS.

Bears are in many ways the most interesting animals of this State. They have never been abundant and have always been restricted in range to the more inaccessible timbered regions of the mountains. These animals have inflicted very little damage on the stock raising interests of the State, and have never been known to attack man unless driven into a corner, or wounded. Bears, as is the custom of all such animals, go into their dens early in December and sleep through the cold winter months, and emerge with the coming of warm weather in the spring. They spend much time at play when in the company of other bears, and if taken when young make very amiable pets. Their thick heavy coats protect them from injury even in very rough frolics, and they often acquire habits of play that make it imprudent to present the bare hand to even the most gentle of bruin pets. They feed on succulent roots, insect larvae, honey, fish, frogs, and almost any other kind of flesh they can secure. At one time it was thought that two kinds of bears lived in Oklahoma, but the small Black bear is probably the only specie which is found here. In the early spring when it emerges from the long winter's sleep, its usual coat of black has become very long and has a dusky brown color that is perhaps responsible for mistaking it for the so-called Brown bear.

LOAFER WOLF.

Wholesale destruction marks the path of the large Gray or Loafer wolf throughout its range. This animal was never abundant enough to extend over any considerable portion of the State, but in bands of from four to eight they were able to kill deer and buffalo, and with the coming of cattle and sheep they were responsible for a destruction that

aroused a widespread demand for their speedy extermination. The "six-shooter," so characteristic of the western cowboy, was originally carried for the purpose of killing this wolf, but the practice soon spread far beyond the limits of the Loafer range and probably will be kept alive forever in the "movies." The ranch owner furnished the guns and ammunition to the cowboys and they were given the skin as a special reward if they were fortunate enough to kill one of these destructive beasts. The Loafer wolf generally frequents the rough country and forages over definite ranges which he covers in cycles every seven days. Settlers have taken advantage of this unusual habit and have proceeded by systematic poisoning to protect their herds from these marauders. The Loafer is now practically extinct in this State, and its passing will be a signal for unbounded rejoicing by cattle men everywhere who have herds within its range.

COYOTES.

The coyote is one of those unfortunate members of our animal society whose position has not been understood and whose services have never met with the appreciation which they deserve. These animals are distributed throughout the State but do not occur in large numbers in any particular locality. The coyote has long been known as a chicken thief, and does occasionally frequent poultry yards that have been carelessly left open at night, but it renders a service to the farmer in the destruction of large numbers of mice, rats, gophers, and rabbits that pays many times over for its one unfortunate indulgence. The coyote may not be an altogether desirable resident of a crowded agricultural district, but it is capable of much good and by no means deserves the unenviable reputation which it has.

BADGERS AND SKUNKS.

With the possible exception of hawks and coyotes no living animals have been more unjustly persecuted than the badger and the common skunk. Both have a few bad habits, but if a ledger of all their services were kept it would show such a balance in their favor as would put to shame the army of thoughtless men and boys who annually pursue to certain and unmerciful death these valuable allies of the farmer.

Badgers were at one time fairly numerous in this State, but persistent and systematic killing by everybody has so reduced them that only a few remain. They can live in arid regions where the annual rainfall is so slight that it would seem impossible for any animal to survive. They live in burrows, and have flat, compact bodies with powerful fore feet and claws which enable them to dig with a rapidity that few animals attain. They are thus equipped to dig out and destroy myriads of ground squirrels, gophers, and prairie dogs, which, on account of their habits of life, are practically immune from the attacks of all other predatory animals.

The skunk, of which several kinds occur in Oklahoma, is scattered more generally throughout the State and perhaps has a few more bad

PLATE XL.

A. HEAD OF BEAVER DAM ON WOLF CREEK, HUNTER'S RANCH, NEAR FARGO, ELLIS COUNTY.

B. SHOWING TREE CUT BY BEAVER AT ABOVE LOCALITY.

habits than the badger, but the record in its favor is scarcely less astounding. Skunks are preeminently animals of the field and wood, and their occasional appearance in the farm yard is accidental. They work, for the most part, at night, and the number of noxious insects, mice, and rats which they annually unearth and devour is almost beyond belief. The furs of these animals are becoming very valuable and a splendid income awaits the boy who has the ingenuity and courage to collect a number of skunks and organize the first fur-growing industry in Oklahoma.

OTHER FLESH-EATING ANIMALS.

Other flesh-eating animals existing in Oklahoma are the bobcat, raccoon, o'possum, weasel, and mink. These animals exist abundantly in some portions of the State, while in others they have already been exterminated. The weasel and bobcat were once found on the open plains wherever prairie dogs lived, but they have long since been driven to the protection of the timber, and even here they are only rarely seen.

GNAWING ANIMALS.

BEAVERS.

The beaver is the largest gnawing animal in Oklahoma, and easily leads the mammals of the world in mechanical and engineering skill. Beavers were at one time common in many of our smaller streams, and the line of their retreat is marked by dams and houses which they were forced to abandon hurriedly, in their efforts to keep away from the habitations of man. Wherever the banks were too low for the beavers to burrow into, they constructed dams across the channels and often raised the water as much as four or five feet, forming large artificial ponds with a depth sufficient to protect the entrance to their houses, and to provide for storing a food supply large enough to carry the beaver colony through the period when the ponds were frozen over and they were cut off from the usual food beyond the limits of the water's edge. The trees generally selected by the beaver for food include the birch, cottonwood, hickory, ash, and willow. To secure the tender limbs and younger shoots they often "cut" down trees as large as a foot in diameter. If only the smaller limbs were used they were cut off and dragged to the pond, but if the trunk was needed for strengthening the dam, a channel was dug from the pond to the tree and the timber was floated into position, as is the custom of lumbermen in all parts of the world. There is only one colony of these interesting animals now within the State. This is located on a small stream in Ellis County. It is hoped that the men who own the adjoining land will see that measures are taken to prevent this last picturesque beaver "town" from being depleted of its industrious population.

PRAIRIE DOGS.

Prairie dogs, which exist so abundantly in many parts of Oklahoma, are social creatures and live together in communities called towns. A

colony may cover only a part of an acre, or it may be miles in extent. The population ranges accordingly from a few individuals to as many as 100,000 in the larger towns. They burrow into the ground to a depth of about 12 feet and they extend the den in a horizontal direction for a distance of from 10 to 15 feet. Any number of lateral channels may extend from this main run. Usually only a single pair occupies a burrow, except in the spring when the four young arrive. The ground for a considerable distance around the mouth of the burrow is stripped free of vegetation, and in thickly settled communities these barren spaces connect, so that large areas of grazing land are sometimes entirely cleared of grass by the presence of these animals. Prairie dogs are not really dogs in any sense of the word, but are large squirrels, and as they subsist entirely on roots, grasses, grain, and vegetables there is no reason, except perhaps the name, why they should not be as palatable as timber squirrels or rabbits. They are preyed upon by wolves, coyotes, bobcats, weasels, and the larger hawks, but since man has driven away or destroyed these natural checks the prairie dogs have increased at a corresponding rate and artificial control must be put into effect. The United States Biological Survey has perfected an effective and inexpensive method for poisoning the prairie dog, and its general use throughout the State is bringing back into cultivation large areas that were formerly occupied by these animals.

GOPHERS.

The common pocket gopher is by all odds the most destructive animal in Oklahoma. We have at least two species in this State; a small one found widely distributed but never numerous; and the large red pocket gopher that is causing more waste at the present time than any other living creature within the State. The gopher is the builder of the countless mounds of dark earth that we see thrown up over prairies and fields wherever we go. Some alfalfa patches have been more than one-tenth covered by these tell-tale hills. The gopher has a compact, muscular body, and with its powerful front feet and claws is able to burrow rapidly through the soft earth. The burrow or "run" usually extends about a foot beneath the surface, and at short intervals vertical tunnels extend upward to the top of the ground and through these the excavated soil is carried out and thrown up in small heaps. A single gopher occupies a burrow and often extends it several hundred feet in a season. The animals live, for the most part, on the roots and tubers which they find in their journeys through the ground. The gopher sometimes emerges from its burrow and fills its pockets with tender leaves and grain, which it always carries into the burrow before eating. Stock are often injured by stepping into gopher burrows, and many a cowboy's life has been lost in a fall caused by his mount plunging a leg into one of these burrows. A few kernels of poisoned grain placed in each burrow will rid a farm of these destructive pests within a reasonably short time. Little, however, will be accomplished unless whole communities cooperate, for a single farm cleared would soon be

overrun from adjoining territory. The animals are still very numerous in certain parts of the State, and unless some concerted action is taken to check them in the localities where they abound, they will presently be doubling the damage they are now inflicting. The gopher rarely is seen above the ground and as a result has few natural enemies except the badger and the bull-snake, both of which have been so reduced by man that now the gopher is practically free to multiply unmolested. The responsibility rests entirely with the land owner; he must act now or pay a constantly increasing penalty.

RABBITS.

The most frequently seen and best known mammals of Oklahoma are rabbits. They refuse to be exterminated and are found in every locality in the State. We have two kinds of rabbits—the large, long-legged variety with athletic form, known as the jack rabbit, and the much smaller rabbit, known as the cottontail. The jack rabbit frequents the open plains. It does not burrow, but depends on its keen vision and powerful legs to keep it out of danger. The nest is made in a small, obscure depression in the ground and lined with soft wool taken from the breast of the mother. The cottontail frequents the wooded and more protected areas. It has short legs, wholly unfit for prolonged flight, but easily makes up for this loss in swiftness and cunning. It burrows well under stones or projecting roots, where it is free from the usual annoyance of men and dogs. Then, too, its color so harmonizes with its surroundings that it is often obliged to seek flight to avoid being trodden upon. Both jack rabbits and cottontails are wonderfully prolific, often rearing as many as four litters during the summer. They feed on grasses, grain, growing wheat, vegetables, fruit, and in winter, when pressed by hunger, they sometimes gnaw the tender bark from young trees. A few wisps of green alfalfa hay scattered regularly about the orchard in winter is the best protection against such attacks. The wholesale destruction of hawks, owls, wolves, and coyotes has removed the natural checks on rabbit production and occasionally they become so numerous in certain localities as to inflict great damage on the growing crops and trees. If properly cared for, their bodies can be made an important contribution to the food supply of the State. The men who hunt have done much to hold the rabbits in check, but sometimes this is not sufficient to keep them within the proper limits, and large hunts organized on a competitive basis often result in the slaughter of thousands in a single day. These hunts sometimes embrace as much as one-third of a county, and the men and boys taking part number into the hundreds.

SMALL RODENTS.

In addition to the gnawing animals discussed above, Oklahoma has the muskrat and the usual army of small rodents that exist abundantly throughout the entire State. The red and gray squirrels are found wherever timber conditions make it possible for them to live, and

in the southern part of the State there are two species of "flying" squirrels. The striped ground squirrel, smaller than its timber cousins, burrows into the ground in meadows and grain fields and is responsible for an annual damage of more than $100,000. Rats and mice exist in abundance throughout the State, and the destruction which they cause in fields and store-houses is common knowledge. But we can avoid much of this loss. If shelter such as heavy grass corners, weeded fence rows, mulching, and unraked hay, is burned or removed, and skunks, hawks, owls, weasels, and bull-snakes are not foolishly killed on account of superstition and hearsay, but are protected as friends, the army of these destructive rodents will soon be so lessened that the annual damage from this source will be reduced to very small proportions.

MOLES.

Moles have long been the unhappy victims of circumstantial evidence. They spend most of their active life in plowing through the soft earth in search of insects, and are guilty of only a few of the crimes with which they are so often charged and convicted. Their food consists almost entirely of insects, and if they are confined in a cage with nothing but vegetable food they soon starve. Moles are attracted to localities where burrowing insects are most numerous, and their presence in a yard or garden indicates that unseen insect pests are at work beneath the ground. The farmer observes a fresh mole run extending the length of a row of planted seeds, and if the seeds fail to come up the damage is charged to the mole and every effort is made to see that summary justice is executed. In reality, the mole was attracted by the grubs that were feeding on the sprouting roots, and was not even remotely interested in the seed. Then to further cloud the real issue, field mice take advantage of the protecting shelter of the mole tunnel and follow up, destroying all seeds and roots that have been exposed by the mole. To these trespassers is directly chargeable most of the destruction usually attributed to the mole. However, the mole is not entirely blameless. Its runs, when extended into lawns, render them unsightly, and many small roots are displaced and plants killed by the tunneling of this industrious animal. They should of course be kept out of yards and gardens, and this can be done by persistently trampling down their runs. The moles will thus be saved for carrying on the work of destroying underground insects in the fields, for which nature has so admirably fashioned them.

BATS.

Bats perform much the same service in the air that moles do beneath the ground. Their diet is made up largely of insects, and they contribute in no small way to holding these pests in check. It is true that we do not often see them at work, for they hang head downward under some protecting object during the day, but at dusk they come from their hiding and with a wierd, broken flight pursue and capture almost every kind of insect that moves about after night. Bats have little to commend

them in the way of beauty or interest, but their persistent destruction of insects represents a saving to the State that should never be overlooked.

BIRDS.

GENERAL STATEMENT.

Oklahoma has a wealth of bird life of which she may be justly proud. Native birds occur here in abundance throughout the year, our rivers and lakes invite the migratory water fowls that annually pass this way, and the wooded streams and timbered hills offer shelter to countless birds that come here every year to nest and rear their young. The bird population is, of course, not as large as it formerly was, but while many valuable and beautiful birds have been reduced and driven to the verge of extinction, only a few species have as yet been entirely lost, and the general awakening of interest in bird life throughout the State marks the beginning of a new and brighter day for our feathered friends. We may confidently expect them in greater numbers as the forces for their protection are taken over by willing hands and carried into new and broader fields.

WILD TURKEYS.

Wild turkeys, like many of the larger native animals, formed no small part of the food supply of the pioneers, and in this way they have rendered a service of importance in the development of the State. These birds were at one time very numerous, but were so easily approached and shot that they were annually slaughtered in great numbers. It was not uncommon in the early days to see as many as five hundred of these splendid birds in a single bunch, and one hunter reports having seen a solid, unbroken acre of turkeys. Their habit of roosting in trees probably contributed in a large measure to their destruction. Hunters would locate a bunch, and after the turkeys had flown into the trees for the night, would walk quietly under them, where their large bodies outlined against the sky made an easy mark for a rifle. A man from Jefferson, with two companions, thus killed eighteen turkeys in one evening. A few wild turkeys are yet free in the mountainous regions of the State, but unless they receive legal protection it will be only a short time, at the present rate of destruction, until they are vanquished. Then we will have only the flock in the Wichita Preserve, which is as tame and fearless as poultry.

PRAIRIE CHICKENS.

We have left only a pitiful remnant of prairie chickens. They have been driven from the plains and rolling sand hills where they normally thrive, into wild retreats where they can secure some measure of protection from the constant illegal war that is being waged against them. A few flocks may yet be found in the Panhandle district, and a small number have in some way kept alive in Ellis County, but they represent only a small portion of what formerly existed here. Flocks of a thousand birds were sometimes reported, and a hunter with two companions once killed a wagon load of chickens on one hunt. The law provides no open season on these birds, and they may be brought back to an abundance where they can again be hunted, but it will take a long time and a more strict enforcement of the law than is now maintained.

QUAIL.

If the United States ever sees fit to erect a Hall of Fame for its birds, the quail will occupy one of the chief places, for it is by all odds the most valuable bird in North America. This is due not for its meat alone, although this is a delicacy that is seldom, if ever, surpassed, but for the constant, unselfish service which this bird renders to the farmer in its never-ending war against the ravages of insects and weeds. The quail is an ally of the farmer, staying at his post throughout the entire year and working on an average ten hours a day. In the summer it runs down and consumes as many as one hundred and fifty different kinds of insects, and in the winter it gathers and eats almost as many varieties of noxious weed seeds. This bird has diminished in number in Oklahoma, not at the hands of hunters alone, though they have contributed in a large measure, but also because farmers have thoughtlessly burned over its nesting and feeding grounds, and have made no provision for it in the new order on the farm. Every effort should be made to bring the quail back to its former abundance, and to anyone within the State who will provide suitable nesting places the State Game Warden will furnish free of charge a stock of these birds. There are a few counties where the quail is yet numerous enough to justify hunting it, but such places are exceedingly rare. Wherever this bird is diminishing, it is not only an economic blunder but a crime to decrease the number.

HAWKS AND OWLS.

Besides the quail we have a number of other birds that annually make a large contribution to the wealth of the State through the service they render to the farm and forest. Hawks and owls stand at the head of this list, but unfortunately the first of these two does occasionally take a chicken, and this causes it to be branded as a thief and an outlaw. No thought is given the excellent service which it renders through the months when it neither attacks nor cares to attack poultry. The average adult hawk consumes each day at least six mice or their equivalent in other rodents or harmful insects. Since we have learned by experiment that a single mouse causes an annual damage of at least two cents, it is a simple process to compute that each adult hawk is worth more than forty dollars a year to the farmers of the State. There are two exceptions—Cooper's hawk, and the sharp-shinned hawk. These species are thoroughly bad and deserve to be shot wherever found, but they look so much like beneficial hawks that it is unwise to hunt them in the field. A better plan is to have a gun at hand and be prepared to execute summary vengeance on any marauder that dares approach the chicken yard. Owls possess all the good habits of hawks, with none of

the bad. They also have the additional advantage of working at night when the rodents are running about, so that it is difficult to compute the economic importance of the silent army of owls with representatives in every community within the State.

WOODPECKERS.

We have not less than ten different kinds of woodpeckers, and each of them represents a distinct value to the orchard and timber interests. They carry on an interminable search for the deadly grubs and other insects that burrow into and endanger the life of trees. Wherever a forest insect pest develops in any section it is sure to attract an army of hammering woodpeckers, and the birds are soon the victors. They also have played a part in spreading the forests. These birds are, in fact, real foresters, in that they are persistent planters of trees and do not give up their watchful care over them as long as they harbor a single insect pest. Yes, they do drill holes in telephone poles and riddle church steeples, but school boys carve their names on beautiful desks. Both are seeking to be perpetuated; there is no more reason for destroying one than the other.

EAGLES AND VULTURES.

People have never ceased to wonder at the matchless flight of eagles and vultures. They soar far into the upper atmosphere and float on motionless wings so smoothly that they appear as mere spots against the sky. It is said that these birds are never caught in the fury of the storms but fly above the clouds and descend only after the wind has spent itself. Both the golden and bald eagle frequent this State and have been known to nest in the mountainous regions of the south and east, but they occur in very small numbers and are only occasionally seen. The turkey and black vultures are found more abundantly and are commonly seen circling far above the earth in their constant search for carrion. They have keen powers of vision, and the characteristic "drop" of a vulture to a carcass will soon bring others from miles around.

WATER AND SHORE BIRDS.

Our State is situated within the migratory path of a very large percentage of all the water and shore birds that annually go north for the breeding and nesting season. Floating clouds of gulls are seen over the State during the spring and summer months, but on account of their powerful wings they do not often come to rest upon the ground. Solitary pelicans occasionally fly over, but they usually come in flocks. As many as one hundred and fifty of these feathered fishermen have spent the night on the Canadian River a few miles west of Norman. Ducks come and go throughout the entire year. On the protected lakes and ponds they become very tame and are often seen in great numbers. It is probable that more ducks occur in Comanche County than in any like area within the State. All told, at least thirty kinds of ducks

frequent Oklahoma every year. Wild geese were once much more abundant than they are now, and while they do yet fly over the State in numbers, they seldom come down except in most inaccessible retreats, and it is a "red letter day" for the hunter who succeeds in bagging one of these birds. The towering form of the sandhill crane is sometimes seen along the larger streams, but its noble cousin, the whooping crane, has ceased to visit us. The great blue heron was never abundant here and its numbers now are very limited. However, we occasionally see this stilt-legged bird, with many of its small relatives, wading about the shallow ponds in search of crayfish and frogs. Its long beak makes it a dreaded hunter of the small streams, but Oklahoma will be the poorer if this ungainly but interesting bird ever disappears altogether from our shores.

CROWS.

Crows are a bad lot. They have a record of misdeeds almost as inky black as the coats they wear. Before the planting of grain fields gave them an unlimited food supply they were never numerous, but now they occur in numbers so large as to inflict heavy damage on the farmer in many sections of the State. Their fondness for sprouting corn is responsible for much of the trouble which they cause, but this is not all. Crows destroy large numbers of bird nests in the spring, and do not hesitate to feed the squawking fledglings to their own young. They come down in clouds on cane and kaffir fields and strip the heads before they can be gathered. This rapidly increasing multitude of destroyers presents a problem which will sooner or later have to be met. The crow has few natural enemies and is far too wise to be poisoned by the usual methods. A bounty is placed on their heads in many states, and this will probably soon be done in Oklahoma.

ENGLISH SPARROWS.

It is impossible to say anything too unkind about the English sparrow. There are few places in the State where this bird does not occur, and it is multiplying five times as rapidly as any other bird in North America. This bird is everywhere displacing the native birds, and is an invariable source of inconvenience about watering places and buildings. The English sparrow is not beautiful, cannot sing, and lives almost entirely on the hospitality of the farm. No one should lightly condemn a bird, but this one unquestionably deserves to die. These sparrows are gregarious in habit and can easily be poisoned in large numbers, so that any farm or city can entirely rid itself of these pests in one winter if it will only learn the methods and apply them.

SONG BIRDS.

Oklahoma is rich in the number and variety of her song birds. The larger part of these are, of course, migratory, and so remain here only a part of the year, but they make the woods merry with their songs from early spring until the horde of destructive insects is killed

or driven to shelter by the approach of winter. These feathered songsters not only contribute immeasurably to the joy of living, which would be argument enough for their eternal protection, but they wage a ceaseless war against insect pests and weeds everywhere. They work at all hours when insects are about and pursue their prey into all accessible places. The robin is abundant here through the summer months, and is continually combing the yards and gardens in search of pests. It is a delight to watch this representative bird attempt to teach its half-grown young to shift for themselves, but they apparenly will not learn and after days of patient but vain effort the exasperated parent leaves part of a wriggling worm on the ground in front of the ravenous youngsters, and flies away. The young birds proceed in an awkward fashion to finish their meal, and with the awakening instincts are soon able to provide for themselves. During the winter months robins are so numerous in the southern part of the State that trees are often covered with the roosting birds, and vicious men go into these colonies at night with a lantern and when the frightened birds become bewildered and fly into the light they are struck down by the hundreds and their mangled bodies picked up and carried away for food. This condition applies, also, in a large measure to the cardinals. In the extreme northern part of the State this bird is migratory, but is a permanent resident of the central and southern part of Oklahoma, where it often gathers in great numbers. They feed very little on insect life, but subsist for the most part on weed seeds and wild fruits. Wherever they are found in large colonies they are preyed upon by degenerate and criminal men, who go about after night armed with lanterns, clubs, and sacks. If public sentiment in such communities is not strong enough to prevent this savagery, its discontinuance should be guaranteed by the State, even at the cost of a permanent patrol.

The present number of song birds can constantly be increased if the citizens will only exercise a little patience and tact. Birds are quick to recognize their friends and anyone who is willing to make the effort can double the number of birds on his premises in a single year. Many cities are organizing bird clubs and providing nesting sites and food for the birds that have suffered most on account of the change in nature occasioned by the coming of man. These communities will reap a reward in increased bird life that will repay the effort a thousand times. Aggressive effort for a worthy cause will ennoble the character of a girl or boy; it will create in the community a moral tone that is at once fine and beautiful. The first-hand study of wild life and its systematic care and protection offer possibilities to the public schools of the State that have not yet even been sounded.

One could not enumerate, much less discuss, in this brief account, all the song birds of Oklahoma. There are more than one hundred kinds, and every one is doing an excellent service for man and deserves every protection we can throw around it. Our bird life, fortunately, has not decreased so much as it has in some other states, and we may always have a wealth of feathered songsters if only we will it now.

FISHES AND MUSSELS.

FISHES.

Fishing in Oklahoma can never be successfully commercialized, for there are few large, permanent bodies of water within the State, and the depth and character of the streams are not such as to make possible the constant production of fish in quantities. Our rivers and creeks, however, contain a large number of excellent food fishes that will always furnish an abundance of wholesome sport for those who have the time and patience to go after them. Seining is legal in all the larger streams, and while too many fish are caught in this way, it probably will never materially lessen the supply, for the rivers are annually restocked from the larger streams during periods of high water. Some large fish are occasionally caught in Oklahoma. The yellow Mississippi cat is taken in many places, and specimens weighing as much as 100 pounds are not unknown. The blue and channel cat fish abound in nearly all our streams, but they are not so large. One weighing more than 50 pounds is extremely uncommon. Eels are found in most of the streams of the State. They range in size up to three feet in length, but the larger ones are rare. Among the scale fishes the buffalo, drums, and bass are the largest and most valuable, while the smaller ones including the goggle-eye, white, and sun perch are the most numerous and most widely distributed. The hickory shad is abundant in all the streams, but it is so thoroughly useless, and has choked so many uninitiated folk with its countless bones, that it does not deserve to be mentioned in an account of the fish resources of the State. Sturgeons and gars occur in all the larger streams and some attain considerable size. While we now have a fair amount of fish, they cannot always withstand the outrages being committed against them. Streams not more than 10 feet in width have been seined to the last fish, and one man was known to dynamite his own stream at spawning time! If, however, fishing is conducted in a sportsmanlike fashion, excellent and profitable sport can be assured and put on a permanent basis.

MUSSELS.

Fresh water clams or mussels occur abundantly in the Verdigris River throughout a large part of its course, and there is no reason why anyone living along this stream could not increase the resources of his farm by a little study and care in the propagation of these animals. Their shells are worth from $8 to $60 a ton, and the occasional finding of a valuable pearl adds an element of excitement and possibilities of

fisherman has secured a pearl from that community which he had sold for $525. The mad excitement which this created did not fully spend itself until the last mussel from that region had been hauled from the water and examined. The clam industry probably never can be developed to large proportions in this State, but it can be made an additional source of revenue for those who have land located along suitable streams.

REPTILES.

SNAKES.

A fear once deeply grounded in the human mind can not easily be destroyed. This explains why we draw back with uncontrolled fright every time a tiny snake crosses our path. There are, of course, poisonous snakes, but we have only four of these in Oklahoma—the rattler, the copperhead, the cotton-mouth moccasin, and the coral snake. All our other snakes are no more poisonous than a rat or dog, and there is not nearly as much reason to fear them. The little spreading viper is totally devoid of any poison glands, and its peculiar habit of spreading its head is only a ruse to fool people, a ruse which to this day works well. The monster bull snake is as harmless as a pelican and worth a hundred times as much. It spends all its active life in search of gophers, rats, and mice, and is one of the most effective forces in holding these destroyers in check. This snake is the only foe of the pocket gopher, except the weasel, that can enter its burrow and pursue the occupant to certain death. It is not uncommon to find that a gopher caught in a trap has been half swallowed by one of these snakes, which found an impassable obstacle in the trap and gave up its victim. Two large bull snakes permitted to remain about a store-house will do more to keep down destructive rodents than five times as many cats. We have about 40 kinds of snakes in Oklahoma, but only the four named above are harmful. Poisonous snakes have distinctive characteristics than can be recognized at a glance. They usually have a head that is distinctly marked off from the body and does not taper gradually into the trunk region, as is the case with all harmless snakes. In addition, the rattlesnake, copperhead, and cotton-mouth moccasin have heavy depressions or pits between the eyes and the nostrils, and the tail is abruptly blunt. The rattler is a true sportsman. His bite is always deadly but he never strikes without first giving warning, and will eat no creature until its life is completely extinct. These snakes were at one time numerous over the prairies but they are now nearly extinct except in the rougher, unsettled regions. No one, of course, regrets the passing of this most deadly animal, but it is a pitiful condition that man insists on making an indiscriminate warfare on even the creeping things on the earth that do us no harm, and which must ever be sacrificed on account of a superstition and false fear that are centuries old.

TURTLES.

Besides the snakes, Oklahoma has a widely distributed reptile population that is both varied and interesting. The turtles and terrapins, of which we have more than 12 varieties, are cold-blooded creatures that lie dormant during the winter months, but are seen crawling or swimming everywhere in the summer. The soft-shelled turtle is especially abundant in many of the rivers, and the tortoises are familiar objects in the fields and gardens. The members of the turtle group in Oklahoma are for the most part rather small, but a few large ones are occasionally taken. Recently an alligator-snapping turtle weighing 110 pounds was taken from Blue River near Durant. When this specimen was discovered a member of the party ventured certain familiarities and extended the paddle end of an oar to within a few inches of its head. At once the massive jaws snapped away a portion of the oar and signaled a warning that was not to be disregarded. These larger reptiles are not abundant, and only a few are ever taken, for they frequent the deeper portions of streams and lakes, and are seldom seen except through periods of prolonged droughts when the retreating water leaves them stranded or in shallow pools.

LIZARDS.

The little blue-tailed lizards are present in large numbers and dart under some protecting object on the first approach of danger. Mountain-boomers are present in rough, hilly parts of the State where rocks abound, and the horny "toad," which is not a toad at all, but a lizard, is a common sight in practically every community of the State. A few small alligators have ascended the rivers as far as the central portion of Oklahoma. A specimen about four and a half feet long was taken from an over-flow lake south of Norman, and another was reported in a small lake near Durant. This is, of course, far outside the usual limits of their natural range, and it is one of the strange, interesting experiments of Nature in thus projecting an animal into a habitat remote from its established home, and under conditions that require radical changes in its manner of living if it is to survive.

INSECTS.

Why is an insect? This question has always been uppermost in the minds of farmers, while gardeners and fruit growers have never ceased to speculate on what a paradise this world would be if insects had never been created. Dwellers in antiquated hotels give eloquent testimony of the annoyance and humiliation caused by certain of these lowly animals, and the inhabitants of swampy regions know only too well of the deadly malaria that abounds and claims many human victims in regions that are infected with the Anophiles mosquito. Texas fever is transmitted through the bite of a tick, and is responsible each year for a loss in this State that cannot be expressed with less than six

figures. The inconvenience and suffering resulting directly or indirectly from the housefly and the diseases which it spreads represent an economic loss that can scarcely be overestimated. Forests in all parts of the State are being weakened by the ravages of insect pests, and it is a common sight to see orchards destroyed and turned into cultivated fields, because the farmers could not compete sucessfully with the hordes of pests that find an easy food supply in the young fruit trees. Those people who were in the State in 1907 remember well how the greenbugs came early in the spring and settled like dust over the wheat fields. They remained until harvest time and destroyed about twenty percent of the wheat crop in Oklahoma. The destruction and waste occasioned by insects each year in this State amounts to more than $40,000,000. This is an economic waste that in time can be and must be controlled. Before the coming of the settlers there were no such things as insect plagues, but man has entirely upset the balance of Nature, and has made possible the unlimited production of these pests by killing or driving away their natural enemies, and providing in the cultivated crops a food supply that would not be possible in the wild order of things. Insects can be checked and reduced to proportions where they can inflict little harm. The United States Department of Agriculture has already provided and tested the methods, but one man working alone cannot do it; a county alone cannot, but the whole State working as an organized unit can, if it will, arouse itself; and by scientific methods strike forever from the ledger this annual waste of millions.

SUMMARY.

Communities in their regard for animal life undergo the usual cycle of development. There are at first the boyhood days, when the primitive instincts to kill and destroy are dominant, and indiscriminate slaughter is the order of the day. Buffaloes are shot from car windows, fish ponds are dynamited during spawning seasons, and song birds are sacrificed by the hundreds for rifle practice. We have now, happily, passed this barbarous age and are living in the young manhood period when some prudence is exercised and some restrictions imposed, but when the spirit of carelessness and indifference prevents the expression of some of the noblest impulses, and keeps us inactive even after we know the truth and have sensed our responsibilities. Let us hope that this State is soon to emerge into the period of mature manhood, characterized by a deep sense of our obligation to wild life, and a resolute determination to make reparation, as far as possible, for the blunders of the past, by preserving and increasing the wild things that yet remain, and to pass them on undiminished to the future generations.

CLASSIFIED LIST OF WILD ANIMALS IN OKLAHOMA.

The following is an annotated check list of the vertebrated animals occuring in Oklahoma. It is intended only as a preliminary list and is by no means complete. In its preparation the writer has been conservative and included only those species which, from authentic published records or personal experience, he knows are residents of this State.

Those animals which have recently been exterminated or occur only in captivity are indicated by an asterisk (*).

The order in which the species are listed is the one which was thought would be the most convenient for the average reader. The scientific names are given for the convenience of those who may wish to check this list with the animals in other states, where the common names differ widely from those of our own.

MAMMALS. CLASS MAMMALIA.

HOOFED ANIMALS. ORDER ARTIODACTYLA.

Buffalo. (American bison.)
Bison bison.

Whitetail deer. (Virginia deer.)
Odocoileus virginianus.

Antelope. (Prongbuck.)
Antilocapra americana.

*Elk. (Wapiti.)
Cervus canadensis.

Mule deer. (Black-tailed deer.)
Odocoileus heminous.

FLESH-EATING ANIMALS. ORDER CARNIVORA.

Mountain lion. (Puma. Cougar.)
Felis concolor.

Ocelot. (Leopard cat. Tiger cat.)
Felis pardalis.

Coyote. (Prairie wolf.)
Canis latrans.

Red fox.
Vulpes fulvus.

*Kit fox. (Swift fox.)
Vulpes velox.

Gray fox.
Urocyon cinereoargenteus.

Otter.
Lutra canadensis.

Weasel. (Long tailed weasel.)
Putorius longicauda.

Mink.
Lutreola vison.

Bobcat. (Wild cat. Red lynx.)
Lynx rufus.

Gray wolf. (Timber wolf.)
Canis occidentalis.

Common skunk.
Mephitis mesomelas.

Little spotted skunk. (Hydrophobia cat.)
Spilogale interrupta.

Badger.
Taxidea berlandieri.

Black Bear.
Ursus americanus.

*Grizzly bear. (Silver-tip grizzly.)
Ursus horribilius.

Raccoon.
Procyon lotor.

GNAWING ANIMALS. ORDER GLIRES. RODENTIA.

Beaver.
Castor texonsis.

Red squirrel. (Chickaree.)
Sciurus hudsonicus.

Gray squirrel.
Sciurus carolinensis.

Chipmunk. (Rock squirrel.)
Tamias striatus.

Striped ground squirrel. (Thirteen-lined, or Leopard Spermophile.)
Citellus tridecemlineatus.

Franklin ground squirrel. (Gray ground squirrel.)
Citellus franklini.

Prairie dog.
Cynomys ludovicianus.

Ground hog. (Woodchuck.)
Marmota monax.

Flying squirrel.
Sciuropterus querceti.

White-footed prairie mouse.
Peromyscus maniculatus bairdi.

Field mouse.
Microtus ludovicianus.

Harvest mouse.
Reithrodontomys dychei.

Small flying squirrel.
Sciuropterus volans.

Muskrate.
Fiber zibethicus.

Wood rat. (Pack rat.)
Neotoma macropus surberi.

Cotton rat. (Marsh rat.)
Sigmodon hispidus texianus.

Meadow vole.
Microtus austerus.

Wood vole.
Microtus pinetorum.

Pocket mouse.
Perognathus paradoxus.

Grasshopper mouse.
Onychomys leucogaster.

Kangaroo rat.
Microdipodops richardsoni.

Deer mouse.
Peromyscus atwateri.

Cotton mouse.
Reithrodontomys chrysotis.

Pocket gopher.
Geomys breviceps.

Prairie mouse.
Peromyscus canus.

RABBITS. FAMILY LEPORIDAE.

Cotton-tail.
Lepus sylvaticus.

Common jack rabbit. (Jack hare.)
Lepus texianus.

Whitetailed jack rabbit. (Prairie hare.)
Lepus campestris.

INSECT-EATING ANIMALS. ORDER INSECTIVORA.

Common mole.
Scadops aquaticus.

Prairie mole. (Silver mole.)
Scalops sp.

Short-tailed shrew.
Blarina brevicauda.

BATS. ORDER CHIROPTERA.

Little brown bat.
Myotis lucifugus.

Big brown bat.
Eptesicus fuscus.

Big-eared bat.
Myotis sublatus.

Tree bat. (Red bat.)
Lasiurus borealis.

POUCHED MAMMALS. ORDER MARSUPIALIA.

Virginia Opossum. ('Possum.)
Didelphis virginiana.

*Murine Opossum. (Mouse Opossum.)
Marmosa murina.

*A tropical species accidentally introduced in bananas. Has been taken at Yukon (2 specimens) and at Norman (13 specimens).

BIRDS. CLASS AVES.

GREBES.

Pied-bill grebe. ("Hell-diver." Dab-chick.)
Podilymbus podiceps.

LOONS.

Great northern diver. (Loon.)
Gavia imber.

GULLS AND TERNS.

Franklin's rosy gull.
Larus franklini.

Herring gull.
Larus argentatus.

Least tern.
Sterna antillarum.

CORMORANTS.

Double-crested cormorant.
Phalacrocorax auritus.

PELICANS.

Great white pelican.
Pelecanus erythrorphynchos.

DARTERS.

Snake-bird. (Darter. Water-turkey. Anhinga.)
Anhinga anhinga.

GEESE, DUCKS, AND SWANS.

American merganser.
Mergus americanus.

Hooded merganser.
Lophodytes cucullatus.

Mallard.
Anas platyrhynchos.

Black duck.
Anas rubripes.

Canvasback.
Marila valisineria.

Lesser scaup duck.
Marila affinis.

American golden-eye.
Clangula americana.

Buffhead.
Charitonetta albeola.

Gadwall.
Chaulelasmus streperus.
Baldpate.
Mareca americana.
Greenwinged teal.
Nettion carolinense.
Bluewinged teal.
Querquedula discors.
Shoveller.
Spatula clypeata.
Pintail. (Sprig.)
Dafila acuta.
Wood duck.
Aix sponsa.
Redhead.
Marila americana.
Greater scaup duck.
Marila marila.
Ringnecked duck.
Marila collaris.
Ruddy duck.
Erismatura jamaicensis.
Lesser snow goose.
Chen hyperboreus.
Blue goose.
Chen caerulescens.
Whitefronted goose.
Anser albifrons gambeli.
Canada goose.
Branta canadensis.
Hutchins's goose.
Branta canadensis hutchinsi.
Smaller whitecheeked goose.
Branta c. occidentalis.
Fulvous tree duck.
Dendrocygna fulva.
Whistling swan.
Olor columbianus.
Trumpheter swan.
Olor buccinator.

IBISES, HERONS, AND EGRETS.

Whitefaced glossy ibis.
Plegadis guarauna.
American bittern.
Botaurus lentiginosus.
Least bittern.
Ixobrychus exilis.
Great blue heron.
Ardea herodias.
Little green heron.
Butorides virescens.
*Snowy heron. (Snowy egret.)
Egretta candidissima.
Blackcrowned night heron.
Nycticorax nycticorax.
Yellowcrowned night heron.
Nyctanassa violacea.
Little blue heron.
Florida caerulea.

CRANES AND RAILS.

*Whooping crane.
Grus americana.
Little brown crane.
Grus canadensis.
Sandhill crane.
Grus mexicana.
King rail.
Rallus elegans.
Sora.
Porzana carolina.
American coot. (Mudhen.)
Fulica americana.
American avocet.
Recurvirostra americana.
Blacknecked stilt.
Himantopus mexicanus.

SNIPES.

Wilson's snipe.
Gallinago delicata.
Yellowlegs.
Totanus flavipes.

Pectoral sandpiper.
Pisobia maculata.
Least sandpiper.
Pisobia minutilla.
Semipalmated sandpiper.
Ereunetes pusillus.
Upland plover. (Bartramian sandpiper.)
Bartramia longicauda.
Marbled godwit.
Limosa fedoa.
Solitary sandpiper.
Helodromas solitarius.
Western willet.
Catoptrophorus semipalmatus inornatus.
Spotted sandpiper.
Actitis macularia.
Longbilled curlew.
Numenius americanus.
*Eskimo curlew.
Numenius borealis.
Wilson's phalarope.
Steganopus tricolor.

PLOVERS.

Blackbellied plover.
Squatarola squatarola.
Snowy plover.
Aegialitis nivosa.
Killdeer.
Oxyechus vociferus.

GROUSE, PARTRIDGE, ETC.

Bobwhite.
Colinus virginanus.
Western blue quail.
Callipepla squamata.
Prairie chicken.
Tympanuchus americanus.
Lesser prairie hen.
Tympanuchus pallidicinctus.

TURKEY.

Wild turkey.
Melleagris gallopavo.

PIGEONS.

Mourning dove.
Zenaidura macroura.
*Passenger pigeon.
Ectopistes migratorius.
Bandtailed pigeon.
Columba fasciata.

VULTURES.

Black vulture.
Catharista urubu.
Turkey vulture. (Turkey "Buzzard.")
Cathartes aura.

FALCONS AND HAWKS.

Mississippi kite.
Ictinia mississippiensis.
Cooper's hawk.
Accipiter cooperi.

Marsh hawk.
Circus hudsonius.
Sharp-shinned hawk.
Accipiter velox.
Red-tailed hawk.
Buteo borealis.
Harlan's hawk.
Buteo b. harlani.
Red-shouldered hawk.
Buteo lineatus.
Swainson's hawk.
Buteo swainsoni.
Goshawk.
Astur atricapillus.
Krider's hawk.
Buteo borealis krideri.
Ferruginous rough-leg hawk.
Archibuteo ferrugineus.
Sparrow hawk.
Falco sparverius.
Osprey.
Pandion haliaetus.
Prairie falcon.
Falco mexicanus.
Rough-legged hawk.
Archibuteo lagopus.

EAGLES.

Golden eagle.
Aquila chrysaetos.
Bald eagle.
Haliaetus leucocephalus.

OWLS.

Barn owl. (Monkey-face owl.)
Aluco pratincola.
Short-eared owl.
Asio flammeus.
Barred owl.
Strix varia.
Screech owl.
Otus asio.
Burrowing owl.
Speotyto cunicularia.
Western horned owl.
Bubo virginianus pallescens.

PAROQUETS.

*Carolina paroquet.
Conuropsis carolinensis.

CUCKOOS.

Road-runner. (Chaparral Cock.)
Geococcyx californianus.
Black-billed cuckoo.
Coccyzus erythrophthalmus.
Yellow-billed cuckoo. (Rain-crow.)
Coccyzus americanus.

KINGFISHERS.

Belted kingfisher.
Ceryle alcyon.
Texas kingfisher.
Ceryle americana.

WOODPECKERS.

Hairy woodpecker.
Dryobates villosus.
Red-shafted flicker.
Colaptes cafer collaris.

Southern downy woodpecker.
Dryobates pubescens.
Red-bellied woodpecker.
Centurus carolinus.
Yellow-bellied sapsucker.
Sphyrapicus varius.
Red-headed woodpecker.
Melanerpes erythrocephalus.
Yellow-shafted flicker.
Colaptes auratus.
Pileated woodpecker.
Phloeotomus pileatus.
Texas woodpecker.
Dryobates scalaris.
Ivory-billed woodpecker.
Campephilus principalis.

GOATSUCKERS.

Whip-poor-will.
Antrostomus vociferus.
Chuck-will's-widow.
Antrostomus carolinensis.
Nighthawk.
Phalaenoptilus nuttallii.
Poor-will.
Chordeiles virginianus.

SWIFTS.

Chimney swift.
Chaetura pelagica.

HUMMING-BIRDS.

Ruby-throated humming-bird.
Archilochus colubris.

PERCHING BIRDS.

FLYCATCHERS.

Scissor-tailed flycatcher.
Muscivora forficata.
King-bird.
Tyrannus tyrannus.
Trail's flycatcher.
Empidonax trailli.
Olive-sided flycatcher.
Nuttallornis borealis.
Phoebe.
Sayornis phoebe.
Wood pewee.
Myiochanes virens.
Arkansas king-bird.
Tyrannus verticalis.
Crested flycatcher.
Myiarchus crinitus.
Yellow-bellied flycatcher.
Empidonax flaviventris.
Least flycatcher.
Empidonax minimus.
Green-crested flycatcher.
(Acadian flycatcher.)
Empidonax virescens.
Vermilion flycatcher.
Pyrocephalus rubinus.
Say's phoebe.
Sayornis saya.

LARKS.

Horned lark.
Otocoris alpestris.
Prairie horned lark.
Otocoris a. praticola.
Desert horned lark.
Otocoris a. lucolaema.

CROWS AND JAYS.

Blue jay
Cyanocitta cristata.
American magpie.
Pica pica hudsonica.
White-necked raven.
Corvus cryptoleucus.
American crow.
Corvus brachyrhynchos.

BLACKBIRDS AND ORIOLES.

Bobolink.
Dolichonyx oryzivorus.
Cowbird.
Molothrus ater.
Yellow-headed blackbird.
Xanthocephalus xanthocephalus.
Red-winged blackbird.
Agelaius phoeniceus.
Meadowlark.
Sturnella magna.
Western meadowlark.
Sturnella neglecta.
Orchard oriole.
Icterus spurius.
Baltimore oriole.
Icterus galbula.
Rusty blackbird.
Euphagus carolinus.
Brewer's blackbird.
Euphagus cyanocephalus.
Purple grackle.
Quiscalus quiscula.
Bronzed grackle.
Quiscalus quiscula aeneus.

FINCHES AND SPARROWS.

Purple finch.
Carpodacus purpureus.
American cross bill.
Loxia curvirostra.
American goldfinch.
Astragalinus tritis.
Arizona goldfinch.
Astragalinus psaltria.
Pine siskin.
Spinus pinus.
Lapland longspur.
Calcarius lapponicus.
English sparrow. (House sparrow.)
Passer domesticus.
Vesper sparrow.
Pooecetes gramineus.
Western vesper sparrow.
Pooecetes gramineus confinis.
Savannah sparrow.
Passerculus sandvichensis savanna.
Western Savannah sparrow.
Passerculus s. alaudinus.
Cardinal.
Cardinalis cardinalis.
Rose-breasted grosbeak.
Zamelodia ludoviciana.
Western grasshopper sparrow.
Coturniculus savannarum.
Baird's sparrow.
Centronyx bairdii.
Lark sparrow.
Chondestes grammacus.
Harris's sparrow.
Zonotrichia querula.
White-crowned sparrow.
Zonotrichia leucophrys.
Chipping sparrow.
Spizella passerina.
Field sparrow.
Spizella pusilla.
Slate-colored junco.
Junco hyemalis.
Song sparrow.
Melospiza melodia.
Lincoln sparrow.
Melospiza lincolni.
Fox sparrow.
Passerella iliaca.
Towhee.
Pipilo erythrophthalmus.
Lasuli bunting.
Cyanospiza amoena.

Blue grosbeak.
Guiraca caerulea.
Western blue grosbeak.
Guiraca c. lazula.
Indigo bunting.
Cyanospiza cyanea.
Painted bunting.
Cyanospiza ciris.
Dickcissel.
Spiza americana.
Lark bunting.
Calamospiza melanocorys.

TANAGERS.

Scarlet tanager.
Piranga erythromelas.
Summer tanager.
Piranga rubra.

SWALLOWS.

Purple martin.
Progne subis.
Cliff swallow.
Petrochelidon lunifrons.
Barn swallow.
Hirundo erythrogaster.
Bank swallow.
Riparia riparia.

WAXWING.

Cedar waxwing.
Bombycilla cedrorum.

SHRIKES.

Northern shrike.
Lanius borealis.
Loggerhead shrike.
Lanius ludovicianus.

VIREO.

Red-eyed vireo.
Vireosylva olivacea.
Warbling vireo.
Vireosylva gilva.
Yellow-throated vireo.
Lanivireo flavifrons.
White-eyed vireo.
Vireo noveboracensis.
Small white-eyed vireo.
Vireo n. micrus.
Black-capped vireo.
Vireo atricapillus.

WARBLERS.

Black and white warbler.
Mniotilta varia.
Worm-eating warbler.
Helmitheros vermivorus.
Golden-winged warbler.
Vermivora chrysoptera.
Nashville warbler.
Vermivora rubricapilla.
Tennessee warbler.
Vermivora peregrina.
Audubon's warbler.
Dendroica audubonii.
Pine warbler.
Dendroica vigorsii.
Parula warbler.
Compsothlypis americana.
Yellow warbler.
Dendroica aestiva.
Myrtle warbler.
Dendroica coronata.
Palm warbler.
Dendroica palmarum.
Ovenbird.
Seiurus aurocapillus.
Water thrush.
Seiurus noveboracensis.
Louisiana water thrush.
Seiurus motacilla.
Kentucky warbler.
Oporornis formosa.
Mourning warbler.
Oporornis philadelphia.
Northern yellow-throated warbler.
Geothlypis trichas.
Yellow-breasted chat.
Icteria virens.

Black-throated blue warbler.
Dendroica caerulescens.
Black-poll warbler.
Dendroica striata.
Black-throated green warbler.
Dendroica virens.
Cerulean warbler.
Dendroica caerulea.
Hooded warbler.
Wilsonia citrina.
Canadian warbler.
Wilsonia canadensis.
American red-start.
Setophaga ruticilla.
Wilson's warbler.
Wilsonia pusilla.
Magnolia warbler.
Dendroica magnolia.

PIPITS.

American pipit.
Anthus rubescens.
Sprague's pipit.
Anthus spraguei.

DIPPER.

American dipper.
Cinclus mexicanus.

THASHERS AND WRENS.

Mockingbird.
Mimus polyglottos.
Western mockingbird.
Mimus p. leucopterus.
Cat-bird.
Dumetella carolinensis.
Brown thrasher.
Toxostoma rufum.
Bewick wren.
Thryomanes bewicki.
House wren.
Troglodytes aedon.
Winter wren.
Nannus hiemalis.
Western marsh wren.
Telmatodytes palustris.
Rock wren.
Salpinctes obsoletus.

CREEPERS.

Brown creeper.
Certhia familiaris americana.

NUTHATCHES.

White-breased nuthatch.
Sitta carolinensis.
Slender-billed nuthatch.
Sitta c. aculeata.
Tufted titmouse.
Baeolophus bicolor.
Black-capped chickadee.
Penthestes atricapillus.

KINGLETS.

Golden crowned kinglet.
Regulus satrapa.
Blue-gray gnatcatcher.
Polioptila caerulea.
Ruby Crowned kinglet.
Regulus calendula.

THRUSHES.

Wood thrush.
Hylocichla mustelina.
Gray-cheeked thrush.
Hylociclia aliciae.

Wilson thrush.
Hylocichla fuscescens.
Hermit thrush.
Hylocichla guttata pallasii.
American robin.
Planesticus migratorius.
Bluebird.
Sialia sialis.
Western or mountain bluebird.
Sialia artica.

REPTILES. CLASS REPTILIA.

POISONOUS SNAKES.

Diamond-backed rattlesnake.
Crotalus adamanteus.
Prairie rattlesnake.
Crotalus confluentus.
Timber rattlesnake.
Crotalus horridus.
Massasauga.
Sistrurus catenatus.
Edward's massasauga.
Sistrurus catenatus edwardsii.
Cotton-mouthed moccasin.
Ancistrodon piscivorus.
Copperhead.
Ancistrodon contortrix.
Coral snake.
Elaps fulvius.

HARMLESS SNAKES.

King snake.
Ophibolus getulus.
Yellow-bellied king snake.
Ophibolus caligaster.
Corn or rat snake.
Coluber guttatus.
Pilot snake.
Coluber obsoletus.
Black snake. ("Blue racer.")
Zamenis constrictor.
Bull snake.
Pituophis sayi.
Coach whip snake.
Zamenis flagelliformis.
Blow snake.
Heterodon nasicus.
Green snake.
Cyclophis aestivus.
Common water snake.
Tropidonotus fasciatus.
Worm snake.
Carphophiops vermes.
Insect snake.
Diadophis amabilis.
"Dryland" moccasin.
Tropidonotus rhombifer.
Texas blind snake.
Glauconia dulcis.
Spreading adder.
Heterodon platyrhinus.

ALLIGATOR.

Alligator mississippiensis.

LIZARDS.

Blue-tailed lizard.
Eumeces quinquelineatus.
Sonora skink.
Eumeces obsoletus.
Clark's swift.
Sceloporus clarkii.
Horned lizard. (Horned "toad.")
Phrynosoma cornutum.

Common spotted lizard.
Holbrookia maculata.

Glass "snake."
Ophiosaurus ventralis.

Mountain boomer.
Crotaphytus collaris.

TURTLES AND TORTOISES.

Snapping turtle.
Chelydra serpentina.

Alligator snapping turtle.
Macrochelys lacertina.

Common musk turtle.
Aromochelys odoratus.

Keeled musk turtle.
Aromochelys carinatus.

Mud turtle.
Cinosternum pennsylvanicum.

Common box turtle.
Cistudo carolina.

Gopher tortoise.
Testudo polyphemus.

Agassiz's tortoise.
Testudo agassizi.

Southern soft-shelled turtle.
Trionyx ferox.

Spiny soft-shelled turtle.
Trionyx spinifer.

Diamond-back terrapin.
Malacoclemmys palustris.

AMPHIBIANS. CLASS AMPHIBIA.

TOADS.

Western spadefoot toad.
Scaphiolpus hammondii.

Common toad.
Bufo cognatus.

American toad.
Bufo americanus.

Toad.
Bufo compactilis.

FROGS.

Tree frog.
Hyla versicolor.

Cricket frog.
Acris gryllus.

Southern leopard frog.
Rana sphenocephala.

Southern tree frog.
Hyla squirrella.

Leopard frog.
Rana pipiens.

Green frog.
Rana clamitans

Common bull frog.
Rana catesbiana.

SALAMANDERS.

Tiger salamander. (Axolotl. Mudpuppy. Water-dog.)
Amblystoma tigrinum.

FISHES. CLASS PISCES.

Lake sturgeon.
Acipenser rubicundus.

Shovel-nosed sturgeon.
Scaphirhynchus platyrhynchus.

Mississippi blue cat.
Ictalurus furcatus.

Channel catfish.
Ictalurus punctatus.

Bullhead.
Ameiurus nebulosus.

Yellow cat.
Ameiurus natalis

Mud cat.
Leptops olivaris.

Common sucker.
Catostomus commersoni.

Hickory shad.
Dorocoma cepedianum.

Large-mouthed black bass.
Micropterus salmoides.

Yellow perch.
Perca flavescens.

Goggle-eye.
Ambloplites rupestris.

Sunfish.
Eupomotis gibbosus.

Long-nosed gar pike.
Lepidosteus osseus.

Black-gill sunfish.
Lepomis pallidus.

Buffalo.
Ictiobus cyprinella.

Common eel.
Anguilla chrisypa.

CHAPTER IX.

PLANT LIFE IN OKLAHOMA.*

INTRODUCTION.

Oklahoma is an especially interesting region botanically, being a transition area between typical Mississippi Valley conditions in its eastern part, and very different conditions in the foot-hill region of the Rocky Mountains. The relation to the flora of the Gulf Plain and the more northern floras within its area is of much importance, since many species of both regions reach the limits of their ranges within the boundaries of the State.

Compared with the eastern states, Oklahoma is large, the area being 70,470 square miles, or more than the combined areas of the six New England states and New Jersey. Oklahoma extends from about 94° 30′ west longitude westward to 103° west longitude and from 33° 38′ north latitude to 37°. Its form is roughly rectangular with a narrow westward extension from the northwest corner, known as the Panhandle of the State.

PHYSIOGRAPHY AND GEOLOGY.

The lowest elevation in the State is in the southeastern corner, where the distance above sea level is about 400 feet. The surface rises gradually to the north and northwest, reaching an elevation of more than 4,000 feet in the west end of the Panhandle. Along the eastern edge of Leflore County, near the southeastern corner of the State, the high elevation of the hilly region, lying between the Ozark Mountains and the Ouchita Mountain uplift, extends from Arkansas into the State, the highest point being on Rich Mountain near Page, with an elevation of about 2,000 feet above sea level. Gradually lower elevations extend westward for about 50 miles. The northern third of the eastern part of the State lies in the western end of the Ozark range, and in some places along the State line the elevation reaches 1,000 to 1,500 feet.

About 30 miles north of Red River, and almost midway along the south side of the State, the Arbuckle Mountains are found, and extend for about 30 miles in a general east and west direction. In the southwestern corner of the State, approximately 30 miles from both the west line and Red River, the Wichita Mountains rise abruptly. These mountains consist of a series of hills and mountains of granite, porphyry,

*Stevens, G. W. and Shannon, C. W.—See "Introduction" page 21.

and limestone which extend southeastward nearly parallel with the general course of Red River for about 60 miles, gradually increasing in elevation to the east end of the range, where the greatest height is attained in Mt. Scott, some 1,500 feet in elevation. The other portions of the State have few local elevations except the conspicuous ranges of gypsum hills through several counties in the western part of the main body of the State (Pl. XI). These bluffs and butts often stand conspicuously above the surrounding regions, but their elevations do not exceed that of the more level country lying west of them.

West of the Gypsum Hills region, the surface is higher and more nearly even, except where cut into valleys and canyons by the nearly parallel rivers, and the surface of the region passes gradually into the Great Plains at about the 100th meridian.

Lying along the north side of the valleys of four rivers in the northwestern part of the State are belts of sand hills, ranging from 2 to 18 miles in width (Pl. VII). In the counties along the 100th meridian, the sandy regions, in some places, extend on both sides of the valleys, occasionally crossing the divides.

The surface of the strip 15 to 40 miles broad, extending from the southeastern corner of the State westward to about the middle of the south side. is a part of the Gulf Coastal Plain and consists of Cretaceous formations. The surface rocks of some areas in the Panhandle part of the State, and the western parts of Cimarron County, are also Cretaceous. The eastern half of the State, with the exception of the Ouachita and Arbuckle mountain uplifts, and the Cretaceous area along Red River, is included in the Carboniferous formations. The extreme northeastern part of the State, north of the Arkansas and east of Grand River, is composed of rocks chiefly of Mississippian age, while the remainder of the area designated consists of rocks of Pennsylvanian age. From about the middle line of the State, westward, with the exception of the Wichita Mountain region, and the High Plains area, the rocks belong to the Permian Redbeds. The surface rocks of the High Plains region consist principally of Cretaceous and Tertiary formations, with considerable areas covered by sands of recent age.

SALT PLAINS.

Low lying level sandy tracts varying from one acre to 50 square miles in area and having salt springs at or under the surface are known as salt plains. These are all in the western third of the State, and are mostly located far apart, although in three instances two or three are grouped in rather close proximity. The saline condition of these plains is due probably in all cases to the presence of salt springs.* However, the existence of such springs has not been demonstrated in the Great Salt Plains or United States Saline Reserve, in Alfalfa County; but the constant presence of salt water in the sandy floor even in the summer when evaporation is very great, strongly suggests the presence of saline springs

*Okla. Geol. Survey Bull. No. 11, Chap. VI. page 202.

beneath the floor of the plain. At this period the surface becomes white with an incrustation of salt. In most of the other salt plains the salt springs are flowing onto the surface, and the evaporation results in a crust of salt sometimes several inches thick on parts of the floor of the plain. One of these, in the valley of the Cimarron River, known as the Big Salt Plain of the Cimarron, beginning about 10 miles south of the Kansas line and extending about 8 miles down the river, is "the only place where rock salt can be obtained on the surface in all the plains country. This salt was known and used by the Indians, and was an article of trade from the Gulf to the British line, and this locality was a well-known geographical point from which distances were reckoned."* On several of the others salt is abundant and has been manufactured for local market at three or four of them.

The most conspicuous biological feature of the Salt Plains is the almost complete absence of life either in the water or soil. In some of the less concentrated ponds ditch grass (*Ruppia maritima*) is found. About their margins are found cat-tail (*Typha angustifolia*), bug-seed (*Corispermum hyssopifolium*), tumble-weed (*Cycloloma antriplicifolium*), sea-blite (*Suaeda linearis*), and water rush (*Scirpus campestris var. pludosus*); while sea purslane (*Sesuvium sesile*) grows in the salty sand of the floor plains. Salt grass, (*Distichlis spicata*), water-rush (*Ssirpus Torrey*), rush grass (*Sporobolus airoides*), and sand rache (*Atriplex argentea*) are found about the margins, but are occasionally likewise in other less alkaline parts of the State. Salt-marsh fleabane (*Pluchea camphorata*) is occasionally found in slightly alkaline situations about the plains and is not reported elsewhere in the State.

The size of the Great Salt Plain, about 12 miles long and 6 miles across in the broadest place, and its low position within a rather extended basin, lead to the belief that it is the site of an ancient lake which is called Lake Barde. The presence of the Least Tern nesting regularly in considerable numbers upon this plain and the Big and Little Salt plains of the Cimarron is taken by ornithologists as evidence of a former inland sea in the vicinity. This is a sea coast bird found rarely elsewhere except on the Florida, Gulf, and Lower California coasts.

GYPSUM HILLS.

Two formations of gypsum occur in the western part of the State (Pl. XI). These are exposed along the juncture of valleys and higher tracts, and mostly have the form of bluffs and buttes, the latter frequently called Glass Mountains or Gloss Mountains. The gypsum caps, on the bluffs or butts preserve the top of the elevation, with their slow decaying rock, while the underlying red clay is eroded more rapidly, often leaving perpendicular faces. (See Plate XX.) The rapid erosion of the sides of these hills and the excess of calcium sulphate (gypsum) on their tops make unfavorable conditions for plants. A few species are

*Okla. Geol. Survey Bull. No. 11, p. 205.

usually found on and about them and some of these are mostly not found elsewhere.

The most exclusively gypsum hill species are plains psilostrophe (*Psilostrophe villosa*), and phacelia (*Phacelia intergrifolia,*) and few-seeded mentzelia (*Mentzelia oligosperma*) which grow on the top of the gypsum cap or the last species in clefts in it; Nama (*Nama compactum*) seems to be confined almost exclusively to the guttered and weathered sides of these hills, the type locality of the species being the side of the butte in Major County known as Gloss Mountain. The sharp-scaled grass (*Erioneuron pilosum*) is common on somewhat more permanent places on the sides of the bluffs and is seen growing at the mouth of the cave in the illustration (Pl. XXI). Evening primrose (*Oenothera missouriensis*), sensitive brier (*Mimosa borealis*). aster (*Aster aricaefolius*), evening primrose (*Oenothera Hartwegi var. lavendulaefolia*), hairy purslane (*Portulaca polisa*), vetch (*Astragalus parviflorus*), and (*A. cuspidata*) are found about the sides and bases of the hills, but they also occur in other locations having red clay soil with a large content of calcium sulphate. The wild gooseberry (*Ribes aurea*), ill-scented sumac (*Rhus canadensis var. trilobata*), and red cedar (*Juniperus virginiana*) are often found rooting in the clefts of the gypsum cap, but are as often found in soil not especially rich in gypsum.

SAND-HILLS REGION.

Beginning about the middle of the State or a little farther westward there extends a strip of sandy country along the north side of each of four nearly parallel rivers, the Salt Fork of the Arkansas, Cimarron, North Canadian, and South Canadian (Pl. VII). These areas are from 2 to 18 miles broad and stretch northwestrly 50 to 210 miles. Near the western edge of the State the sandy area along the South Canadian broadens and becomes continuous on the north with that of Wolf Creek, a tributary of the North Canadian, and extending southward continues to Washita River. Farther southward along the western edge of the State extensive sandy regions are encountered on both sides of Salt Fork and North Fork of Red River, and east of the latter near its junction with Red River.

The sandy regions along the rivers in the northwestern part of the State seem to owe their origin to certain weather conditions which have maintained for a long period in the past, and to some extent are still operating.

These rivers are relatively long, the Cimarron and South Canadian having their sources in the Rocky Mountains. The rains in a semi-arid country are usually more rapid and of shorter duration than in better watered regions. In western Oklahoma formerly many rains lasted from 15 minutes to an hour, precipitating in that time from 1 to 4 inches of water. The uncultivated condition of the soil and the short duration of the rain resulted in most of the water running off and leaving, it is

estimated, in some instances, as little as 10 per cent of it in the soil. The erosion caused by the resulting freshets and floods was great and the intensely muddy water of the streams carried much sand. The clay and dissolved substances were mostly carried on to larger rivers, but the sand was dropped in the river bed in the shape of bars as the velocity of the water diminished. Long periods of dry weather often intervened between rains, and in these drouth periods the rivers often became completely dry. During the summer dry periods the wind blows almost constantly from the south and has a velocity of from 10 to 40 miles per hour. The finer sand is carried by such wind and during most of the time, probably, since the Tertiary period, the winds have been strewing northward much of the sand brought down by the spring freshets. The area in the State thus covered by the sand from these four rivers is estimated to be between 3,000 and 4,000 square miles.

The average rainfall here has not increased in the last few decades, but the cultivation of the soil and growing of crops and trees since the settlement of the country have resulted apparently in the rainfall occuring more gently and for longer duration. This fact, together with the receptive condition of the soil caused by cultivation, results in a much larger part of the precipitation entering the soil and in fewer freshets and floods as well as less erosion. The sand supply of the river beds is no longer greatly increased and the sand is mostly kept moist during the summer and not carried by the wind. These rivers are now seldom dry and the areas of shifting sand are much reduced. In a few places the sand still drifts during the summer. In the southwestern part of Woods County, there are several square miles covered with shifting dunes and the region is advancing northward covering elm and cottonwood trees and causing Dog Creek to change its course.

The plant life of the sand-hills consists of fewer species than that of the adjacent non-sandy regions, the number being greatest along the margins of the sandy areas, in better watered places and on sand-hills where sand has long since stopped drifting. The Waynoka dunes, some of which are 75 feet high, have no plant life except an occasional top of a buried cottonwood still projecting above the drifting surface.

BLACK MESA REGION.

Where the Cimarron River enters the northwestern corner of the State it traverses a rather deep valley or broad canyon bounded by sandstone-capped bluffs and buttes on the south and by the Black Mesa on the north. The Black Mesa is a bed of lava or mal pais rock, now standing above the level of neighboring elevations. The flora is distinctly western.

SOILS.

The great variety of rock formations found in the regions above named produces soils differing much in character. The granites, limestones, sandstones, shales, and clays each make different types of soil.

The soils of the State may be grouped under the following heads: (1) Residual soils; (2) Transported soils. Under the second type are: (a) Colluvial soils; (b) Alluvial soils; (c) Aeolian soils. Residual soils are those which have been formed in the place where they are now found, and the soils of Oklahoma belong chiefly to this type. The transported soils of the State consist of those along the streams and the sand areas of the State. The eastern half of the State has limestone generally present in the soil. The western half has an abundance, and even an excess of gypsum, even in the sand hill areas which are in the general gypsum region. The ground water also contains gypsum, and wells in the Permian red clay often furnish water so strong with gypsum that farmers must depend upon cisterns for holding water for domestic purposes. A large percentage of the soils of the State are alkaline. The percentage of acid soils is relatively small.

PRECIPITATION.

The rainfall is greatest in the southeastern part of the State, where it averages about 43 inches per year, gradually diminishing westward to Cimarron County, where the average is only 15 inches per year. A considerable part of the central-western part of the State also has a scanty rainfall. For further information concerning the precipitation, the reader is referred to a discussion of rainfall on page 37.

Lines marking places of equal rainfall extend mostly a little west of south from the northern boundary of the State.

LIFE ZONES.

Four life zones have been distinguished in Oklahoma. The Upper Austral covers a small area at the middle of the north edge and most of the Panhandle. The Carolinian zone extends over the rough and elevated regions in the eastern part of the State. The Lower Austral zone covers the central and a part of the eastern portions, while about two-thirds of the eastern portion is in the Austroriparian. These regions pass imperceptibly into each other, except in a few cases, where the change is rather abrupt (the Carolinian having rather distinct lines of contact with the Austroriparian).

RELATION OF PHYSICAL CONDITIONS TO THE FLORA.

In Oklahoma the problem of determining the relation of the different types of soil, of the elevation (life zones), of rainfall, and of distributing agents to the distribution of our species is complicated and difficult. By reference to the maps contained in this report, it will be seen that the lines showing the limits of the geological formations, and lines of equal rainfall largely coincide, and that the lines of equal elevation also in a general way coincide with these. Along the line of junction between the Pennsylvanian and Permian formations, numerous species reach the limit of their western range in the State. Conspicuous among these are Sycamore (*Platanus occidentales*), hickory (*Carya Illinoensis*), hickory (*Carya cordiformis,*) hackberry (*Celtis mississippiensis*), blackberry (*Rubus villosus*), black-cap raspberry (*Rubus occidentalis*), dwarf chestnut oak (*Quercus prinoides*), black oak (*Quercus veluntina*), southern red oak (*Quercus texana*), blue ash (*Fraxinus quadrangulata*), persimmon (*Diospryros virginiana*), winged elm (*Ulmus alata*), flowery dog wood (*Cornus florida*). Several of these extend somewhat father westward than the Pennsylvanian-Permian line in the southern part of the State. Since the lines of equal precipitation swing westward toward the southern end of the State, and the species named are found in their farthest west stations in places suffering less from evaporation than the average conditions of the regions (mountains, canyons, and river valleys), it seems that the governing factor of their western limits is the amount of moisture accessible in the soil and the relative freedom from excessive evaporation, rather than the nature of the soil.

There is a gradual thinning out of eastern species toward the western part of the State, the western limits of their ranges often extending as slender tongues along the valleys of the larger rivers, a fact which seems to point to the reduced moisture supply as the determining factor limiting their ranges. Prairie crab apple (*Pyrus ioensis*), Amercian hazelnut (*Corylus americana*), beech (*Fagus grandifolia*), hop hornbeam (*Ostrya virginiana*), cucumber tree (*Magnolia acuminata*), smooth alder (*alnus rugosa*), chinquapin (*Castanea pumila*), willow oak (*Quercus phellos*), water oak (*Quercus nigra*), are found but the division of the Carboniferous formations where they grow terminates mostly in a zone of precipitation between 37 and 40 inches, and since the range of most of these species includes regions of unlike soil conditions, but not any territory with less than 37 inches of annual rainfall, it seems to follow that the amount of precipitation is the governing condition. Aside from certain plans characteristic of special conditions to be described later, the delimiting factor in most of our plant ranges seems to be the amount of rainfall.

RELATION OF OUR FLORA TO THAT OF ADJACENT REGIONS.

The examination of the ranges of 1,000 of our species chosen as representatives shows the following facts concerning the relation of our flora to that of adjacent regions. This number of species was chosen rather than the entire number (about 1500) because the ranges of about one-third of them are broken, very irregular, or of such outline, such as introduced and vestigial species, as not to lend evidence in the present investigation. The results are given in the number of species per hundred of our range, minor fractions being omitted, and major fractions used as integers.

The flora is divided into groups as follows: (1) *Northern flora,* consisting of species whose southern range does not extend farther southward than Oklahoma (or rarely slightly farther), and divided into two groups: (a) species ranging through Upper Austral or the Carolinian

and into the Transition or Alleghanian; and (b) species whose northern range limits lie in the Upper Austral or Carolinian. (2) *Mid-Mississippi Valley flora,* species ranging well into both the Upper Austral or Carolinian and the Lower Austral or Austroriparian. (3) *Southern flora,* consisting of species whose ranges are confined to the Lower Austral and Austroriparian, and divided into two groups: (a) those species ranging mostly through the lower Mississippi Valley, and (b), those species having ranges confined to Oklahoma, eastern Texas, and Louisiana. (4) *Western species* placed into two groups: (a) those whose ranges extend westward beyond the Upper Austral and into various zones beyond, and (b) those species confined to the Upper Austral zone (Great Plains). (5) Local species: (a) those species whose ranges do not extend beyond any adjacent state, and (b) those whose ranges are confined to Oklahoma. There is some duplication of species in division (3) group (b), and division (5) group (a), but the number is less than one per cent.

Approximately 5 per cent of our species are found throughout the State, or in other words, 19 out of 20 of our plants reach the limit of their ranges in Oklahoma. 70 per cent of our flora is the western extension of Mississippi Valley flora, and 7 per cent more is doubtless derived from the flora of that region. Twenty-one per cent is derived from the Great Plains or more westerly regions, and there are reasons for believing that about 2 per cent probably had local origin in Kansas, Oklahoma and Texas.

DISTRIBUTING AGENCIES.

The importance of distributing agencies is exaggerated in Oklahoma by the fact that 95 per cent of our species do not extend entirely over the State. The present distribution of many species is comparatively recent, for the details of their ranges are determined by local soil and water conditions that have been developed within a comparatively brief past. The western limits of many of our eastern species have numerous slender extensions or outlying stations in the regions west of them, these being mostly strips following the valleys and canyons of streams up their courses.

Two of the most generally distributed species in the State are Carolina poplar (*populus deltoides*), and long-leafed willow (*Salix longifolia*). Their wide range depends upon the facts that appropriate soil and moisture conditions for them exist over most of the State, and that the species have been able to reach the stations where now found. The wind is doubtless the agency responsible for the wide distribution of these, as well as for numerous others blown as tumble-weeds or whose seeds have pappus or coma of such nature as to enable them to be carried by the wind, notable examples being found among our composites and milkweeds.

As far as our eastern species are concerned, the consideration of water as a distributing agency may be discarded. Our rivers all flow

south-easterly, and while they doubtless contribute to the distribution of some of our western species, they cannot assist those migrating westward.

Oklahoma is far enough south (33° 38′ to 37°) so that many birds which are only summer residents farther northward, such as Robins, Bluebirds, and Waxwings are common here in the winter, and subsist largely or partly upon various kinds of dried fruits. In summer many species of berry-eating and drupe-eating birds assist in the distribution, and as a result one or more species of hackberry (*Celtis*), plum (*Prunis*), grape (*Vitis*), Virginia creeper (*Parthenocissus*), soapberry (*Sapindus*), sumac (*Rhus*), greenbrier (*Smilax*), pokeweed (*Phytolacca*), Cedar (*Juniperus*), oak (*Quercus*), prickly pear (*Opuntia*), and *cactus* (*Mammillaria*) have found their way up valleys, into tributary and adjacent valleys or far out on the prairies.

The examination of numerous stomachs of cedar waxwings, robins, bluebirds, blackbirds, tanagers, orioles, mockingbirds, brown thrashers, catbirds, and thrushes reveals seeds and nuts of fruits that help make up the birds diet. The red cedar high on the canyon bank, the soapberry tree at the head of a tributary canyon or on a hillside above other trees, the solitary grape vine or sand plum in a grassy valley far removed from others of its kind, the skunk-bush (*Rhus canadensis var. trilobata*) perched on the brow of a gypsum-capped butte, the Missouri currant among the rocks on the rough side of a glass mountain, the lone hackberry in a prairie draw, the rock-grape growing in a cleft in a sandstone or granite ledge, are monuments to the services of birds as distributors of plants.

The writer has been much interested in the relation of the wild turkey to the distribution of the black-jack (*Quercus marilandica*) and Texas oak (*Q. undulata*). In years when these oaks bear fruit, their acorns have supplied a large proportion of the food of the wild turkeys in the vicinity, and the forests of the former species (black-jack oak) have been most favorable places for the hunter of these birds in winter. Examination of their crops in winter reveals surprisingly large numbers of acorns, often more than a hundred being found in a single bird.

The turkey is a ground-living bird and often travels in flocks for several miles on foot, passing frequently across divides between valleys. Until 20 or 25 years ago this bird was abundant in the semi-timbered and prairie regions of Oklahoma and Texas. The accidental death of one of them often resulted in leaving dozens or scores of acorns on the ground miles from oak trees. Some of these acorns must have been in condition for germination and grown into trees, and the oaks' range was thus extended. In the sandhill region along the north side of Cimarron River in Woods County the black-jack oak reaches its northwestern limit in the State. A similar region along the North Canadian has this tree reaching its last station 30 or 40 miles farther southwestward. Along the borders of the wooded regions in these sections and especially

just at the western edge and often from a half to two miles beyond one finds places where numerous small oaks grow very closely together over a few square rods of area showing by their cross-sections about the same age. One finds no such clusters of quite young trees, nor does one find the large oaks in the woods conspicuously clustered. The explanation seems to be that the cluster of young oaks is from acorns left where a coyote, wild-cat, or eagle destroyed a turkey. Most of the trees in the clusters that have been formed for centuries have disappeared in the struggle for existence, and the cluster as such is no longer evident. There are no new outlying clusters now appearing because, it is believed, there are no longer wild turkeys in these regions.

PLANT FAMILIES IN OKLAHOMA.

The following pages give a summarized discussion of the plant life of Oklahoma. The summary is by families, and under each family name, the more common representatives are given, also general statements in regard to habitat, character of growth, distribution, and importance. In some cases where several species are known, the number is indicated by the figure (7) within the parenthesis directly following the name.

FERNS AND AILLIES (PTERIDOPHYTA.)

FERN FAMILY—(*Polypodiaceae*).—Including a large number of ferns, among which are the scaly, beach, powdery, maidenhair, bracken and lip, lady, walking, christmas, shield, woods, evergreen, wood bladder, and sensitive ferns, also several varieties of the royal fern family, adder's tongues, water ferns, the horsetail or scouring rush family, and quillworts.

SEED-BEARING PLANTS—FLOWERING PLANTS (SPERMATOPHYTA).

GYMNOSPERMAE.

PINE FAMILY—(*Pinaceae*).—Includes the pines, cedars (3), juniper, and water cypresses (in swamps in southeastern corner of the State).

ANGIOSPERMAE.

CATTAIL FAMILY—(*Typhaceae*).—The broad-leaved cattail is found in wet places throughout the State, while the narrow leaved or salt plains cattail is found only in wet places in the northwestern part of the State about the salt plains.

BUR-REED FAMILY—(*Sparganiaceae*).—Includes the bur-reeds found in moist or wet places in the eastern half of the State.

POND-WEED FAMILY—(*Naiadoceae*).—Includes the pond-weeds and ditch grasses, water-plantin family (*Alis maceae*). This family includes the arrowheads (*Sagittaria*) (9), the burr-heads (*Echinodorus*), and water-plantins (*Alisma*).

GRASS FAMILY—(*Gramineae.*)—This family includes a very large number of grasses, both wild and cultivated, including the Johnson grass, foxtail, reed grass, blue stems, wild oats, and many others.

SEDGE FAMILY—(*Cyperaceae*).—Includes the cypresses, found in wet sandy soils over most of the State, nut grasses, spike rushes (36), bullrushes (9), umbrella grasses, dwarf sedges, beak-rushes, nut-rushes, and sedges, of which there are a large number.

ARUM FAMILY—(*Araceae*).—This family includes the Indian turnip, or Jack-in-the-pulpit, found in moist woods in the eastern part of the State. The green dragon or dragon root is found in moist woods over the State, except the west and northwest part; and the sweet flag or calamus-root is found in the eastern part of the State.

DUCK WEED FAMILY—(*Lemnaceae*).—This family includes several species of small green plants, floating in large numbers on quiet water, found to some extent over the State, but chiefly in the eastern half.

YELLOW-EYED GRASS FAMILY—(*Xyridaceae*).—Includes only one genus found in the State. This is the slender yellow-eyed grass in the eastern part of the State.

SPIDERWORT FAMILY—(*Commelinaceae*).—Herbs with jointed round stems, mostly branched, including the spiderworts and day-flowers.

PICKEREL WEED FAMILY—(*Pontederiaceae*).—Including the picarelle, wood and mud plantins. The plants of this family grow in the central-eastern part of the State.

RUSH FAMILY—(*Juncaceae*).—Includes the rushes (20).

LILY FAMILY—(*Liliaceae*).—This family includes the bunch flower, false helebore, wild onions (including the garlics), and Oklahoma lily—found on prairies over the entire State, except part of northeast corner, lilies, dog-tooth violet, bellworts, hyacinths, star flower, yuccas (soap root), asparagus, false Solomon's Seal, Solomon's Seal, lily of the valley, wake robin (*Trillium*), and Green briars (7).

YAM FAMILY—(*Dioscoreaceae*).—Wild yam root (Colic root).

AMARYLLIS FAMILY—(*Amaryllidaceae*).—Yellow star-grasses.

IRIS FAMILY—(*Iridaceae*).—Irises, blue flags, and blue-eyed grasses.

ORCHARD FAMILY—(*Orchidaceae*).—This family includes the mocassin flower, the lady's slippers and showy orchis, and several other species.

LIZARD-TAIL FAMILY—(*Saururaceae*).—Lizard-tail in swamps and along pond margins in eastern part of State.

WILLOW FAMILY—(*Salicaceae*).—Including the willows of which there are at least 6 species and the poplars, including the silver-leaved or white poplar and the cottonwoods (2).

WALNUT FAMILY—(*Juglandaceae*).—The walnuts (3) and hickories (10).

BIRCH FAMILY—(*Betulaceae*).—Including the hazel, iron wood, hornbean, birches, and alders.

OAK FAMILY—(*Cupuliferae*).—Including the beech, chestnuts (2), and oaks (17).

NETTLE FAMILY—(*Urticaceae*).—Including the elms (3), hackberries (2), Bois d'Arc (Osage orange), mulberries, woodnettles, stinging nettles, and hops.

SANDAL-WOOD FAMILY—(*Santalaceae*).—Mistletoe. The toad-flaxes, partly as root parasites on trees and shrubs.

DUTCHMAN'S-PIPE FAMILY—(*Aristolochia macrophylla*).—

JOINT WEED FAMILY OR BUCKWHEAT FAMILY—(*Polygonaceae*).—Includes the gray-weeds, docks and sorrels, and joint weeds.

GOOSE FOOT FAMILY—(*Chenopodiaceae*).—Including the sand tumble weed, small cypress, lamb's quarters, mealy goosefoot, oak-leaved goosefoot, dwarf lamb's quarters, Russian thistle, Russian lamb's quarters, and several others; white sage (winter-foot), bug-seed, Jerusalem oak, Mexican tea.

AMARANTH FAMILY—(*Amaranthaceae*).—Includes Amaranths pig-weeds, tumble weeds, western water hemp, and blood-leaf (*Iwda's* bush).

POKE-WEED FAMILY — (*Phytolacaceae*). — The poke-weeds (poker-root), common in wet and moist places throughout the State, except the Panhandle counties.

FOUR O'CLOCK FAMILY—(*Nyctaginaceae*).—Including several species of the four o'clock, generally widely distributed.

CARPET WEED FAMILY—(*Aizoaceae*).—Western sea purslane and carpet weeds.

PINK FAMILY—(*Caryophyllaceae*).—The pearl worts, sand worts, chickweeds, corn cockle (corn rose), catchfly, fire pink, starry campion, and bouncing bet.

PURSLANE FAMILY—(*Portulacaceae*).—Spring beauties, common throughout the State, fairy flower, talinums, purslanes, and rose moss.

HORNWORT FAMILY—(*Ceratophyllaceae*).—Hornweeds or hornworts, common in ponds and slow streams in the eastern part of the State.

WATER LILY FAMILY—(*Nymphaeaceae*).—Includes the cow lily (spatterdock), water lilies, American lotus (Chinquapin, water yuan-kapin), and water target.

CROWFOOT FAMILY—(*Ranunculaceae*).—Including the butter cups (crows-foot), meadow rues, anemone, wild clematis, leather flowers, columbine (rock-bells), lark-spurs, and baneberry.

MAGNOLIA FAMILY—(*Magnoliaceae*).—Magnolia, includes several species, only one of which is native to the State. This is the *magnolia accuminata* (Cucumber tree).

CUSTARD APPLE FAMILY—(*Anonaceae*).—Pawpaws, (*Asimina triloba*) in wooded areas in the northeastern corner of the State.

MOON SEED FAMILY—(*Menispermaceae*).—Includes the moonseeds and cupseeds. These plants grow along streams, and are widely distributed, except are not found in the western part of the State.

BARBERRY FAMILY—(*Berberidaceae*).—This family includes the may-apple or mandrake. This is found in rich woods in the eastern part of the State.

LAUREL FAMILY—(*Lauraceae*).—Includes the sassafras (ague-tree) and spiced bush. The plants of this family are limited to the eastern part of the State.

POPPY FAMILY—(*Papaveraceae*).—Includes the blood-root, found in rich woods in the eastern part of the State, and the prickly poppies on prairies and sandy soils, widely distributed over the State.

FUMITORY FAMILY—(*Fumariaceae*).—Includes the corydalis, of which there are several varities found chiefly in the eastern half of the State.

MUSTARD FAMILY—(*Cruciferae*).—Includes the whitlow grasses, velvet-flowers, bladder-pods, pepper-grasses (including the tongue grass, penny-cress), shepherd's purse, false flax, horseradish, mustards, turnip, yellow phlox, water-cresses, purple rocket, bitter-cresses, and rock-cresses.

CAPER FAMILY—(*Capparidaceae*).—Clammy-weeds and spider flower.

ORPINE FAMILY—(*Crassulaceae*).—Includes the stonecrop, live-for-ever and rock-moss.

SAXIFRAGE FAMILY—(*Saxifragaceae*).—Texas saxifrage, alum roots, mock-orange, wild hydrangea, Virgina willow, Missouri currant (buffalo-currant).

WITCH-HAZEL FAMILY—(*Hamamelidaceae*).—The witch-hazels, sweet gum (star leaved gum, red gum, bilsted), in woods in eastern and southeastern part of the State, sycamore (buttonball tree, buttonwood plane tree), along streams. This last known tree is found along the streams in the eastern half of the State, and westward to the Chickaskia River, along the north side.

ROSE FAMILY—(*Rosaceae*).—American ipecac, in the extreme eastern edge of the State; apple trees including the western crabapple, on river bottoms in the northeastern part of the State; service berry (shad-bush) over the eastern edge of the State, westward to the Arkansas River in the northern part.

HAWS OR THORN FAMILY—(*Crataegus*).—Thorns (11). Wild strawberries, cinquefoils, avens, small-leaved nut, mahogany (on sandstone buttes in Cimarron County), blackberries, raspberries, dewberries, agrominy, wild roses, (6), wild plums, wild berries (10).

PEA FAMILY—(*Legiminosae*).—This family includes the sensitive briar found on rough hill sides and grassy slopes throughout the State, except in the extreme western part; Desmanthus (3), mesquite (on prairies and river valleys in the western third of the State); Kentucky coffee tree (coffee-bean tree), honey locust, blueweed or cycle pod, partridge pea, sensitive plants, bank burr, redbud, Judas tree, wild indigo, and false indigo, rattle boxes, Nebraska bluepine (western Panhandle counties), clovers (trifolium), sweet clovers, prairie bird's foot, trefoil. snakeroot, Indian or prairie turnip, also called bread-root, bead plant, or devil's shoestring, river locust or false indigo, wild sweet pea, western indigo plant, peatree, wisteria, ground plums, tick-trefoil (15), bush-clovers (12), pencil flower, vetches (8), wild peas, ground-nut, wild bean, hog peanut, milk peas.

FLAX FAMILY—(*Linaceae*).—Includes the cultivated and wild flaxes (8).

OXALIS FAMILY—(*Oxalidaceae*).—This family includes the oxalis or wood sorrels. All of the forms are found throughout the State, but are most abundant in the central and eastern part.

GERANIUM FAMILY—(*Geraniaceae*).—Crane's bill geraniums, in waste places and lawns, over most of the State, but chiefly in the eastern part.

CALTROP FAMILY—(*Zygophyllaceae*).—Herbs having prostrate, much branched stems, including the coltrap burr, or Mexican sand burr, found in the northwestern part of the State; and the greater caltrop found throughout the prairie parts of the State.

RUE FAMILY—(*Rutaceae*).—Includes the prickly ash or toothache tree, found in the eastern and southern parts of the State; and the hop tree (*ptelea trifoliata*), found in open woods and rocky banks throughout the State.

MILKWORT FAMILY—(*Polygalaceae*).—Includes 5 species of the milkwort, widely distributed throughout the State.

SPURGE FAMILY—(*Euphorbiaceae*).—This family includes several plants, among which are the spurge nettles (tread-softly), the croton weeds (goat weed), the three-seated mercury, queen's delight, and the spurges (23).

SUMAC FAMILY—(*Anacardriaceae*).—Includes the sumacs, poison ivy and American smoke-tree (eastern part of the State).

HOLLY FAMILY—(*Ilicaceae*).—Includes the hollys of which 2 species are found in Oklahoma, the American white or Christmas holly, and the swamp holly, found in swamps and thickets in the eastern part of the State.

STAFF TREE FAMILY—(*Celastraceae*).—Includes the wahoos (burning bush) and bittersweets.

BLADDERNUT FAMILY—(*Staphyleaceae*).—The true bladdernut is represented by only one species in our State, the American bladdernut found in woods and thickets in the northeast corner of the State.

MAPLE FAMILY—(*Aceraceae*).—Several species found growing chiefly in the eastern part of the State, also many varieties in cultivation. (See list of trees and shrubs following).

SOAPBERRY FAMILY—(*Sapindaceae*).—This family is represented by the chinaberry or soap berry tree, and three or four species of the buckeye.

FOR-GET-ME-NOT FAMILY—(*Balsaminaceae*).—This family is represented only by the spotted or wild touch-me-not, sometimes called silver leaf, found in moist places in the eastern part of the State.

BUCKTHORN FAMILY—(*Rhamnaceae*).—This family includes chapparel (condilia), supple jack (rattan vine), Carolina buckhorn, and New Jersey Tea or redroot.

GRAPE FAMILY—(*Vitaceae*).—This family includes the Virginia creeper, which is common throughout the State; the false grapes, pepper vine, and several species of wild grapes.

LINDEN FAMILY—(*Tiliaceae*).—This family includes the basswood or linden tree of which there is but one species growing native in the State.

MALLOW FAMILY—(*Malvaceae*).—Includes the Indian mallow, false mallow, running mallow, poppy mallows (6), and rose mallows (3).

SAINT JOHN'S-WORT FAMILY—(*Hypericaceae*).—This family includes St. Andrews' cross and the St. John's-wort of which there are several species, found chiefly in the eastern part of the State.

ROCK-ROSE FAMILY—(*Cistaceae*).—This family includes the frost weeds and the pin weeds, found growing in dry, sandy places in the eastern two-thirds of the State, and also in the vicinty of the Wichita and Arbuckle mountains.

VIOLET FAMILY—(*Violaceae*).—There are about 20 species of violets known in the State. Some of these are widely distributed, but are chiefly found in the eastern part of the State.

PASSION FLOWER FAMILY—(*Passifloraceae*).—This family is represented by 2 species found in the eastern part of the State.

LOASA FAMILY—(*Loasaceae*).—Consisting of small, much branched herbs with rough surfaces and with barbed stinging hairs, found on sandy hill sides and prairies throughout the State.

CACTUS FAMILY—(*Cactaceae*).—This family is represented by the hedgehog, pin cushion, cacti, and the prickly pears.

LOOSESTRIFE FAMILY—(*Lythraceae*).—This family includes the water purslane, tooth cups, loosestrifes and wax-weeds.

MEADOW BEAUTY FAMILY—(*Melastomaceae*).—Includes the meadow beauties found growing in sandy, swampy places in the eastern part of the State.

EVENING PRIMROSE FAMILY—(*Onagraceae*).—Includes various willow-herbs, the evening primroses (19), gaura, and enchanters night shade.

WATER MILLFOIL FAMILY—(*Haloragidaceae*).—These are aquatic herbs, including the water millfoil and the mermaid weeds.

GINSENG FAMILY—(*Araliaceae*).—This family is represented in our State only by the common ginseng (*panax quinquefolia*), found in rich woods in the eastern part of the State.

PARSNIP FAMILY—(*Umbelliferae*).—This family is represented in our State by several species of the snakeroot, pennyworts, chervil, sweet cicely, sand parsley, cowbane, hedge parsley.

DOGWOOD FAMILY—(*Cornaceae*).—The dogwoods, small trees or shrubs, represented in this State by 4 species and the tupelos, represented by tupelo gum, and the sour or black gum.

LOGANIA FAMILY—(*Loganiaceae*).—A family represented by only 2 species in our State, so far as known.

GENTIAN FAMILY—(*Gentianaceae*).—This family includes the rose-pinks and centaurys.

DOGBANE FAMILY—(*Apocynaceae*).—Includes amsonia, dogbane and Indian hemp.

MILKWEED FAMILY—(*Asclepiadaceae*).—This family includes the milkweeds, of which there are at least 20 species, the sand vine, and baldwin's anglepods.

MORNING-GLORY FAMILY—(*Convolvulaceae*).—This family includes the morning-glories, of which there are 10 or 12 species, widely distributed over the State; the bindweeds and dodders.

PHLOX FAMILY—(*Polemoniaceae*).—The family includes the phloxes and gilias.

WATERLEAF FAMILY—(*Hydrophyllaceae*).—Includes phacelia and nama.

BORAGE FAMILY—(*Boraginaceae*).—This family includes the heliotropes (4), wild comfrey, stickseeds, for-get-me-nots, scorpion grasses. puccoons, and western false gromwell.

VERVAIN FAMILY—(*Verbenaceae*).—Includes the verbenas or vervains, of which there are 11 species; the lippia (fogfruit); and the French mulberry, a fruit with a blue, berry-like group, with 4 nutlets, but does not belong to the mulberry family.

HEATH FAMILY—(*Ericaceae*).—This family includes the Indian pipe or ghost flower, the azeleas, male berry, and the huckleberries. All the plants of this group growing are found in the eastern and southeastern parts of the State.

PRIMROSE FAMILY—(*Primulaceae*).—This family includes the water pimpernells, loosestrifes, chaffweeds, shooting star (American cowslip), Indian chief, rooster head. The plants of this group occur in moist soils and along streams in the southern and southeastern part of the State.

SAPODILLA FAMILY—(*Sapotaceae*).—This family is represented in our range by only one species, chittim-wood, the woody buckthorn (Bumelia launginosa). This species occurs in open woods throughout the State. Southern buckthorn occurs in the Arbuckle Mountains (*Bumelia lyciodesQ*.

EBONY FAMILY—(*Ebenaceae*).—This family is represented by one species in our State, the common persimmon (*Diospyros virginia*). This species occurs as a shrub or small tree in creek valleys and draws throughout the State, except in the Panhandle counties.

STORAX FAMILY—(*Slyracaceae*).—This family is represented by the silverbell or snowdrop tree. It occurs in the southeastern part of the State.

OLIVE FAMILY—(*Oleaceae*).—This family includes the ashes of which there are at least 3 species in the State; the swamp privets; and the fringe-tree or old man's beard.

MINT FAMILY—(*Labiatae*).—This family includes a large number of plants which are the fermanders (woodsage), pennyroyal, skullcaps (6), common or white horehound, hyssop, catnip or catmint, ground ivy, carpenter weed or heal-all, dragonhead or lion's heart, henbit, common motherwort, hedgenettle, sage, horsemint, woodmint, pennyroyal (3), low calamint, mountainmint, water horehounds, spearmint and peppermint.

POTATOE FAMILY—(*Solanaceae*).—This family includes the night shades (8), among which are the various night shades, named chiefly from the shape of the leaf; the horsenettle; and buffalo burr (bull-nettle, Santa Fe thistle, sand burr); the ground cherries (31); and the jimson weeds.

FIGWORT FAMILY—(*Scrophulariaceae*).—This family includes the mullins (2), found in the eastern and northeastern parts of the State, the toad flaxes (2) (butter and eggs, blue toad-flax), the figworts, beard-tongues, monkey flowers, hyssops, mullin (fox-glove), gerardia (9), blue-hearts, painted cup, and Indian paint brush.

BLADDERWORT FAMILY—(*Lentibulariaceae*).—This family includes certain low, delicate herbs living in water or moist soils. The family is represented by 4 or 5 species occuring in the eastern half of the State, and in the vicinity of the Wichita Mountains.

BROOM-RAPE FAMILY—(*Orobranchaceae*).—This family is represented by 2 species—the Louisiana broom-rape, found in sand soils in the western end of the State, and in the Panhandle counties, and the one flowered broom-rape or cancer root, growing parastic on the roots of several species of herbaceous plants in the eastern part of the State.

CATALPA FAMILY—(*Bignoniaceae*).—The family is represented in Oklahoma by the trumpet creeper vine (*tecomma radiacans*); and the western catalpa, (hardy catalpa, cigar tree, catawba tree) (*catalpa*

speciosa), and the southern catalpa or Indian bean (*catalpa bignoniydes*). Both of these catalpas are planted for shade and the former one especially being extensively grown.

MARTYNIA FAMILY—(*Martyniaceae*).—This family is represented in the western part of the State by a single genus which includes one species so far as known—devil's claw or unicorn plant.

ACANTHUS FAMILY—(*Acanthaceae*).—This family includes the water-willows (3) and the ruella.

LOPSEED FAMILY—(*Phrymaceae*).—The family is represented by a single species of lopseed found in woods and thickets in the northern and northeastern parts of the State.

PLAINTAIN FAMILY—(*Plantaginaceae*).—This family includes the common plaintains (12), widely distributed over the State.

MADDER FAMILY—(*Rubiaceae*).—This family includes several species of plants within the State, among which are the bed-straws, wild liquorice, the button weeds, partridge berry or tern berry, butterbush or globe flower and the bluets.

HONEY-SUCKLE FAMILY—(*Caprifoliaceae*).—Includes the honeysuckles, found chiefly in the eastern and southern parts of the State, the coral berry or buck-bush (*symphoricarpos symphoricarpos*), found in woods along streams throughout the State, except the extreme northwestern and Panhandle counties, black haws (2), and the common elder, found along streams over the entire State, except in the Panhandle counties.

VALERIAN FAMILY—(*Valerianaceae*).—This group includes 2 or 3 species among which are the cornsalids found in the eastern and southern parts of the State.

GOURD FAMILY—(*Cucurbitaceae*).—This family includes the wild gourds, squashes, and pumpkins.

THE CAMPANULA FAMILY—(*Campanulaceae*).—Herbs with milky sap, among which are the venus-looking glass, and bell flowers.

LOBELIA FAMILY—(*Lobeliaceae*).—Includes lobelias (6).

THISTLE FAMILY—(*Compositae*).—This family includes a large number of our herbs and a few of the shrubs. Among these plants are the iron weeds (veronia) *(7), bonesets or thoroughworts (10) (*eupatorium*) elephant's foot (*elephantopus*), blazing stars (5), rosinweeds or gumplants (3), broom weeds, kindling weed or august flower, golden asters (4), goldenrods (21), sand daisies, daisies, asters (20), fleabanes (11), willow baccharis (in river valleys in the western half of the State), rabbit tobacco, marshfleabanes, cat's-foot, pearly everlasting, white balsam, sweet life everlasting, purple cudweed, leaf-cups, rosin-weeds (5), ferverfew, ragweeds (5), cockle-burs (3), prairie zinnia, false sunflowers, cone-flowers (14), column flowers, sunflowers (20), coreopsis (7), beggar-ticks or sticktights, including the Spanish needles, sneeze weeds, yarrows, dog-fennel (may-weed), feted marigold, ox-eyed daisy, sage brushes (11),

Indian Plantains, common groundsel, butterweed, ragworts, squawweed, common burdock, thistles (5), American starr thistle, chickory, dwarf dandelion (3), false dandelion, common dandelion, sow thistles, including the spring sow thistle and rabbit lettuce, wild lettuce (8), rattlesnake root, white lettuce, and hawkweeds (3).

TREES AND SHRUBS.

Far back in geologic history we find the records of tree growth.

Our coal beds are the products of abundant growth of vegetation, consisting in a large part of trees, many of which reached large proportions. Fossil leaves, plants, and twigs in the shales and sandstones, and the silicified trunks of trees commonly found bear out the extensive growth of trees in times past.

Within recent times the greater part of the land surface of the earth has been covered with forest growth. At the present time trees are among the most conspicuous objects of nature. It has been estimated that the aggregate original area of the forests of North America was about 850 million acres. This original area has been reduced until not more than 550 million acres remain, and a large percentage of this is not to be considered in the area of the economic timbered region.

A tree is usually defined as a plant with a single trunk of woody structure that does not branch for some distance above the ground. Woody plants that branch directly above the soil, although they grow to a height of 20 feet or more, are called shrubs or bushes. Certain shrubs may be made to grow treelike, and some plants which are shrubs in the northern states grow as trees of considerable size farther south.

A tree consists of three parts; first, the root; second, the branch or stem; third, the crown. The root extends into the ground from a few inches to several feet, according to the variety of tree, character of soil, and the moisture conditions. The trunk or stem supports the crown and supplies it with mineral food and water from the roots. The crown consists of a network of branches, buds, and leaves. The most important processes in the growth, reproduction and nourishment of the tree, take place in the crown.

Trees and shrubs as they stand together on some large area whose principal crop is trees and shrubs constitutes a forest. However, a forest is far more than a collection of trees. It has a population of animals and plants peculiar to itself, a soil largely of its own making, and climatic conditions differing from those in the open country. The forest prevents floods, influences rainfall, supplies fuel, timber, and food.

But with all the good that the forest has been to man its real value has not been considered and it has been recklessly used and ruthlessly destroyed.

The United States is divided into several forest regions. A single unbroken forest belt—the spruce forest of Canada, extends across North America. *(1) A part of this belt extends within the borders of the United

(1) Bowman, Isaac, Forest Physiography, p. 123.

States in the region about the Great Lakes. This region has the typical growth of black and white spruce, poplar, canoe birch, aspen, and tamarack.

To the southward from the south limit of this spruce forest are marked forest regions extending in a north-south line. These are the Atlantic forest, the Pacific forest, the Rocky Mountain forest, and the forested regions of the Great Basin. The Great Plains region is forestless but not treeless.

Oklahoma is in part in the forest region of the Great Basin and part in the region of the Great Plains. The east one-third of the State lies chiefly in the timbered belt. The southeastern part of the State has a forest growth, which places it in the southern forest belt which is chiefly characterized by the long leaf, short leaf, loblolly, and slash pine. In the northeastern part of the State east of Grand River and north of the Arkansas is found a tree growth very characteristic of a hardwood forest of the central Mississippi valley. The remainder of the principal timbered region of the State lies within the Sandstone Hills region, except the area in the Arbuckle Mountain and the Cretaceous plains along Red River.

A strip 75 miles wide clear across the east side of the State is covered with heavy timber. The northern part of the strip is hard wood. South of Arkansas River it is chiefly pine, hickory, and oak. There are millions and millions of feet of valuable timber. The pine is of the yellow variety. The hardwood is oak, hickory, walnut, elm, and maple. In the southeastern part of the State pine timber is of much more value than the land on which it stands. One lumber company, it is said, owns enough timber to keep its mills running 20 years if they cut 100,000 feet every day.

In the western half of the State trees are found usually only along the streams or on the sandhills. The level uplands are grass covered. Cottonwood, elm, hackberry, chinaberry, walnut, willow, dogwood, redbud, soapberry, box elder and mulberry are the chief kinds found. On the flat prairies and along some of the streams in the western part is found the thorny mesquite. Blackjack, barren, post oak, hackberry, hickory, and sumac grow on the sand hills. On the high plains in the extreme western part of the State there are very few trees even along the streams, but even here an occasional low elm or dwarf cottonwood or willow may be found. One of the problems which confronts the citizens is to discover what trees may be transplanted and grown in the treeless part of the State. The inhabitants desire shade trees and it is important that trees be secured which will meet the conditions. Difficulty will often be experienced in getting trees started in this region, but many efforts will meet with success.

The black locust, soft maple or silver maple, box elder or ash leaved maple, the green ash, mulberry, and catalpa are being most widely planted

for shade in our cities. Cottonwood may also be added to the list. The chief reason for selecting most of these trees is that they are quick growing. The locust if used will have to be safeguarded against the locust borers which have wrought such great havoc in other states; the catalpa against the catalpa sphinx. The cottonwood, while a very rapid grower, has its faults. It sheds leaves continually through the summer and becomes bare in early fall, and the roots find their way into wells and sewers and do much damage. In many eastern cities ordinances have been passed requiring all cottonwoods within 100 feet of sewers to be cut. The walnut, red bud and oaks may also be added to the list for shade. In Oklahoma City many oaks and cottonwoods of the original forest still stand for shade. Among imported trees suitable for street and lawn planting are the dwarf catalpa, linden, tree of Heaven, Paulounia, and Koelreuteria paniculata, a native of China. Fruit trees may also be used for shade even for planting along streets and roadways. People will soon learn to respect the trees and they will not be abused in securing the fruit.

Trees have two distinct modes of branching—one has a central stem running the entire length of the tree as in the hickory or pine. This is called the excurrent growth. In the second class the main stem is soon lost in the branches as in the walnut or catalpa. This is known as delinquescent growth. Two kinds of roots are found on trees—those having a tap root as in the hickory and oaks. These trees are difficult to transplant. Those having multiple roots in which the roots are numerous, and extend outward from the base, as in the maples and elms. Such trees are easily transplanted.

Willows and poplars may be started by branches placed in the ground. Most trees are best grown from the seed. Trees best for transplanting are those not more than two years old.

A LIST OF TREES AND SHRUBS OF OKLHAMOA.

Trees and shrubs are plants which belong to the sub-kingdom—SPERMATOPHYTA—the seed-bearing plants. The plants of this division belong to two classes—the GYMNOSPERMAE, plants with naked seed; and ANGIOSPERMAE, plants with protected seeds.

CLASS I. GYMNOSPERMAE.

Naked Seeds.

The Gymnosperms are an ancient group of plants. They are found among the fossils of the Silurian age, and are most numerous in Triassic time. They are now represented by about 450 species of trees and shrubs. They are flowering plants in which the ovules, or seeds, are not inclosed in an ovary. but are borne naked upon an open scale. This scale is a modified leaf. The plants have a resinous juice, and chiefly parallel-veined, needle-shaped, or scale-like evergreen leaves. By far the larger number of the Gymnosperms are Coniferous (Pinacae or Coniferae including some shrubs) or cone-bearing trees, the fruit being called a cone because of its form. This family of the class is the only one represented in our area.

PINE FAMILY. PINACEAE.

Pines. Conifers.
Pinaceae. Coniferae.

The trees belonging to this family are commonly known as Evergreens, because with the exception of the Larch and the Bald Cypress they do not shed their leaves during the winter.

PINES. GENUS PINUS.

Loblolly pine. (Old Field pine. Rosemary pine).
Pinus Taedea.

Yellow pine. (Short-leaf pine. North Carolina pine, Spruce pine.)
Pinus echinata.

Southern or Bald cypress. (Deciduous cypress.)
Taxodium distichum.

Red cedar. (Common cedar. Juniper.)
Juniperus Virginiana.

Juniper. (Ground cedar.)
Juniperus communis.

Arbor vitae. (White cedar.)
Thuja occidentalis.

CLASS II. ANGIOSPERMAE.

Enclosed Seeds.

MAGNOLIA FAMILY. MAGNOLIACEAE.

Found in the extreme eastern and southeastern part of the State.

TULIP TREE. GENUS LIRIODENDRON.

Tulip tree. (Yellow poplar. Tulip poplar.)
Liriodendron tulipifera.

CUSTARD APPLE FAMILY. ANONACEAE.

PAPAWS. GENUS ASIMINA.

Common papaw. (Found only in the eastern part of the State)
Asimina triloba.

TAMARISK FAMILY. TAMARISCINEAE.

The *Tamarisks* are sub-evergreen, shrubs or small trees, with very small pinkish flowers, in spike-like clusters, or thickly grouped along the slender drooping branches. The leaves are very small and scale-like. There are several species in cultivation, and numerous names have been applied by nursery men. Many of the members of this family are found growing escaped from cultivation about old building places. Some of the varieties are now being used to considerable extent for hedges about lawns and gardens.

MALLOW FAMILY. MALVACEAE.

The *Hibiscus* or *Rose Mallows* comprise a large family of mainly herbaceous plants with large holly-hock-like flowers. There is but one cultivated species in this region which has woody structure and tree-like appearance. This is the *Shrubby Althea* or *Hibiscus Syriacus* commonly called *Tree Hibiscus* or *Rose of Sharon.* This was originally introduced from Syria. There are many varieties with single or double flowers of many colors,—white, pink, red, purple, and variegated. A large number of these have been planted for ornament over the State and some have been observed which had reached a height of 15 to 20 feet.

LINDEN FAMILY. TILIACEAE.

LINDENS OR BASSWOOD. GENUS TILIA.

Basswood. (Whitewood. Linden. Lime Tree.)
Tilia Americana.

The range of the basswood extends through the eastern half of Oklahoma and though it is not abundant, is found scattering here and there in the areas of good soil. It is also in cultivation in the State. Another tree, probably a variety of the above, is found in cultivation. This is *Tilia pubescens,* small leave basswood. Several introduced species and nursery varieties are much valued for their dense foliage, odd-shaped leaves, and slender branches.

RUE FAMILY. RUTACEAE.

PRICKLY ASHES. GENUS XANTHOXYLUM.

Prickly ash. (Toothache tree.)
Xanthoxylum Clava-Hercules.

WAFER ASHES. GENUS PTELEA.

Wafer ash. (Hop-tree. Shrubby trefoil.)
Ptelea trifoliata.

This shrub, often growing with the true shape of a tree, never attains a height of more than a few feet (6-10). The fruit resembles that of

the elm but is larger. It is known to occur from the east side to as far west as Alva in Woods County.

CORK TREE. GENUS PHELLODENDRON.

Chinese cork tree.
Phellodendron Amurense.

An introduced tree with compound leaves resembling those of the Tree of Heaven. The cork tree is being planted in some of our city parks, and grows fairly well.

MELIA FAMILY. MELIACEAE.

CHINA TREE. GENUS MELIA.

China-tree. (China-Berry tree. Pride of India.)
Melia Azedarach.

QUASSIA FAMILY. SIMARUBACEAE.

TREE OF HEAVEN. GENUS AILANTHUS.

Tree of Heaven. (Paradise tree. Chinese sumac.)
Ailanthus glandulosus.

This tree was originally introduced from China and Japan, but it is now widely cultivated and naturalized. It is found growing wild in many places, having escaped from cultivation. It is a very rapid-growing tree and hardy throughout. At all times of the year it has a good appearance and is well adapted for shade and ornamental purposes.

HOLLY FAMILY. ILICINAE.

HOLLIES. GENUS ILEX.

American holly. (Christmas holly.)
Ilex apaca.

Swamp holly. (Deciduous holly.)
Ilex decidua.

Ink berry.
Ilex glabra.

STAFF-TREE FAMILY. CELASTRACEAE.

WAHOO. GENUS EUONYMUS.

Wahoo. (Burning Bush. Spindle tree.)
Euonymus atropurpureus.

BITTER SWEET. GENUS CELASTRUS.

Bitter sweet. (Waxwork.)
Celastrus scandens.

SOAPBERRY FAMILY. SAPINDACEAE.

SOAPBERRY. GENUS SAPINDUS.

Soapberry (c). (Western soapberry. Wild China tree.)
Sapindus Drummondi.

A small tree common throughout the State, except extreme northwest. Rare in some localities. Easily distinguished by its clusters of fruit remaining more or less shriveled on the tree until spring. The

largest tree observed was in the Grand River Valley and was 10 inches in diameter and more than 30 feet high. Often a large number of the trees are found growing together.

HORSE-CHESTNUT FAMILY. HIPPOCASTANACEAE.

HORSE CHESTNUTS. GENUS AESCULUS.

Common horse chestnut.
Aesculus Hippocastanum.

Yellow buckeye. (Sweet buckeye.)
Aesculus octandra.

Ohio buckeye. (Sweet buckeye. Fetid buckeye.)
Aesculus glabra.

GENUS KOELREUTERIA.

Koelreuteria paniculata.

MAPLE FAMILY. ACERACEAE.

MAPLES. GENUS ACER.

Silver maple. (Soft maple. White maple. River maple.)
Acer saccharinum.

Red, scarlet, or water maple. (Swamp maple.)
Acer rubrum.

Hard maple. (Sugar or rock maple. Sugar-tree.)
Acer saccharum.

Black maple. (Sugar maple.)
Acer nigrum.

Box Elder. (Ash-leaved maple.)
Acer negundo.

The NORWAY MAPLE, *acer platanoides,* and CUT-LEAVED JAPANESE MAPLE, *acer palmatum,* are in cultivation, but so far have not made very successful growth in the localities where planted.

BLADDER-NUT FAMILY. STARPHYLEACEAE.

American Bladder-nut.
Staphylea trifoliata.

CASHEW FAMILY. ANACARDIACEAE.

SUMACHS. GENUS RHUS.

Smooth sumac. (Upland or scarlet sumac.)
Rhus glabra.

Dwarf, black or mountain sumac. (Upland sumac.)
Rhus copallina.

Poison sumac. (Poison dogwood. Poison elder.)
Rhus Venenata.

Cut-leaved sumac.
Rhus lacinata.

Ill scented sumac. (Skunk bush.)
Rhus trilobata.

Fragrant or sweet-scented sumac.
Rhus aromatica.

Poison ivy. (Poison oak. Climath. Three leaf ivy.)
Rhus radicans.

Wild or American smoke tree. (Chittam wood.)
Rhus cotinoides.

PULSE OR PEA FAMILY. LEGUMINOSAE.

LOCUSTS. GENUS ROBINIA.

Common locust. (Yellow locust. Black locust. Silver chain.)
Robinia pseudacacia

REDBUD. GENUS CERCIS.

Judas tree. (Redbud.)
Cercis canadensis.

Common throughout except far western part of State. Grows as a shrub to small tree, reaches height of 20 feet. Excellent for lawn planting.

COFFEE TREE. GENUS GYMNOCLADUS.

Kentucky coffee tree. (Coffee-nut.)
Gymnocladus Canadensis.

HONEY-LOCUSTS. GENUS GLEDITSCHIA.

Honey locust.
Gleditschia triacanthos.

Water locust.
Gleditschia aquatica.

ROSE FAMILY. ROSACEAE.

PEACHES, PLUMS, AND CHERRIES. GENUS PRUNUS.

Common peach.
Prunus Persica.

Nectarine. (Smooth-skinned peach.)
Prunus laevis.

Pigeon cherry. (Pincherry. Bird cherry. Wild red cherry.)
Prunus Pennsylvanica.

Wild black cherry. (Cabinet or river cherry.)
Prunus serolina.

American plum. (Wild plum.)
Prunus Americana.

Wild goose plum. (River plum.)
Prunus hortulana.

Chickasaw plum.
Prunus Augustifolia.

Watson's plum. (Sand plum.)
Prunus Watsoni.

Low plum.
Prunus gracilis.

Choke cherry.
Prunus Virginiana.

Western sand cherry. (Bessy's cherry.)
Prunus Besseyi.

APPLES AND PEARS. GENUS PYRUS.

Common apple
Pyrus malus.

Soulard crab.
Pyrus soulardi.

Prairie crab.
Pyrus isensis.

Common pear.
Pyrus communis.

American or garland crab. (Fragrant crab.)
Pyrus coronaria.

American or small fruited ash.
Pyrus americana.

Elder-leaved or large fruited mountain ash.
Pyrus sambricifolia.

GENUS AMELANCHIER.

June-berry. (Service-berry. Shad bush.)
Ameleanchier Canadensis.

HAWS OR THORNS. GENUS CRATAEGUS.

Green haw.
Crataegus viridis.

Washington thorn.
Crataegus cordata.

Dotted fruited hawthorn.
Crataegus punctata.

GENUS RUBUS.

WITCH HAZEL FAMILY. HAMAMELIDACEAE.

GENUS HAMAMELIS.

Witch hazel.
Hamamelis Virginiana.

Found in central-east side, north of Arkansas River. The largest observed was south of Marble City.

GENUS LIQUIDAMBAR.

Sweet gum. (Bilsted. Red gum.)
Liquidambar styraciflua.

This tree is found in the east side of the State south of Arkansas River. It is abundant along Poteau and Kiamichi rivers and their tributaries. It is a tree worthy of extensive cultivation.

GINSENG FAMILY. ARALIACEAE.

GENUS ARALIA.

Angelica tree. (Hercules club.)
Aralia spinosa.

The range of this tree would include the southeastern corner of the State; however, so far as known it has not been found. It is used for ornamental planting and is worthy of extensive use.

DOGWOOD FAMILY. CORNACEAE.

DOGWOOD OR CORNELS. GENUS CORNUS.

Flowering dogwood.
Cornus florida.

Rough leaf or white fruited dogwood.
Cornus asperifolia.

TUPELOS. GENUS NYSSA.

Pepperidge. (Black or sour gum.)
Nyssa sylvatica.

HONEY-SUCKLE FAMILY. CAPRIFOLIACEAE.

NANNY-BERRIES. GENUS VIBURNUM.

Rusty nanny berry. (Southern nanny berry.)
Viburnum rufidulum.

Small black haw.
Viburnum globosum.

Cranberry tree. (Snow ball or Guelder rose.)
Viburnum opulus.

GENUS SYMPHORICARPOS.

Coral-berry.
Symphoricarpos symphoricarpos.

Wolfberry.
Symphoricarpos occidentalis.

GENUS LONICERA.

Tartarian bush honeysuckle. *Lonicera Tartarica.*

Honeysuckle. *Lonicera.*

GENUS DIERVILLA.

Bush honeysuckle. *Diervilla diervilla.*

GENUS SAMBUCUS.

American elder. (Sweet elder. Elderberry.) *Sambucus Canadensis.*

SAPODILLA FAMILY. SAPOTACEAE.

BUMELIAS. GENUS BUMELIA.

Wooly bumelia. (Chittim wood. Buckthorn. Gum elastic.) *Bumelia languinosa,* also *Bumelia lycioides.*

BUCKTHORN FAMILY. RHAMNACEAE.

BUCKTHORNS. GENUS RHAMNUS.

Yellow buckthorn. (Indian cherry.) *Rhamnus Caroliniana.*

GENUS CEANOTHUS.

New Jersey tea. (Red root.) *Ceanothus Americanus.*

EBONY FAMILY. EBENACEAE.

PERSIMMONS. GENUS DIOSPYROS.

Common persimmon. *Diospyros Virginiana.*

Japan persimmon. (c). *Diospyros Kaki.*

STORAX FAMILY. STYRACACEAE.

SILVER BELL TREES. GENUS MOHRODENDRON.

Silver bell tree. (Snow drop tree.) *Mohrodendron Carolinum.*

OLIVE FAMILY. OLEACEAE.

ASHES. GENUS FRAXINUS.

White ash. *Fraxinus Americana.*

Blue ash. *Fraxinus quadrangulata.*

Swamp ash or water ash. *Fraxinus platycarpa.*

Green ash. *Fraxinus viridis.*

FORESTIERA. GENUS ADELIA.

Adelia. (Forestiera. Swamp privet.) *Adelia acuminata.*

PRIVET. GENUS LIGUSTRUM.

Privet. (Prim.) *Ligustrum Vulgari.*

SYRINGIA. GENUS SYRINGIA.

Common lilac. *Syringia vulgaris.*

Japan lilac. *Syringia Japonica.*

GENUS CHIONANTHUS.

Fringe tree. *Chionanthus Virginica.*

FIGWORT FAMILY. SCROPHULARIACEAE.

GENUS PAULOWNIA.

Imperial paulownia. (Paulownia tree.)

BIGNONIA FAMILY. BIGNONIACAE.

CATALPAS. GENUS CATALPA.

Indian bean. (Southern catalpa.) *Catalpa bignonioides* or *Catalpa catalpa.*

Hardy catalpa. (Western catalpa. Catawba tree.) *Catalpa speciosa.*

Japanese catalpas. (c). *Catalpa Kaempferi* and *Catalpa Bungei.*

Dwarf forms growing from 5 to 10 feet, umbrella-shaped tops. Grown in cities and parks.

LAUREL FAMILY. LURACEAE.

BAY TREE. GENUS PERSEA.

Red bay. *Persea Borbonia.*

SASSAFRAS. GENUS SASSAFRAS.

Sassafras. *Sassafras sassafras* or *Sassafras officinale.*

GENUS LINDERA.

Spice bush. (Benjamin bush.) *Lindera Benzoin.*

OLEASTER FAMILY. ELAEAGNACEAE.

Several members of the family in cultivation. A specimen of the RUSSIAN OLIVE, or OLEASTER, was observed which was at least 20 feet in height. The DESERT WILLOW, *chilopsis linearis,* from Texas is found in Oklahoma City. The BUFFALO BERRY or RABBIT BERRY has been found by the writer growing along the Canadian in the western part of Cleveland County.

NETTLE FAMILY. URTICACEAE.

ELMS. GENUS ULMUS.

American or white elm. *Ulmus Americana.*

Slippery or red elm. *Ulmus fulva* or *U. pubescens.*

Wahoo or winged elm. *Ulmus alata.*

GENUS PLANERA.

Planer tree. (Water elm.) *Planera aquatica.*

HACKBERRIES. GENUS CELTIS.

Sugar berry. (Hackberry.) *Celtis occidentalis.*

Hackberry. *Celtis var.*

Mississippi hackberry. (Sugar hackberry.)
Celtis Mississippiensis.

OSAGE ORANGE. GENUS MACLURA.

Osage orange. (Bow-wood. Bois d'Arc.)
Toxylon pomiferum, or Maclura aurantiaca.

MULBERRIES. GENUS MORUS.

Red mulberry. *Morus rubra.*
White mulberry. *Morus alba.*

Both of these mulberries are grown for shade. The largest white mulberry known in the State is in Norman. This tree is a foot in diameter and 50 feet high. The Russian or barren mulberry, extensively grown for shade, is the staminate white mulberry. It is a rapid grower and a good tree to plant.

GENUS BROUSSONETIA.

Paper mulberry. *Broussonetia papyrifera.*
French mulberry. *Callicarpa Americana.*

A shrub reported as occuring in the northeast corner of the State. Does not belong to the Mulberry family.

PLAN-TREE FAMILY. PLATANACEAE.

GENUS PLATANUS.

Sycamore. (Buttonwood.) *Platanus occidentalis.*
Oriental plane. (c). *Platanus orientalis.*

WALNUT FAMILY. JUGLANDACEAE.

WALNUTS. GENUS JUGLANS.

Butternut. (White walnut.) *Juglans cinerea.*
Black walnut. *Juglans nigra.*

HICKORIES. GENUS CARYA OR HICORIA.

Bitternut hickory. (Swamp hickory.)
Hickory minima.

Water hickory. (Swamp hickory.)
Hicoria aquatica.

Big shell bark hickory. (King nut.)
Hicoria ovata or *Carya sulcata.*

Mocker-nut hickory. *Hicoria alba* or *Carya tomentosa.*
Pignut hickory. *Hicoria glabra* or *Carya porcina.*

Pecans. *Hicoria pecan.*
Pale-leaf hickory. *Hicoria villosa.*

WILLOW FAMILY. SALICACEAE.

WILLOWS. GENUS SALIX.

Peach or almond-leaf willow. (Western black willow.)
Salix amygdaloides.

Long-stalked willow. (Ward willow.) *Salix longipes.*
Black willow. *Salix nigra.*

Narrow or long-leaved willow. (Sand-bar willow. Ring willow.)
Salix longifolia or *S. fluviatilis.*

POPLARS. GENUS POPULUS.

White poplar. (Abele tree. Silver-leaf poplar.)
Populus alba.

Cottonwood. (Necklace poplar. Carolina poplar.)
Populus deltoides.

Western cottonwood. *Populus deltoides occidentalis.*
Lombardy poplar. *Populus nigra Italica* or *P. Dilatata.*

Swamp poplar. (Downy-leaved poplar.)
Populus heterophylla.

Lance-leaf cottonwood and narrow-leaf cottonwood.
Populus acuminata. *Populus angustifolia.*

OAK FAMILY. CUPULIFERAE.

BIRCHES. GENUS BETULA.

River birch. (Water birch. Red birch.)
Betula nigra.

European white birch.
Betula alba.

ALDERS. GENUS ALNUS.

Sea side alder. *Alnus maratima.*
Smooth alder. *Alnus rugosa* or *A. serrulata.*

HAZELNUTS. GENUS CORYLUS.

Wild hazlenut or common hazlenut.
Corylus Americana.

HORNBEAMS. GENUS CARPINUS.

American hornbeam. (Blue or water beech.)
Carpinus Caroliniana.

HOP HORNBEAM. GENUS OSTRYA.

Iron-wood. (American hop-hornbeam.)
Ostrya Virginiana.

OAKS. GENUS QUERCUS.

Red oak. *Quercus rubra.*
Southern red oak. (Schneck's oak.) *Quercus Texana.*

Pin oak. (Swamp oak.) *Quercus palustris.*
Spanish oak. *Quercus digitata,* or *Quercus falcata.*

Yellow oak. (Black oak. Quercitron oak.)
Quercus velutina.

Black jack oak. (Barren oak.)
Quercus Marilandica or *Quercus nigra.*

Water oak. (Duck oak. Possum oak.)
Quercus nigra or *Quercus aquatica.*

Willow oak. *Quercus phellos.*
Shingle oak. *Quercus imbricaria.*

White oak.
Quercus alba.

Post oak. (Rough or box white oak.)
Quercus minor or *Q. obtusiloba* or *Q. stellata.*

Burr oak. (Mossy cup oak.) *Quercus macrocarpa.*
Over-cup oak. *Quercus lyrata.*
Swamp white oak. *Quercus platanoides.*
Cow oak. (Basket oak.) *Quercus Michauxii.*
Chestnut oak. (Chinquapin oak. Yellow oak.) *Quercus acuminata* or *Q. muhlenbergii.*
Live oak. *Quercus Virginiana.*
Dwarf chestnut oak. (Scrub oak.) *Quercus prinoides.*

CHESTNUTS. GENUS CASTANEA.

Chestnut. *Castanea sativa* or *C. dentata.*
Chinquapin. *Castanea pumila.*

BEECHES. GENUS FAGUS.

American beech. *Fagus grandifolia.*

HUCKLEBERRY FAMILY. VACCINICAEAE.

GENUS BATODENDRON.

Farkleberry. (Tree huckleberry. Sparkleberry.) *Batodendron arboreum.*

MADDER FAMILY. RUBIACEAE.

GENUS CEPHALANTHUS.

Button bush. *Cephalanthus occidentalis.*

HYDRANGA FAMILY. HYDRANGEACEAE.

GENUS HYDRANGEA.

Wild hydrangea. *Hydrangea arborescens.*

GENUS PHILADELPHUS.

Syringa. *Philadelphus.*

GOOSEBERRY FAMILY. GROSSULARIACEAE.

GENUS RIBES.

Gooseberries. *Ribes.*
Common currants. (c). *Ribes rubrum* and *ribes nigrum.*
Slender gooseberry. *Ribes gracile.*
Missouri gooseberry. *Ribes Missouriensis.*
Golden buffalo or Missouri currant. (Clove bush.) *Ribes aureum chrysococcum.*

MISCELLANEOUS.

Prairie mesquite. *Prosopis glandulosa.*
False or bastard indigo. *Amorpha fruticosa.*
Lead plant. (Shoestrings.) *Amorpha canescens.*
Trumpet flower or trumpet creeper. *Tecoma radicans.*
American mistletoe. *Phoradendron flavescens.*

CHAPTER X.

A DISCUSSION OF THE PHYSIOGRAPHY, GEOLOGY, MINERAL RESOURCES, INDUSTRIES, AND POPULATION, BY COUNTIES.

ADAIR COUNTY.

LOCATION AND EXTENT.

Adair County is located in the extreme eastern part of the State, the third county from the north along the Arkansas line. It is approximately rectangular in shape and contains an area of about 600 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the Ozark Mountain region, in the area of Mississippian rocks. The Boone chert forms the surface rock of nearly the whole county. The formations of the Chester group and the lowermost Pennsylvanian formations cover some of the hills. The surface is quite hilly, but many of the hills and ridges are flat-topped and of sufficient breadth to produce considerable areas of level land. The valleys are, in general, very narrow.

The drainage of the northern part of the county is into Illinois River, principally through Barren Fork and its tributaries. A large area in the southern part is drained directly into Arkansas River through Sallisaw Creek. Much of the drainage is underground, and sinkholes and springs are common. The rainfall averages about 40 inches annually, and is well distributed through the year. Nearly the whole county is timbered.

INDUSTRIES.

Agriculture is the industry of practically the entire population. The wooded areas furnish some lumber, and large numbers of railroad ties are produced, but most of the large timber has been cut. Farming is not usually conducted on a large scale. Corn is the principal crop, but cotton is important in the southern portion.

The mineral industries are very unimportant. Attempts to find oil and gas have been made but without success, and it is highly improbable that commercial deposits of either substance will be found in the county. The chert of the Boone formation and the limestones of the higher Mississippian and lower Pennsylvanian rocks will furnish an

abundance of material for macadam roads when the demand for improved roads arises.

TRANSPORTATION.

Railroad facilities are afforded by the Kansas City Southern Railway and the Fayetteville-Okmulgee branch of the St. Louis & San Francisco Railway. The former crosses the county in a north-south, and the latter in an east-west direction. The country roads are generally unimproved and in poor condition.

POPULATION.

The population is now estimated at 14,500, an average density of about 24 per square mile. Stilwell (1,600), the county seat, and Westville (802), at the junction of the two railroads, are the only important towns.

ALFALFA COUNTY.

LOCATION AND EXTENT.

Alfalfa County is located along the northern line of the State, west of a north-south line drawn through the center of the State. It is rectangular in shape and contains an area of about 860 square miles.

GEOGRAPHY AND GEOLOGY.

It lies entirely in the Redbeds Plains region. The surface rocks are soft red shales with thin red and gray sands, all belonging to the Enid formation. These rocks are very soft and weather down easily so that the surface is in most places covered to a depth of several feet with soil. The surface is level to rolling. The streams have cut only shallow channels in the general surface of the plain.

The drainage of the greater part of the county is east, through Salt Fork into Arkansas River. The principal tributaries of Salt Fork are Wagon, Clear, Rook, Medicine Lodge, and Sandy creeks. The extreme southern part of the county is drained southward into Cimarron River through several tributaries, the principal one of which is Eagle Chief Creek. The rainfall averages between 25 and 30 inches annually. The greater portion of it falls in the summer months. There is no native timber in the county except a few cottonwoods, china berries, and elms along the streams.

INDUSTRIES.

Agriculture is the only industry of importance. Practically the entire area is farmed, and the percentage of waste land in the county is very small. The soils are fertile and all of the staple crops of the northern part of the State are raised. Wheat is easily the leading crop, but alfalfa, corn, and the sorghums are also important. Large quantities of live stock are raised, but there are few large pastures.

TRANSPORTATION.

The county is well supplied with railroads. The Geary-Alva branch and the branch from Ingersoll to Anthony, Kansas, of the Chicago, Rock Island & Pacific; the Enid and Kiowa line of the Atchison, Topeka & Santa Fe; the main line of the Kansas City, Mexico and Orient, and the Enid and Avard line of the St. Louis & San Francisco Railway give connections in all directions. No part of the county is more than 12 miles from a railroad. The country roads are generally graded and in fair condition. No material for permanently improved roads is available.

POPULATION.

The county is fairly thickly settled, the present estimated population being 20,000, giving a density of 22 per square mile, including all the towns. Cherokee (2,500), the county seat and principal town, is a railroad center and trading point. Other villages along the railroads are Carmen (1,000), Helena (800), Goltry (400), Aline (350), Jet (400), Byron (300), Burlington (150), Ingersoll (260).

ATOKA COUNTY.

LOCATION AND EXTENT.

Atoka County is located in the southeastern quarter of the State, in the second tier of counties north from Red River and the third west from the Arkansas line. The county is irregular in shape and contains about 990 square miles.

GEOGRAPHY AND GEOLOGY.

This county lies in several physiographic and geologic provinces. The northern portion lies in the lower Arkansas Valley region and the rocks are sandstones and shales of lower Pennsylvanian age. A large area in the eastern and northeastern portion belongs to the Ouachita Mountain region and the rocks are the Standley shale, Jackfork sandstone, and older rocks of that region. The extreme southwest portion belongs to the Cretaceous region. The Trinity sand outcrops in a broad belt across this portion of the county and the Goodland limestone forms an irregular escarpment near the southern boundary. The extreme western portion is in the Arbuckle Mountain region. The surface is very rough in most parts of the county, although, owing to the different geologic provinces, there is great variation in the kinds of topography.

The drainage is to the southeast through Muddy Fork and Clear Fork of Boggy Creek and their tributaries. The valleys of these creeks are broad but in many places are poorly drained. Where the drainage is good, the valley soils are very fertile. The rainfall is rather heavy, averaging about 40 inches annually, and is well distributed throughout the year. The greater part of the surface is timbered. Considerable prairie land occurs locally in the stream valleys and some of the hilltops are prairie or very thinly timbered.

INDUSTRIES.

Agriculture is the principal industry of the county, although much of the surface, especially in the eastern portion, is too rough for farming to be prosecuted with great success. The valleys of both Clear and Muddy Boggy creeks and their tributaries are farmed extensively. Some of the broader, flat-topped ridges have sufficient thickness of soil to be productive, but the steeper slopes throughout the county are not farmed. Grazing is the principal industry in the rougher sections and there are some very large pastures.

Coal is mined near Midway and Atoka. The area of possible producing coal land in the county is not large, comprising only a few square miles along the branch of the Missouri, Kansas & Texas Railway northwest from Atoka. The limestone from the Wapanucka formation has been utilized at a crusher quarry at Limestone Gap for several years. The crusher and quarry are operated by the Missouri, Kansas & Texas Railway Company and the material has been used to ballast the line for many miles north and south of the quarry. Some asphalt is known to occur in the eastern part of the county but no deposits of commercial importance are known. Several attempts to secure oil and gas have been made in the county but so far without success. The northern and western portions may produce some gas, but it is improbable that oil will be found in this county.

TRANSPORTATION.

The main line of the Missouri, Kansas & Texas Railway crosses the county in a north-south direction about midway from east to west. The branch northwest from Atoka lies in this county for a few miles. The Ardmore branch of the Chicago, Rock Island & Pacific Railway crosses the extreme northwestern portion.

The country roads are on section lines only in the leveler parts of the county. In the rougher eastern portion the section lines have not been opened and in much of this region it is not feasible to open them for roads. Beyond grading the more heavily traveled roads and the building of bridges, no road improvements have been made. Material is present in abundance for permanently improved roads when the demand for it arises.

POPULATION.

The county is moderately thickly settled, the greater portion of the population being in the western two-thirds, while the eastern one-third of the county is rather sparsely settled. The density is about 14 per square mile. Atoka (1,968), is the county seat and principal town. Other villages along the Missouri, Kansas & Texas Railway are Caney (295), Stringtown (225), and Tushka (150). Wardville (125) is the principal town in the county along the Chicago, Rock Island & Pacific Railway.

BEAVER COUNTY.

LOCATION AND EXTENT.

Beaver County is the easternmost of the three counties in the Panhandle, the northwestward extension of Oklahoma. It is rectangular in shape and covers an area of about 1,825 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the High Plains physiographic province. The surface consists of a high, level plain into which the streams have cut fairly deep canyons. The surface rocks are principally Tertiary sands and gravels. The streams have cut their valleys through these and down into the Permian Redbeds which underlie the Tertiary. The soft Tertiary rocks weather easily and the broad flat-topped hills and even the majority of the slopes are covered with a good thickness of soil.

The drainage is to the east through Beaver Creek, one of the principal branches of the North Canadian River. This creek flows almost directly east across the county and numerous small tributaries enter it from the north and south. The county has a light rainfall, averaging about 20 inches annually. There is practically no native timber in the county.

INDUSTRIES.

Agriculture is the industry of the entire population outside of the merchants in the towns. On account of the light rainfall dry farming is practiced extensively but the greater part of the territory is given over to pasture. There is not much attempt to raise corn, but the sorghums are grown extensively for feed. Broom corn is an important product. Alfalfa does well in the richer soils, especially along the stream valleys. Wheat is grown throughout the county. There are no manufacturing or mineral industries of any sort. Until the last few years this county was without railroad facilities.

TRANSPORTATION.

The Wichita Falls & Northwestern branch of the Missouri, Kansas & Texas Railway now penetrates the northeastern portion of the county to Forgan. The country roads are in general laid out on section lines but very little work has been done on them. There are no permanently improved roads, but the natural roadways are satisfactory the greater part of the year. Owing to the light rainfall less work is necessary on the roads than in some other parts of the State.

POPULATION.

The county is sparsely populated. The present estimated population is 16,000, a density of about 9 per square mile. All the towns are small. There are several little trading villages and country post-offices.

Forgan (700) is the terminus of the Wichita Falls & Northwestern Railway, and Knowles (225), and Gate (250) are other important villages along this line. Beaver (1,500), the county seat, is located at the southern terminus of a short line of railroad connecting with the Wichita Falls & Northwestern Railway at Forgan.

BECKHAM COUNTY.

LOCATION AND EXTENT.

Beckham County is located on the western boundary of the State in the second tier of counties north from Red River. It has an area of approximately 948 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies principally in the Gypsum Hills region. A belt of sand hills of as much as 10 miles in width extends though the county on the south side of North Fork of Red River. The gypsums of the Greer formation make strong escarpments along North Fork of Red River in the southeastern part of the county. The surface consists of a plain into which the streams have cut fairly deep canyons, especially in the southeastern part, where the gypsum ledges are prominent. The areas between the streams are in general flat-topped. In the southeastern part of the county there are many small inequalities of surface due to the presence of gypsum ledges.

The drainage is to the southeast to North Fork of Red River, which crosses the county from northwest to southeast. The river has several small tributaries from both the north and south. Sweetwater Creek is the largest tributary of North Fork and drains a couple of townships in the northern part of the county. A small area in the extreme northeastern portion is drained northward into Washita River, while another section is drained south into Elm Fork of Red River. There is a little timber in the stream valleys. The rainfall is light, averaging about 22 or 23 inches annually.

INDUSTRIES.

Agriculture is the industry of practically the whole population. The greater part of the county is in farms, although much of the rougher territory is in pasture. Cotton and wheat are the leading crops. Sorghum, kaffir, and milo are raised extensively for feed, and some of the grain is marketed. Broomcorn is also an important crop.

There are no manufacturing or mineral industries. There is a small salt plain on North Fork of Red River near Carter, but the brine has not been utilized. The gypsums of the Greer formation are available in this same locality but no attempt has been made to make use of them. The amount of gypsum available in the southeastern portion of the county is very great.

TRANSPORTATION.

The Amarillo line of the Chicago, Rock Island & Pacific Railway gives outlet to the county east and west, and the Wichita Falls & Northwestern branch of the Missouri, Kansas & Texas Railway to the north and south. The two lines cross at Elk City in the northeastern part of the county.

The country roads are similar to those in other portions of the Redbeds area of the State. The soil usually contains sufficient sand to make a sort of natural sand-clay road, which with a little grading can be kept in good condition. No attempt has been made to construct permanently improved roads.

POPULATION.

The county is fairly well populated, having a present estimated population of 19,699, giving a density of about 20 per square mile. Elk City with a population of about 5,000 is the largest town. Sayre, the county seat, has a population of about 1,900. Other villages on the Chicago, Rock Island & Pacific are Erick (915), Doxey (120), and Texola (361). Carter (500), on the Wichita Falls & Northwestern is the leading town in the southeastern part of the county.

BLAINE COUNTY.

LOCATION AND EXTENT.

Blaine County is located about the center of the northwestern quarter of the State. It is approximately rectangular in outline, containing about 935 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the Gypsum Hills region. The gypsums of the Blaine formation make a pronounced escarpment facing the northeast and extending across the county northwestward from the Canadian and Kingfisher county lines at the southeastern corner. The portion of the county northeast of this escarpment lies in the Redbeds Plains and is underlaid by the Enid formation. Considerable areas of sand hills lie along North Canadian River in the central part of the county and along Canadian River in the southwest portion. The northeastern portion of the county, that in the Redbeds Plains, is very level. The strong escarpment of the Blaine gypsum has already been noted and to the southwest of that the surface is irregular, on account of the sandstones of the Woodward formation which underlies this part of the county.

The drainage of the greater part of the county is to the southeast through North Canadian River. This river enters the county at the northwestern corner and flows southeast entirely across the county. Tributaries are short and unimportant. The northeastern portion of the county (the Redbeds Plains) is drained northeastward into Cimarron River which touches the corner of the county. Salt Creek is the principal

tributary. Canadian River crosses the extreme southwestern portion. The rainfall is rather light, averaging between 25 and 30 inches annually. Timber occurs only along the streams, and on a few of the sand hills.

INDUSTRIES.

All the county is in farms except the roughest portions of the gypsum hills, and most of this region is devoted to pasture. Almost any of the crops of the northern portion of the State can be grown successfully. Considerable acreage is usually devoted to corn, but it is not a sure crop in this part of the State. The sorghums are depended upon very largely for feed. Cotton is grown to some extent in the southern part of the county. Wheat is the leading crop.

The outcrop of the Blaine gypsums is crossed by railroads in several localities, and several plants for the manufacture of gypsum into plaster have been erected. There are two plants at Watonga, one each at Bickford, Ferguson, Okeene, Darrow, and Southard. Of these only the ones at Watonga, Darrow, and Southard have made much production in the last few years.

TRANSPORTATION.

Two branches of the Chicago, Rock Island & Pacific Railway cross the county in a north-south direction. The Arkansas City and Vernon branch of the St. Louis & San Francisco and the main line of the Kansas City, Mexico & Orient cross the northwestern portion.

The country roads in the leveler portions of the county are fairly good. In the Gypsum Hills they are seldom laid out on section lines, but rather, either at the bottom of the canyons or on top of the ridges. Some attempts have been made to use the gypsum as a macadam material, but the material is too soft to be of value for this purpose.

POPULATION.

The present estimated population is 18,000, giving a density of 19 per square mile. Watonga (1,723) is the county seat and principal town. Geary (1,423), in the extreme southeastern corner, is at the junction of two divisions of the Chicago, Rock Island & Pacific Railway. Homestead (383), Darrow (169), Greenfield (300), Hitchcock (75), Okeene (920), Eagle City (150), Southard (171), Canton (703), and Longdale (296), are the principal railroad villages in the county.

BRYAN COUNTY.

LOCATION AND EXTENT.

Bryan County is located along Red River east of the middle line of the State. The county is irregular in outline and contains about 925 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Cretaceous region and is underlaid by rocks of the Lower and Upper Cretaceous systems. The

varying hardness of the limestones and shales produces a sort of stair-step topography with escarpments facing north. The county has no extremely rough territory but practically all of the surface is more or less regular. The Trinity and Silo sands produce a fairly rough topography.

The drainage is south into Red River. Washita River forms the western boundary of the county and Blue River crosses it in a northwest-southeast direction, while Clear Boggy Creek touches the northeastern corner. Other smaller tributaries of Red River are Sandy and Webb creeks, Island Bayou, and Whitegrass Creek. Blue River has some important tributaries in the county, among which are Caddo, Bokchito, and Sulphur creeks. Even the smaller of these streams generally flow throughout the year. The rainfall is heavy, averaging about 40 inches annually. A large portion of the county is covered by a good growth of timber. Most of the large timber has been cut. There are considerable areas of prairie on the shale formations and on the higher limestones.

INDUSTRIES.

Farming is the only important industry of the county. Cotton is by far the leading crop. Only a very small amount of wheat is grown. Corn is raised extensively for feed and alfalfa is grown on the black land with considerable success. The average rainfall is sufficient for corn and little use is made of the sorghums except possibly for second crops. Some of the rougher land, especially on the outcrop of the Silo sandstone in the southern part of the county, is pasture. There are no manufacturing or mining industries of importance. There are cotton gins at practically all the villages. Asphalt has been reported from several localities but so far it has not been found in sufficient quantity to be of any importance commercially.

TRANSPORTATION.

The main lines of the Missouri, Kansas & Texas and of the Missouri, Oklahoma & Gulf railways give connection to the north and south, and the Hope-Ardmore division of the St. Louis & San Francisco to the east and west. The country roads are mostly upon section lines. The roads over the area of the Trinity and Silo formations are usually very sandy. On the limestone and shale formations (the black land), the roads are fairly good in dry weather but are almost impassable when wet.

POPULATION.

The county is fairly thickly populated. A large proportion of the population is of Choctaw Indian descent, and much of the land is held by members of this tribe. The present estimated population is 35,000, giving a density of about 37 per square mile. Durant, at the intersection of the three lines of railroad, is the county seat and principal town, having an estimated population of 10,500. The Southeastern State Normal School is located here. Caddo (1,143), Calera (575), and Colbert (240) are villages on the Missouri, Kansas & Texas Railway. Bennington (513), Bokchito (535), Meade (200), and Platter (120) are located on the St. Louis & San Francisco Railway.

CADDO COUNTY.

LOCATION AND EXTENT.

Caddo County is located just slightly to the southwest of the center of Oklahoma. The county is one of the larger counties in the western part of the State, having an area of about 1,400 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the Redbeds Plains and Gypsum Hills regions. The northern part of the county in the Redbeds Plains is underlaid by red shales and sands belonging probably to the Enid and Woodward formations. The southern part is covered by the outcrop of the Greer formation. The northern part is smooth, while the southern part is rolling to hilly. Paleozoic rocks of the Wichita Mountains outcrop in the southwestern portion where they form pronounced hills.

The drainage for the greater part of the county is into Washita River, which crosses from west to east through the middle part of the county. The principal tributaries, Pond and Sugar creeks, are from the north. The tributaries from the south are short and unimportant. The extreme southern portion is drained to the south through the headwaters of Cache Creek. The county is in the belt of moderate rainfall, having an average annual rainfall of about 30 inches. Timber occurs only along the streams.

INDUSTRIES.

The soft rocks which underlie the county weather easily and produce a good thickness of fertile soil. Practically the entire surface of the county is in farms and agriculture is the one important industry. Cotton and wheat are the leading crops, both being raised extensively throughout the country. Corn is grown largely for feed, as are also the sorghums, milo, kaffir, and feterita. Alfalfa does well, especially in the stream valleys. Large numbers of cattle and hogs are raised, but stock-raising is conducted principally in connection with farming. There are a few large pastures.

The gypsums in the southern part of the State are available to the railroads and a plaster mill was formerly operated at Cement. This burned some years ago and has not been rebuilt. There are no other manufacturing industries in the county.

TRANSPORTATION.

The county is crossed in a north-south direction by one branch of the Chicago, Rock Island & Pacific Railway and in an east-west direction by two branches of the same road. The Oklahoma City-Quanah branch of the St. Louis & San Francisco crosses the extreme southeastern portion. Country roads are mostly of red sandy clay and are fairly good, although they receive little attention. Practically all the section lines are open as highways.

POPULATION.

The county is fairly well populated, having an estimated population of 40,500, a density of about 29 per square mile. Anadarko (3,439) is the county seat and principal town. It is located at the crossing of the two branches of the Chicago, Rock Island & Pacific Railway. Carnegie (835), Ft. Cobb (382), Binger (280), Lookeba (217), Hinton (686), Bridgeport (428), Apache (950), Hydro (562), Cyril (520), and Cement (752) are the railroad towns and villages of the county.

CANADIAN COUNTY.

LOCATION AND EXTENT.

Canadian County is located just west of the center of the State. It has an area of about 925 square miles.

GEOGRAPHY AND GEOLOGY.

It lies entirely in the Redbeds Plains region and the surface rocks are the soft red shales and sandstones of the Enid formation. The surface is level to gently rolling.

The drainage is to the southeast through North Canadian and Canadian rivers. North Canadian enters the county at the northwest corner, flows in a southeasternly direction and leaves near the middle of the east line. Canadian River enters at the middle of the west line, flows southwest across the corner of the county, and forms the southern boundary of the east half. The northeastern portion is drained into Cimarron River through tributaries of Kingfisher and Cottonwood creeks. The county lies in the belt of moderate rainfall, the mean annual precipitation being about 30 inches. Native timber occurs along the streams.

INDUSTRIES.

The soils of the county are deep and fertile, and agriculture is the only important industry. Practically the entire area of the county is farmed, there being only a small percentage of waste land. Wheat and corn are the principal crops. Cotton is grown to some extent, but much less extensively than in the adjoining counties to the south. Stock-raising is important but is conducted in connection with farming. There is practically no range or large areas of pasture.

Except for the manufacture of red clay shale into brick in a small way at one or two localities there are no manufacturing industries. A gypsum mill was formerly operated southwest of Okarche, but was abandoned a few years ago.

TRANSPORTATION.

The main line of the Chicago, Rock Island & Pacific Railway crosses the county in a north-south direction, and the Amarillo line of the same road crosses in an east-west direction. The St. Louis, El Reno & Western Railway extends northeast from El Reno to Guthrie. The country roads are fairly satisfactory, although they receive little attention. Practically all the section lines are open as country roads.

POPULATION.

The population is fairly dense, being estimated as 26,550, giving a density of about 29 per square mile. El Reno (7,872) is the county seat and important center and division point of the Chicago, Rock Island & Pacific Railway System. A large number of men are employed in the office and yards of this company. Union City (171), Okarche (402), Calumet (158), Yukon (1,018), Piedmont (255), and Richmond (250) are the principal towns and villages of the county. Yukon is especially noted for large flouring mills.

CARTER COUNTY.

LOCATION AND EXTENT.

Carter County is located in the south-central part of the State, in the second tier of counties north from Red River. It is rectangular in shape and has an area of about 832 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies principally in the Redbeds Plains region, and the Sandstone Hills region south of the Arbuckle Mountains. The northern portion lies in the Arbuckle Mountain region and the extreme southern and southeastern portions lie along the margin of the Red River or Cretaceous region. The rocks of the Arbuckle Mountains in the county are limestones, sands, and shales, which are very steeply tilted in a general southwest direction. In the east-central part of the county, around Ardmore, is an area of Pennsylvanian rocks which are very steeply tilted. The formations are principally sandstones and shales. Owing to a very high inclination the sandstones appear as dikes or narrow rock walls extending for miles across the county. The surface of the county is irregular. The north half is rolling to very hilly, while the southern portion is level to rolling.

The north half of the county is drained eastward into the Washita River, which cuts the corner of the county. The principal drainage of the northwestern portion is into Caddo Creek, which receives the water of several small tributaries, principally from the north. The southern half of the county is drained southward into Red River through the branches of Hickory Creek, Walnut Bayou, and Mud Creek. The greater part of the county is covered by a growth of oak. There are some prairie areas in the southern and western portions. The rainfall is moderately heavy, averaging about 35 inches annually.

INDUSTRIES.

Agriculture is the leading industry, although a considerable part of the land, especially in the northern part of the county, is too rough to be good farming land. Cotton is easily the leading crop, although considerable wheat is raised in the western part. Corn is grown extensively for feed throughout the county. There is considerable grazing and some large pastures in the Arbuckle Mountain region.

In addition to agriculture the county has some important mineral resources, the principal one being oil and gas. The Healdton oil and gas field is located along the western boundary of the county, extending into Jefferson County. This is the most important field so far discovered outside of the main oil and gas field in the northeastern part of the State, and has produced hundreds of thousands of dollars worth of oil. Large flows of gas have been found about 12 miles north of the Healdton field and it seems probable that there will be important developments in this vicinity. Asphalt has been mined southwest of Ardmore and also to the northwest, near Woodford. This material has been used for paving in several cities in Oklahoma and adjoining states. The Pennsylvanian shales have been utilized for brick at Ardmore.

TRANSPORTATION.

Transportation facilities are afforded by the Atchison, Topeka & Santa Fe Railway to the north and south, the branches of the Chicago, Rock Island & Pacific and St. Louis & San Francisco to the east, and by the Oklahoma, New Mexico & Pacific to the west. Ardmore (15,700) is the county seat and principal town. It is located in the southeastern part of the county, at the junction of the four railroads named above. Besides being an important railroad and trading center it is the seat of a large oil refinery. Berwyn (400), Lone Grove (500), Wilson (1,500), and Province (100) are small villages on the railroads. Some of the country towns, particularly Wirt, (1,800) in the midst of the oil field, are of considerable size. New Healdton has just been established.

POPULATION.

The county as a whole is fairly well populated, although the northern portion is very sparsely settled. The present estimated population is 35,000, a density of 40 to the square mile.

CHEROKEE COUNTY.

LOCATION AND EXTENT.

Cherokee County is located in the northeastern part of the State. It is in the third tier of counties from the north line and the second from the east line of the State. The area of the county is about 800 square miles.

GEOGRAPHY AND GEOLOGY.

This county lies entirely in the Ozark Mountain region. The surface rock of the greater part of the area is the Boone chert, which underlies considerably more than half of the county. The hills in the southern and western parts of the county are capped by Upper Mississippian and lowermost Pennsylvanian rocks, while in the northeastern part the deeper valleys cut into the older rocks beneath the Boone. The surface is very hilly. Even the larger stream valleys are generally less

than one mile in width. The region is well dissected by streams and the ridges between them are not often of great width. They are, however, flat-topped, and where of sufficient width produce considerable areas of possible farming land.

The drainage of the west half of the county goes to the west into Grand River, which forms the western boundary of the county. The principal tributaries are Clear, Spring, Ranger, and Flower creeks, and Bayou Manard. Illinois River enters the county near the northeast corner and flows nearly south through the east half of the county. It receives most of its tributaries from the east, the more important ones being Barren Fork, Caney, Elk Fork, and Terrapin creeks. The county receives ample rainfall, averaging about 40 inches annually, which is well distributed through the year. The whole county except the tops of some of the broader regions is timbered.

INDUSTRIES.

Agriculture is the principal industry, although much of the county is too rough for farming purposes. Cotton is raised extensively in the stream valleys and to a less degree on the flat uplands. The hillier land and practically all of the hill slopes are left in pasture. Considerable areas are too rough and too much covered with chert fragments to be good pasture land. There are no manufacturing or mineral industries.

TRANSPORTATION.

The Okmulgee-Fayetteville branch of the St. Louis & San Francisco Railway crosses the county in an east-west direction and the Missouri, Oklahoma & Gulf touches the northwest corner. The country roads are unimproved. In the leveler portions the section lines have been opened as roads, but in much of the county the roads are still merely winding trails through the valleys and over the wooded hills.

POPULATION.

In spite of the rough surface the county is fairly thickly settled. According to the present estimation it has a population of 17,500, giving a density of about 21 per square mile. Many of the inhabitants are of Cherokee descent. In the hillier sections much of the land is allotted to the full-blood Cherokee Indians and cannot be sold. Tahlequah (3,500) is the county seat and principal town. It is the seat of the Northeastern State Normal School. Hulburt (600) and Welling (75) are villages along the railroad. There are many country towns and post offices, a few of which have a population of nearly 100.

CHOCTAW COUNTY.

LOCATION AND EXTENT.

Choctaw County is located in the southeastern part of the State, on Red River. It is the second county west of the Arkansas line. The area of the county is about 800 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Red River region and the surface rocks are the shales and limestones of the Lower Cretaceous system, with some areas of the Silo sandstones of the Upper Cretaceous. The surface is somewhat uneven. The alternation of hard and soft strata in the Lower Cretaceous system produces a stairstep topography, with the escarpments facing north. The general slope is slightly east of south.

The drainage is into Red River. Boggy Creek enters the county near the northwest corner and flows southeast to Red River, and Kiamichi River enters the county east of the middle of the northern boundary and flows south and east into Red River. Several smaller creeks flow into the same stream. The rainfall is heavy, the mean annual precipitation being about 40 inches. There are considerable areas of timber in the northern part of the county, but the southern portion is largely prairie.

INDUSTRIES.

The region is altogether an agricultural region. The soils of the Lower Cretaceous rocks are generally deep and very fertile. Cotton is the important crop, although considerable acreage is devoted to corn. Very little wheat and sorghums are raised. Stock-raising is carried on to some extent but to a less degree than in the western part of the State. The large timber has mostly been cut but there is considerable industry in the railroad ties and small timber.

TRANSPORTATION.

The main line of the St. Louis & San Francisco Railroad crosses the county in a north-south direction, and the Hope-Ardmore branch in an east-west direction. The country roads are in general on section lines, but are little worked and in most parts of the county are in poor condition. The roads on the black soil are practically impassable in wet weather.

POPULATION.

The present estimated population of the county is 23,500, a density of about 29 per square mile. Hugo (7,500) is the county seat and principal town. It is at the junction of the two lines of the St. Louis & San Francisco Railway. Grant (416), Boswell (828), Soper (233), Sawyer (210), and Fort Towson (697) are railroad villages. Besides the cotton gins there are no manufacturing establishments at any of these towns and they are chiefly trading centers for their vicinities.

CIMARRON COUNTY.

LOCATION AND EXTENT.

Cimarron County is the westernmost of the three Panhandle counties. It has an area of about 1,850 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the High Plains region and the greater part of it is covered by Tertiary clays, sands, and gravels. In the northwestern part is an area of several square miles of Dakota sandstone of Upper Cretaceous age. In the extreme northwestern corner there is a small area of igneous rock known as the Black Mesa. The surface is a high plain with a gentle slope to the east. The streams have cut rather deep canyons into the surface of the plain.

The drainage of the northern part of the county is into Cimarron River, and of the southern part into Beaver Creek. Both of these streams flow from west to east, almost the entire length of the county. The rainfall is very light, averaging about 15 inches annually. There is no timber, except a few elms and cottonwoods along the streams. The soils of the county are comparatively deep and fertile, but on account of the light rainfall, not much of it can be considered agricultural land.

INDUSTRIES.

Grazing is the most important industry. Some wheat is raised on some of the better land, and the sorghums are grown extensively for feed. Broomcorn is grown in parts of the county.

TRANSPORTATION.

The county is without railroads. The country roads are merely trails across the prairie, only part of them on section lines.

POPULATION.

The county is thinly settled, the present estimated population being 4,000, less than 3 per square mile. Boise City (150), the county seat, is just a small village, and the other towns of the county are merely post offices and stores.

CLEVELAND COUNTY.

LOCATION AND EXTENT.

Cleveland County is located south of the center of the State. It has an area of about 600 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Redbeds Plains region and is underlaid by the soft red shales and sandstones of the Enid formation. The western part of the county is very level, while the eastern is more hilly on account of the greater proportion of sandstone in the bed rocks.

Canadian River forms the southwestern boundary of the county. The northern portion is drained eastward through Little River. The eastern part of the county is largely covered by a growth of black-jack oak, while the rest is prairie except for narrow belts of timber along the streams. The rainfall is between 30 and 35 inches annually.

INDUSTRIES.

Cleveland is one of the leading agricultural counties of the State. Cotton is the most important crop, but wheat and corn are both raised extensively and large quantities of kafir and milo maize are produced for local use. Stock-raising is carried on in connection with farming.

TRANSPORTATION.

The main line of the Atchison, Topeka & Santa Fe Railway crosses the western portion of the county. The country roads are on section lines and are kept fairly well graded. There are no permanently improved roads, but a great deal of work on road improvement is being done at the present time.

POPULATION.

The county is rather thickly settled, the present estimated population being 24,000, or about 40 per square mile. Norman (6,000) is the county seat and largest town. It is the site of the State University, and one of the State Insane Hospitals. Moore (300) and Noble (500) are villages on the Atchison, Topeka & Santa Fe Railway.

COAL COUNTY.

LOCATION AND EXTENT.

Coal County is situated southeast of the center of the State. It has an area of about 525 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies principally in the Lower Arkansas Valley region, and the bed-rocks are sandstones and shales of Pennsylvanian age. These are strongly folded. An area in the extreme southwestern portion of the county is in the Arbuckle Mountain region. The surface of the county is quite rough, although there are large flat areas on the outcrop of the thick shale formations. The sandstone formations form strong ranges of hills rising above these flats. The larger creek valleys are locally three or four miles wide.

The drainage is to the south and east, through Muddy Boggy and Clear Boggy creeks and their branches. The rainfall is fairly heavy, averaging between 35 and 40 inches annually. The hillier portions of the county are timbered, while the flat shale lands are prairie.

INDUSTRIES.

Farming is probably the principal industry, and cotton is, by far, the most important crop. Considerable areas of the hillier land are devoted to pasture, and cattle-raising is one of the important industries. The southeastern part of the county is in the coal district and mining is carried on extensively at Coalgate, Phillips, Lehigh, and Midway.

TRANSPORTATION.

The main line of the Missouri, Oklahoma & Gulf Railway crosses

the western part of the county from north to south. The Atoka-Oklahoma City branch of the Missouri, Kansas & Texas and the Oklahoma Central division of the Atchison, Topeka & Santa Fe Railway crosses in a northwest-southeast direction, and the Ardmore branch of the Chicago, Rock Island & Pacific Railway crosses the northeastern corner of the county in the opposite direction. Most of the section lines are open as country roads, but they are poorly worked and mostly in bad condition.

POPULATION.

The population is fairly dense. The present estimated population is 17,200, averaging about 32 per square mile. A large portion of this population, however, is concentrated in the coal mining district in the southeastern part of the county, and the population of the rural district is sparse. Colgate (3,255) is the county seat and principal town. Phillips (680), Lehigh (1,880), and Midway (1,653) are mining towns along the Missouri, Kansas & Texas Railway. Tupelo (387) and Clarita (150) are railroad villages in the western part of the county.

CRAIG COUNTY.

LOCATION AND EXTENT.

Craig County is located along the Kansas line, in the northeastern part of the State. It is the second county from the east. It has an area of 770 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies principally in the Prairie Plains region, with the extreme southeastern corner in the margin of the Ozark Uplift. The rocks in the southeastern corner are the Boone chert and Chester limestones and shale. The main part of the county is underlaid by the Cherokee shales. The surface of the major portion is very level. In the Ozark Mountain region the surface consists of hills of Boone chert. In the extreme northwestern corner ledges of sandstone produce rough topography.

The drainage of all except the extreme western part of the county is south through Big Cabin Creek and its tributaries. The western tier of townships is drained westward through Verdigris River and its several tributaries. Neosho River touches the northeastern corner of the county. The average annual rainfall is nearly 40 inches. The southeastern part of the county is heavily timbered, but the major portion is prairie with timber only along the streams.

INDUSTRIES.

Craig County is almost entirely an agricultural county. Corn and wheat are the leading farm crops. A large portion of the prairie region is left to the wild native grasses. This is pastured in part, but is largely utilized for hay, the making of prairie hay being one of the leading industries. Practically no cotton is grown in the county. Some

oil and gas have been found in the western part of the county, but the chances for any important fields are very small.

TRANSPORTATION.

The main line of the Missouri, Kansas & Texas Railway gives connections to the north and south, and the main line of the St. Louis & San Francisco Railroad to the east and west. The country roads are practically all on section lines. There are no permanently improved roads, but where graded the natural roads are fairly good except in extremely wet weather.

POPULATION.

The county is well settled, the present estimated population being 22,500, an average of about 30 per square mile. Vinita (5,200) is the county seat and principal town. It is situated at the junction of the Missouri, Kansas & Texas, and the St. Louis & San Francisco railroads. Blue Jacket (508), Welch (684), and Big Cabin (190) are railroad villages and trading points. Centralia (400) is an important inland town in the western part of the county.

COTTON COUNTY.

LOCATION AND EXTENT.

Cotton County was formerly part of Comanche County. It has an area of approximately 640 square miles.

GEOGRAPHY AND GEOLOGY.

The remarks just made concerning the Redbeds portion of Comanche County apply equally as well to Cotton County. The valley of Red River is not very wide but forms exceptionally fine farming land.

INDUSTRIES.

The county is more important as an agricultural county than Comanche.

TRANSPORTATION.

The Enid-Waurika branch of the Chicago, Rock Island & Pacific Railway crosses the northeastern portion of the county. The Wichita Falls & Northwestern Railway touches the southwestern corner.

POPULATION.

The present estimated population is 20,000, an average density of 30 per square mile.

CREEK COUNTY.

LOCATION AND EXTENT.

Creek County is located northeast of the center of the State. It has an area of about 970 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Sandstone Hills region. The surface rocks are sandstones and shales of Pennsylvanian age. These in general dip to the west and northwest at a very low angle, but the general dip is often interrupted by gentle folding which produces structure favorable for oil and gas accumulation. The surface is rough, the sandstones forming steep escarpments above the valleys, which are mostly cut out in the shale formations.

Cimarron River crosses the northwest portion of the county and drains a small area through several short tributaries. The central and eastern part of the county is drained into Arkansas River through Polecat Creek and its tributaries. Deep Fork River flows near the southern boundary and drains that portion of the county. Its principal tributary is Little Deep Fork. The rainfall is fairly heavy, averaging about 35 inches per year. Practically all of the county is timbered.

INDUSTRIES.

Creek County is largely an agricultural county, although at present the value of the oil and gas produced is in excess of the agricultural products. The stream valleys and broad, flat-topped ridges have fairly thick, fertile soil. Cotton and corn are raised extensively. Wheat and other small grains are grown to a less degree.

Several important oil and gas pools are located in this county. The Cushing pool, which has made the greatest production of high grade oil of any pool in Oklahoma, and which has probably had more effect on the oil and gas industry than any other like discovery in the State, is located near the western boundary. The Glenn pool, which was the most important pool developed in Oklahoma before the Cushing field, lies near the eastern boundary and extends into Tulsa County. Several smaller pools have also been developed.

A large brick factory at Sapulpa uses the Pennsylvanian shale and produces a good grade of building brick. Large glass factories are located at the same town on account of the abundance of natural gas which furnishes extremely cheap fuel. A large oil refinery is also located at Sapulpa.

TRANSPORTATION.

The main line of the St. Louis & San Francisco Railroad crosses the county in a southwest-northeast direction, and an important branch extends south from the main line from Sapulpa. The Atchison, Topeka & Santa Fe Railway has a new line into the Cushing field in the northwestern part of the county. The country roads are only partially opened on section lines, and in most cases are very rough. The roads over the sandstone hills will require considerable work before they can be said to be even fairly good.

POPULATION.

The population outside of the oil and gas fields is rather sparse, but the concentration in these fields brings the average of this county up to that of others in this part of the State. The present estimated population is 60,000, an average of 61 per square mile. Sapulpa through the branches of Cache and Big Beaver creeks. The rainfall is (12,929). At the junction of the main line and the Denison branch of the St. Louis & San Francisco Railroad, is the county seat and leading town. It is located in the extreme northeastern part of the county. Bristow (1,667), and Depew (230) are railroad towns in the southwestern part of the county. Drumright (.....), Pemeta (.....), and Markham (.....) are oil towns in the Cushing field on the new line of the Atchison, Topeka & Santa Fe Railway in the northwestern part of the county. Kiefer (1,500) and Mounds (1,000) are oil towns in the extreme southeastern part of the county on the St. Louis & San Francisco Railroad.

COMANCHE COUNTY.

LOCATION AND EXTENT.

Comanche County is located in southwestern Oklahoma, in the third tier from the west line of the State and the second north from Red River. The area of the county is about 1,100 square miles.

GEOGRAPHY AND GEOLOGY.

The northwestern part of the county lies in the Wichita Mountain region and contains the greater portion of the main range of the Wichitas. The surface of this portion is very rough, consisting of hills of granite with narrow, V-shaped valleys. The elevation of many of the hills is more than 1,000 feet above their bases. The south and southeastern portions of the county are in the Redbeds Plains and are very level or rolling.

The drainage of the county is principally south into Red River medium, averaging about 25 inches annually. Parts of the slopes of the granite mountains are timbered, but in the level parts of the county timber occurs only along the streams.

INDUSTRIES.

The most of the mountain area of the county is included in the Wichita Forest and Game Reserve, and another large area is included in the Fort Sill military reserve. These large areas are non-productive. The plains portion of the county is good agricultural and grazing land and is practically all in farms. Cotton is the leading crop. Corn is not so important as farther east, on account of the lighter rainfall. Kafir, milo maize, and feterita are grown extensively as feed crops.

Some asphalt is known to occur, but so far it has not been found in sufficient quantities to make it of commercial importance. Some oil and gas have been found in the western part of the county. Great excitement has been raised at different times by the report of the discovery of gold and silver in the Wichitas and up to the present time a great sum of money has been spent there from which no returns have been realized.

TRANSPORTATION.

The Enid-Waurika branch of the Chicago, Rock Island & Pacific Railway crosses the county in a north-south direction and has a branch from Lawton southwest to Chattanooga. The Quanah-Oklahoma City division of the St. Louis & San Francisco Railroad enters the county near the northeastern corner and exends southwest to Lawton and then west out of the county. In the Wichita Mountain region there are practically no roads. In the rest of the county the roads are on section lines and are the typical sandy clay roads of the Redbeds region.

POPULATION.

Lawton (10,500) is the county seat and principal town. It is at the junction of the Chicago, Rock Island & Pacific and the St. Louis & San Francisco railways. Fletcher (374), Elgin (178), Cache (317), Fort Sill (199), Indiahoma (188), Chattanooga (471), Faxon (215), and Geronimo (186) are railroad villages and trading points. The population of Fort Sill is almost entirely connected with the business of the military reservation.

CUSTER COUNTY.

LOCATION AND EXTENT.

Custer County lies in the west-central part of the State, about the middle, north and south, and in the second tier of counties from the west. It is rectangular in shape, and contains about 1,000 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely within the Gypsum Hills region, and the greater part of it is included in the outcrop of the Greer formation. The gypsums of the Greer in this county are lenticular and produce low, rounded knobs. Only in the southwestern and extreme southeastern parts of the county is there any very rough territory.

The drainage of the county is principally to the east of south. Canadian River touches the northeastern corner but drains directly a very small area. Deer Creek is an important tributary of the Canadian, but empties into it outside of Custer County. Washita River touches the southwestern portion and drains three-fourths or more of the county. Its tributaries are numerous but are mostly short. Barnett Creek, which drains the north-central and northwestern portions, is the largest. The rainfall is fairly light, averaging a little less than 25 inches annually. Timber is found only along the streams.

INDUSTRIES.

The soils of Custer County are deep and, as a rule, fertile. The county is altogether an agricultural region and is practically all in farms. Cotton and wheat are the principal crops. Kafir, milo maize, and feterita are raised extensively for feed, although considerable acreage

is devoted to corn. The gypsums of the Greer formation in the southeastern part of the county are sufficiently thick to be utilized, but no steps have been made to utilize them, and in the present condition of the industry it is doubtful whether they could be used profitably. Volcanic ash has been found and is shipped from near Custer City.

TRANSPORTATION.

The main line of the Kansas City, Mexico & Orient, and the Vernon branch of the St. Louis & San Francisco railways cross the county from north to south, and the Chicago, Rock Island & Pacific Railway from east to west. The Clinton, Oklahoma & Western extends from Clinton, in the southern part of the county, westward into Roger Mills County. The country roads are on section lines and are reasonably good where any attention is given them. This is true of all the roads in the whole Redbeds region.

ROPULATION.

Arapahoe (800) is the county seat. Clinton (2,781), in the southern portion of the county, is the largest town. It is a railroad center at the junction of the Chicago, Rock Island & Pacific; the Clinton, Oklahoma & Western; the Kansas City, Mexico & Orient; and the St. Louis & San Francisco railways. Custer City (854), Thomas (137), Weatherford (2,118), and Butler (101) are railroad towns and trading points. Weatherford is the site of the Southwestern State Normal School. The total population of the county is about 22,000.

DELAWARE COUNTY.

LOCATION AND EXTENT.

Delaware County is located in the eastern part of the State, the second county from the north along the Arkansas line. It contains an area of about 800 square miles.

GEOGRAPHY AND GEOLOGY.

It lies entirely in the Ozark Mountain region, in the area of the Mississippian rocks. Almost the whole surface is underlaid by Boone chert. Two or three hills in the southeastern part are capped with younger rocks, and some of the deeper valleys cut for short distances into the older rocks beneath the Boone. The surface is very rough. Many of the hills are broad and flat-topped, with considerable areas of level land, some of which is prairie. With the exception of the small areas of prairie on the hill tops, the entire county is wooded. The valleys are in general very narrow and steep-sided.

Grand River crosses the northwestern portion of the county, and with its tributaries drains the most of the area. The southern portion is drained westward into Grand River through Spavinaw Creek, and its many tributaries. Much of the drainage is underground. Sink holes and springs are abundant. Rainfall is plentiful, averaging above 40 inches annually.

INDUSTRIES.

Much of the surface of Delaware County is too rough for agricultural purposes, but still agriculture in its different phases is almost the only industry in the county. The timber is mostly scrubby growth and not of great value. Much of the more level portions of the county are suitable for fruit raising, but transportation facilities are lacking for making this industry successful. Wild hay grows well on the prairie and is an important industry in this section. Corn is probably the principal crop, and some cotton is grown in the southern portion. A large acreage of wheat is grown, especially in the northern part.

TRANSPORTATION.

The Missouri, Oklahoma & Gulf Railway crosses the northwestern portion of the county, and the Rogers-Grove branch of the St. Louis & San Francisco Railroad penetrates the northeastern portion at Grove. The country roads are in general mere trails over the hills. Only in the leveler portions are the section lines opened.

POPULATION.

Jay, in the central part of the county, is the county seat. It is merely an inland village. Grove (900), at the terminus of the branch of the St. Louis & San Francisco Railroad is the largest town. Bernice is an important trading point on the Missouri, Oklahoma & Gulf Railway, in the northeastern portion of the county. The county is rather sparsely settled. Much of the land belongs to the full-blood Cherokees who form a large proportion of the inhabitants of the hillier parts of the county. The present estimated population is 12,500, an average of about 15 per square mile.

DEWEY COUNTY.

LOCATION AND EXTENT.

Dewey County lies in the west-central portion of the State, a little north of the middle, and in the second tier from the Texas line. It has an area of about 1,000 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Gypsum Hills region, and the surface is a rolling plain rather deeply cut by Canadian River, which enters the county about the middle of the west line and flows in large curves entirely across it, leaving it at the southeast corner. There are large areas of sand dunes along the stream. The North Canadian cuts the county in the extreme northeastern part. The tributaries of both streams are fairly numerous, but are short and unimportant. The rocks are the soft shales and sandstones of the Woodward and Greer formations. Gypsum is quite abundant, but the ledges are lenticular and probably of no commercial importance. The entire county is

prairie except for scant timber along some of the streams. The rainfall is rather light, averaging less than 25 inches annually.

INDUSTRIES.

The soils of the county are fairly deep and fertile but the light rainfall acts as a considerable handicap to agriculture. Wheat is easily the leading crop. Considerable areas are in pasture. Kafir and milo maize are the principal dependents for feed crops, although corn is grown to some extent. Alfalfa does well in the lowlands.

TRANSPORTATION.

The Kansas City, Mexico & Orient Railway crosses the extreme southeastern portion, and the Wichita Falls & Northwestern branch of the Missouri, Kansas & Texas Railway crosses from north to south in the west tier of townships. The country roads, in general, receive little attention, but are fairly good, except in the sand hills region. Most of the section lines are opened for roads.

POPULATION.

The population is rather sparse. The present estimated population is 14,750, an average of about 14 per square mile. Taloga (500), the county seat, is an inland town on Canadian River. Leedy (1,025) is the largest town. Tray (100), Camargo (200), and Vici (500) are important trading points on the Wichita Falls & Northwestern Railway in the western part of the county. Oakwood (200) is the largest village in the eastern part of the county. It is on the Kansas City, Mexico & Orient Railway.

ELLIS COUNTY.

LOCATION AND EXTENT.

Ellis County is in the extreme western part of the State, the second county from the north along the Texas Panhandle line. It has an area of about 1,200 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the High Plains region and the surface rocks are principally Tertiary clays, sands, and gravels, with large areas of sand dunes along the principal streams. The surface is a high plain broken by the sharply cut stream valleys.

The drainage of the northern part of the county is east through Wolf Creek, one of the principal tributaries of the North Canadian. The southern part is drained into Canadian River, which forms the southern boundary. The whole county is prairie except for scanty timber along the stream courses. The rainfall is light, averaging between 20 and 25 inches annually.

INDUSTRIES.

While the soils of the greater part of the county are fairly fertile, agriculture is greatly handicapped by the light rainfall. A large portion of the county is in pasture. Wheat is the leading farm crop and the sorghums, milo, kafir, and feterita are grown extensively for feed crops. Corn cannot be depended upon on account of the lack of rainfall. Broomcorn is an important crop. There are no manufacturing or mineral industries.

TRANSPORTATION.

The Panhandle division of the Atchison, Topeka & Santa Fe Railway crosses the northern part of the county. The country roads are generally upon the ridges and are only partially on section lines. While they receive little attention, they are generally fairly good.

POPULATION.

The population is sparse, the entire population for the county being 15,375, or an average of about 12 to the square mile. Arnett (500), the county seat, is an inland town in the southern part of the county. Shattuck (1,231), Gage (934), and Fargo (341) are the leading towns along the Atchison, Topeka & Santa Fe Railway.

GARVIN COUNTY.

LOCATION AND EXTENT.

Garvin County is located south of the center of the State. It has an area of about 820 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies almost entirely in the Permian Redbeds geologic area and in the Redbeds Plains physiographic province. The extreme southeastern portion is in the Arbuckle Mountains. The rocks are mostly red clay shales and sandstones. A thick limestone conglomerate underlies portions of the southeastern townships. The surface is generally rolling, becoming hillier toward the southeast. Washita River has a broad, flat valley through the county.

The drainage is entirely into the Washita, which flows in a general southeast direction across the county. Rush, Wild Horse, Sandy, Peavine, and Washington creeks are its principal tributaries. The rainfall is moderate, averaging about 30 inches per year. Some of the sandy region in the eastern part of the county is covered with blackjack oak, but the greater part of the county is prairie. The soils of the county are derived, for the most part, from the red sandy shales of the Enid formation and are fertile. Considerable areas in the eastern portion are quite sandy.

INDUSTRIES.

The broad Washita valley contains some of the most productive lands in the State. Corn and cotton are the leading crops. No minerals

of value have been produced in the county. Several wells have been drilled for oil and gas, but with only partial success.

TRANSPORTATION.

The main line of the Gulf, Colorado & Santa Fe Railway crosses the county in a north-south direction, with branches extending northeast and northwest from Pauls Valley. The country roads are generally poor and receive little attention. The present estimated population is 27,500. Pauls Valley, the county seat, has a population of 4,500. Wynnewood (2,250), Maysville (500), Paoli (250), and Lindsay (1,200) are railroad towns and trading centers.

GARFIELD COUNTY.

LOCATION AND EXTENT.

Garfield County is located in the north-central part of Oklahoma. It has an area of 1,080 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Permian Redbeds geologic area, and in the Redbeds Plains physiographic province. The bedrocks belong to the Enid formation, which consists of red shales with thin lentils of red and gray sands. The surface is gently rolling, the maximum relief being about 100-150 feet.

The drainage of the greater part of the county is south through tributaries of Cimarron River. The northeastern portion is drained by tributaries of Arkansas River. The rainfall is moderate, averaging about 30 inches per year. Timber occurs only along the streams.

INDUSTRIES.

The soils are residual from the Enid formation and are, in general, sandy clay soils of great fertility. Wheat is easily the leading crop, but corn, alfalfa, and the sorghums are of importance. Much live stock is raised, and many fine herds of pure-bred cattle and hogs are owned in the county.

The red clays of the Enid formation furnish the only mineral resources. They are manufactured into brick at Enid. Several attempts have been made to secure oil and gas, and oil has recently been found about midway between Garber and Covington, in the eastern part of the county.

TRANSPORTATION.

The county is well provided with railroads. Lines of the St. Louis & San Francisco; Chicago, Rock Island & Pacific; and Atchison, Topeka & Santa Fe railways radiate in all directions from Enid. The country roads are fair where they receive any attention.

POPULATION.

The present estimated population is 37,000, an average of about 34 per square mile. Enid (18,600), the county seat, is at the intersection of the railroad lines mentioned above. It is an important wholesale center and distributing point, and has some small manufacturing industries. The State School for the Feeble Minded and Phillips University are located here. Bison (400), Waukomis (533), Fairmont (215), Covington (183), Hayward (150), Breckenridge (176), Garber (382), Hunter (34), Drummond (450), Kremlin (253), Carrier (315, and Hillsdale (150) are railroad villages.

GRADY COUNTY.

LOCATION AND EXTENT.

Grady County lies just southwest of the center of the State. It has an area of approximately 1,100 square miles.

GEOGRAPHY AND GEOLOGY.

This county lies entirely in the Permian Redbeds and in the Redbeds Plains physiographic region. The bed rocks are all soft red shales with some soft sandstones. The shales are generally sandy. The only hard rock in the county is in a narrow belt of very hard sandstone extending northwest-southeast past Ninnekah. It seems to be the filling of an old stream channel since it has a great extent from northwest to southeast, but does not seem to pass back under the hills to the west. The surface of the county is rolling to hilly. The southern and eastern portions are, in general, rougher than the northern and western parts.

The drainage of the county is into Washita River, which crosses the county in a general southeasterly course. The principal tributaries are Little Washita River, Rush, Roaring, Salt, Bitter, and Winter creeks. The rainfall is moderate, averaging about 30 inches annually. The greater portion of the county is prairie, but there are some extensive tracts in the southern and southeastern portions which are covered by a growth of black-jack oak.

INDUSTRIES.

Agriculture is by far the most important industry. Corn is probably the prinicpal crop, although considerable production of cotton and wheat is made. Sorghums and alfalfa also receive considerable attention. Live stock raising is carried on principally in connection with farming, although there are some large pastures in the rougher parts of the county. No mineral industries have been developed. Attempts to find oil and gas have been made but without success.

TRANSPORTATION.

The county is well supplied with railroads. The main line and two branches of the Chicago, Rock Island & Pacific Railway, the Oklahoma City-Quanah line of the St. Louis & San Francisco Railroad, and the Oklahoma Central radiate in all directions from the center of the county. The country roads are fairly good where they are worked, but for the most part little attention is paid to them.

POPULATION.

The county is rather thickly settled, having an estimated population at this time of 33,000, giving an average density of 32 per square mile. Chickasha (13,447), the county seat and principal town, is located at the junction of the railroads mentioned, and is on the Washita River. The Oklahoma College for Women is located here. Rush Springs (850), Ninnekah (200), Bradley (150), Alex (225), Tuttle (800), Pocasset (250), Minco (750), and Verden (550) are small villages and trading points along the railroads.

GRANT COUNTY.

LOCATION AND EXTENT.

Grant County lies along the Kansas line, just west of the middle of the State. The area of the county is about 1,000 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Permian Redbeds and is underlaid by sandy red shales and sandstone of the Enid formation. The surface is level to rolling. The relief is very slight, probably not over 100 to 150 feet.

The drainage is into Arkansas River, which crosses the southern part of the county from west to east. The prinicpal tributaries are Crooked, Cottonwood, Thompson, Sand, and Cold Water creeks. The county is prairie, except for narrow belts of timber along the streams. The rainfall averages about 25 inches annually.

INDUSTRIES.

Agriculture is the leading industry. The shales of the Enid formation weather rapidly and give a deep, fertile, sandy, loam soil. Wheat and corn are the leading crops. Alfalfa is raised extensively, as are also the different sorghums. Stock-raising is carried on in connection with farming. There are no manufacturing or mineral industries.

TRANSPORTATION.

The main line of the Chicago, Rock Island & Pacific Railway crosses the county in a north-south direction, and the Blackwell-Wellington branch of the Atchison, Topeka & Santa Fe Railway in a northeast-southwest direction. The Guthrie-Kiowa branch of the Atchison, Topeka & Santa Fe Railway crosses the extreme southwestern part of the county, and the Wichita-Enid branch of the St. Louis & San Francisco Railroad crosses the extreme southeastern part. The country roads are

all on section lines and are fairly good, sandy clay roads. With a small amount of attention they could be kept in good condition.

POPULATION.

The county is fairly well populated. Its present estimated population is 20,000, an average density of about 20 per square mile. Pond Creek (1,113), on the Chicago, Rock Island & Pacific Railway, and Medford (1,250), at the junction of the Chicago, Rock Island & Pacific, and Atchison, Topeka & Santa Fe railways are the largest towns in the county. Nash (350), Renfrow (250), Manchester (275), Wakita (425), and Lamont (650) are the principal railroad towns.

GREER COUNTY.

LOCATION AND EXTENT.

Greer County is located in the southwestern portion of the State. Formerly included in Greer County was what now forms all of Greer, Harmon, Jackson, and part of Beckham counties. The county as it now stands has an area of about 640 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the Permian Redbeds geologic region and is underlaid by the rocks of the Greer formation. These consist of red shales with some sandstones and at least five ledges of gypsum. The gypsum ledges form pronounced escarpments along most of the streams of the county. In the east-central part of the county are the westernmost granite peaks of the Wichita granite mountains. Physiographically the region lies in the Gypsum Hills region. The surface is rolling to hilly. The streams have cut rather deep channels through the gypsums, but the ridges between them are broad and flat-topped with little relief.

North Fork of Red River forms the eastern boundary of the county. The drainage of the central portion is into North Fork through Elm Fork and its tributaries, of which the principal ones are Haystack, Deer, and Fish creeks. The southern part of the county is drained south into Red River through Salt Fork. The rainfall is rather light, averaging about 22 or 23 inches annually. The county is prairie, except for a small growth of timber along some of the streams.

INDUSTRIES.

The entire county is devoted to agriculture. Cotton is the leading crop, but wheat is also of considerable importance. Corn is not depended upon so greatly as it is farther east, and the sorghums, kafir, and milo are the principal dependents for the feed crops. Considerable areas are in pasture.

The granite of Headquarters Mountain has been quarried with success at the town of Granite. The red shales of the Greer formation are made into brick at Mangum.

TRANSPORTATION.

The Wichita Falls & Northwestern division of the Missouri, Kansas & Texas Railway crosses the county in a north-south direction, and the Chickasha-Mangum branch extends eastward from Mangum. The country roads receive little attention, and in the western part of the county they are merely trails through the gypsum hills. Most of them are laid out on section lines.

POPULATION.

The county is rather sparsely settled. The present estimated population is 17,000, giving an average density of 26 per square mile. Mangum (5,000) is the county seat and only large town. Granite (1,350), Willow (150), and Hester (50) are the leading villages on the railroads. There are several small country post offices and trading points.

HARMON COUNTY.

LOCATION AND EXTENT.

Harmon County lies in the extreme southwestern portion of the State. It was formed from the western portion of old Greer County. It has an area of 565 square miles.

GEOGRAPHY AND GEOLOGY.

Like Greer County, Harmon County lies entirely in the Gypsum Hills region, and is underlaid by the rocks of the Greer formation. The gypsums are much less regular than in Greer County, and except in the extreme northern townships of the county, do not form continuous escarpments. The surface produced by them is rolling to low, rounded hills. There are several areas of sand hills in the southern part of the county.

Red River forms a portion of the southern boundary of the county, and the drainage is into this stream through Elm Fork, Salt Fork, Deep Red Run, and Lebos creeks. Rainfall is light, averaging about 22 inches annually. Timber is found only along the streams.

INDUSTRIES.

Agriculture is the important industry, with cotton and wheat the important staple crops. The sorghums are raised largely. Corn is not dependable on account of the light rainfall. Alfalfa is an important hay crop.

The county is without mineral resources, except gypsum, which has not been utilized. An important bed of gypsite or dirt gypsum is known in the southern part of the county, but no attempt has been made to use it for plaster as yet.

TRANSPORTATION.

The county has only one line of railway. The Wichita Falls & Northwestern crosses the southern part in an east-west direction. The

country roads are of a type common to the Gypsum Hills region. They are fairly good where they receive anything like the proper amount of attention.

POPULATION.

The population is rather sparse. It has an estimated population at present of 16,000, an average of 29 per square mile. Hollis (1,150) is the county seat and largest town. Gould (250) is a small railroad village, and Vinson (200) is the largest country town and trading point for the northern part of the county.

HARPER COUNTY.

LOCATION AND EXTENT.

Harper County is located in the northwestern portion of the State, and has an area of about 1,075 square miles.

GEOGRAPHY AND GEOLOGY.

Harper County lies principally in the Permian Redbeds area, but has some portions covered by Cretaceous and Tertiary rocks. Physiographically it lies principally in the High Plains region. The surface is a high plain broken by steep-sided canyons. The ridges between the canyons are broad and flat-topped.

The drainage of the northeastern part of the county is east into Cimarron River, principally through Buffalo Creek. The southwestern part is drained to the southeast through North Canadian River. The rainfall is light, averaging little more than 20 inches annually. The only timber is a few elms and cottonwoods along the streams.

INDUSTRIES.

Agriculture is the principal industry. Wheat is probably the leading grain crop, and the sorghums, kafir, and milo are depended upon almost entirely for feed. Corn, while it does well some seasons, cannot be depended upon on account of the light rainfall. Large areas are in pasture. There are no mineral or manufacturing industries.

TRANSPORTATION.

The Wichita Falls & Northwestern Railway crosses the southwestern part of the county. The country roads receive little or no attention, but on account of the light rainfall they are generally in passable condition.

POPULATION.

The population is sparse. The present estimated population is 12,000, an average of 12 per square mile. There are no large towns in the county, but several country post offices and trading points. Buffalo, the county seat, has a population of 600. Murray, Laverne, and May are stations and small villages on the Wichita Falls & Northwestern Railway.

HASKELL COUNTY.

LOCATION AND EXTENT.

Haskell County is situated in east-central Oklahoma, about the middle of the State north to south, and in the second tier of counties west from the Arkansas line. It has an area of approximately 615 square miles.

GEOGRAPHY AND GEOLOGY.

The county is within the region of Pennsylvanian rocks, and is underlaid by a thick series of sandstones and shales which have been thrown into a series of folds trending northeast-southwest. Physiographically the county lies in the Arkansas Valley region. The surface is rough. The thick sandstone ridges dipping at fairly low angles form pronounced ranges of hills, some of which are locally called mountains.

The drainage is into Arkansas River, which forms the northeast boundary. Canadian River forms the northwest boundary for several miles, and the southern portion of the county is drained into the Arkansas through Sansbois Creek. The rainfall is rather heavy, averaging about 40 inches per year. The greater part of the county is timbered.

INDUSTRIES.

Agriculture is an important industry, but much of the surface is too rough to be devoted to farming. The stream valleys, and especially the valleys of Canadian and Arkansas rivers, contain many square miles of extremely fertile soil on which cotton is the leading crop. Rougher portions of the county are mostly in pasture.

Important beds of coal occur in the Pennsylvanian rocks and have been mined extensively at McCurtain, in the southern part of the county. Coal has been mined, but to a much less extent, at Stigler. Several wells have been drilled in search of oil and gas, but so far only small quantities of gas have been found. It does not seem probable that important deposits of oil will be found in the county.

TRANSPORTATION.

The Ft. Smith & Western and Midland Valley railroads both cross the county in a general east-west direction. The country roads are on section lines only in the smoother portions. The roads in the rougher portions, in general, follow the topography, and are almost impassable trails through the hills.

POPULATION.

On account of the mining industry the county has a considerable population, but large areas of the rougher part are very sparsely settled. The present estimated population is 20,500, giving an average density of 30 per square mile. Stigler (1,700) is the county seat and principal town. McCurtain (700) is an important mining town on the Ft. Smith & Western Railroad in the southern part of the county. Keota (150)

is the principal trading point for the eastern part of the county. Small villages have grown up around some of the country post offices, such as Tamaha, Whitefield, and Enterprise.

HUGHES COUNTY.

LOCATION AND EXTENT.

Hughes County lies southeast of the center of the State. It has an area of 850 square miles.

GEOGRAPHY AND GEOLOGY.

The surface rocks are sandstones and shales of Pennsylvanian age. Physiographically the county lies in the Sandstone Hills region. Alternating sandstones and shales which dip northwestward at low angles produce a broken topography with pronounced ranges of sandstone hills extending in a general northeast-southwest direction separated by broad, flat valleys which are underlaid by shale.

Canadian River crosses the central part of the county from west to east. North Canadian touches the extreme northern portion. The drainage is into these streams through small tributaries. The rainfall is fairly heavy, averaging between 35 and 40 inches per year. The sandstone ridges are generally timbered, while most of the shale valleys are prairie.

INDUSTRIES.

Agriculture is the principal industry. The leveler portions of the county produce fairly good crops of corn and cotton. The hillier land is devoted almost entirely to pasture. Several attempts have been made to secure oil and gas, and some oil has been reported from near Holdenville. However, up to the present, no production has been secured.

TRANSPORTATION.

The Missouri, Oklahoma & Gulf, and a main line of the St. Louis & San Francisco Railroad cross the county in a general northeast-southwest direction; the Chicago, Rock Island & Pacific Railway from east to west, and the Ft. Smith & Western crosses the northeastern part. The country roads are in general very poor.

POPULATION.

The county is fairly thickly settled. The present estimated population is 25,500, an average density of 30 per square mile. Holdenville (3,000), at the crossing of the Chicago, Rock Island & Pacific and the St. Louis & San Francisco railways, is the county seat and largest town. Calvin (600), Stuart (350), Lamar (250), Dustin (600), and Wetumka (1,200) are the other railroad towns and villages.

JACKSON COUNTY.

LOCATION AND EXTENT.

Jackson County lies in the extreme southwestern part of Oklahoma and was formed from a part of old Greer County. The county has an area of approximately 810 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the area of the outcrop of the Greer formation of the Permian Redbeds and is entirely in the Gypsum Hills region. A few isolated peaks of granite of the Wichita Mountains occur in the northeastern part of the county. There are extensive areas of sand hills in the southern and southeastern portions. In general, the bed rocks consist of red shales with some sandstones and important ledges of gypsum. All these weather easily, giving a deep, productive soil. One ledge of dolomite is present in the county and near Creta attains a workable thickness. The surface is level to rolling and has a gentle slope to the south. The county is drained into Red River, which forms the southern boundary, through Deep Red Run and Gypsum creeks. North Fork of Red River forms the eastern boundary and receives the drainage of the extreme eastern part of the county. The rainfall is rather light, averaging less than 25 inches per year. Timber occurs only along the streams.

INDUSTRIES.

Agriculture is the principal industry, and cotton and wheat the leading crops. Corn, kafir, and milo maize form the principal feed crops. The only mineral resource which has been utilized is the gypsite which is manufactured into plaster at Eldorado. The county contains some of the largest beds of gypsite in the State, and enough of the material is in sight to support the plaster industry for a long time. Some salt springs near Eldorado might possibly be used for the production of salt.

TRANSPORTATION.

The St. Louis & San Francisco, the Kansas City, Mexico & Orient, and the Wichita Falls & Northwestern railways radiate from the center of the county. The country roads are generally fair, but in the hillier parts of the county are not properly kept up.

POPULATION.

The population is fairly thick. The present estimated population is 24,250, an average density of 31 per square mile. Altus (6,200), the county seat, is located at the intersection of the three railroads. Eldorado (926), Olustee (850), Headrick (270), Elmer (350), Martha (250), Blair (508), and Duke (400) are the principal towns and villages.

JEFFERSON COUNTY.

LOCATION AND EXTENT.

Jefferson County lies along Red River in the central-southern part of the State. The area is approximately 767 square miles.

GEOGRAPHY AND GEOLOGY.

The surface rocks are principally sandstone and shales of the basal portions of the Redbeds. Some of the rocks in the northeastern portion of the county are non-red. There are considerable areas of sand in the southern part. The surface is level to hilly, the relief increasing toward the northeastern part of the county, which is quite hilly. The drainage of the county is south into Red River, principally through Mud and Beaver creeks and their tributaries. The rainfall is moderate, averaging about 30 inches per year.

INDUSTRIES.

Agriculture is the leading industry, with cotton the leading crop. All the other staple crops, however, are raised in considerable quantities. Stock-raising is conducted principally in connection with farming, although there are considerable areas of pasture.

The extreme western portion of the Healdton oil field reaches into Jefferson County, and several attempts have been made to secure oil or gas in other parts of the county, but without success.

TRANSPORTATION.

The main line of the Chicago, Rock Island & Pacific Railway crosses the county in a north-south direction, with a branch northwestward from Waurika. The Oklahoma, New Mexico & Pacific Railway penetrates the eastern part of the county at Ringling. The country roads are fairly good except in the hillier parts of the county.

POPULATION.

The county is fairly well populated, the present estimated population being 20,000. an average density of about 26 per square mile. Waurika (3,500) is the county seat and principal town. Terral (600), Ryan (1,250), Addington (500), Ringling (1,500), and Hastings (750) are other small railroad towns.

JOHNSTON COUNTY.

LOCATION AND EXTENT.

Johnston County lies in the south-central portion of the State. It has an area of approximately 658 square miles.

GEOGRAPHY AND GEOLOGY.

The greater part of the county lies in the Arbuckle Mountain geologic and physiographic region. The extreme southern portion is underlaid by Trinity sand of Lower Cretaceous age and belongs to the Red River

region. The surface is, in general, quite rough, especially in the northern or Arbuckle Mountain portion of the county.

The drainage is to the south, principally into Washita River, which crosses the southwestern portion of the county. Its principal tributaries in the county are Mill and Pennington creeks. The eastern part of the county is drained into Red River through Blue River. The rainfall is fairly heavy, averaging about 35 inches annually. Timber covers most of the county, although there are some considerable areas of prairie land.

INDUSTRIES.

Johnston County does not rank high as an agricultural county on account of the rough surface and thinness of the soil over many of the hard formations of the Arbuckle Mountain region. However, there are considerable areas of very fertile soil. Cotton is the leading crop and large quantities of corn and other forage crops are produced.

The formations of the Arbuckle Mountains furnish an inexhaustible supply of building stone and road materials. Granite has been quarried at Tishomingo, Ravia, Troy, and Mill Creek, but no where on a large scale. The granite used in the State Capitol building was quarried at Troy. A good grade of oolite limestone greatly resembling Bedford limestone of Indiana has been quarried at Bromide, in the northeastern portion of the county. Gold has been reported from the county at various times, but, so far, no production has been made and it seems highly improbable that commercial deposits of any of the precious metals are to be found. Manganese is known to occur near Bromide and may be found to be of commercial importance. Oil and gas probably do not occur in the county in commercial quantities.

TRANSPORTATION.

The main line of the St. Louis & San Francisco Railway crosses the western part of the county in a north-south direction, and the main line of the Chicago, Rock Island & Pacific Railway crosses the southern part in an east-west direction. The Missouri, Oklahoma & Gulf touches the eastern side of the county. The country roads, in general, receive very little attention and are in poor condition. In the hillier parts of the county there are almost no roads.

POPULATION.

The population is rather sparse. The total population as estimated at this time is 17,000, an average of 24 per square mile. Tishomingo (1,500) is the county seat and principal town. Ravia (600), Troy (35), Mill Creek (700), Milburn (500), and Wapanucka (1,100) are small railroad towns.

KAY COUNTY.

LOCATION AND EXTENT.

Kay County is situated along the Kansas line, about the middle of the State. It has an area of approximately 970 square miles.

GEOGRAPHY AND GEOLOGY.

Geologically, Kay County lies in the area of Permian rocks, but principally in the region in which these rocks are not red. The geologic sections consist of alternating limestones and shales. In the eastern part of the county limestones are abundant, but in the western part, the outcrop of the upper part of the section, the rocks are almost entirely blue and gray shales, grading into red to the south and southwest. Physiographically the county is placed in the Redbeds Plains region, although the rocks are mostly non-red. The surface of Kay County is level to hilly. The relief decreases across the county from east to west.

Arkansas River forms the eastern boundary of the county and receives directly the drainage of a narrow belt along the eastern side. Salt Fork of Arkansas River crosses the southern portion of the county in a general easterly direction and drains almost the entire county through Bois d' Arc and Thompson creeks and Chickasha River with its tributaries Buck and Bitter creeks. The rainfall averages about 32 inches annually. The county is generally prairie with timber along the streams and in some areas in the eastern part.

INDUSTRIES.

Agriculture is the leading industry, all of the staple crops except cotton being produced in large quantities. The county is well known as a stock-raising section, but stock-raising is conducted principally in connection with farming. There are few large pastures.

The Ponca City, Newkirk, and Blackwell oil and gas fields are situated in this county. These have made large productions of gas and of high grade refining oil. On account of the gas, several factories have been located at Ponca City and Blackwell. The blue shale has been manufactured into brick at Blackwell. Limestone has been quarried in a small way near Ponca City.

TRANSPORTATION.

The county is well supplied with railroads. The main line of the Atchison, Topeka & Santa Fe crosses the eastern part in a north-south direction, with a branch to the southeast from Newkirk, and one to the west and northwest from Ponca City. Another branch of the Atchison, Topeka & Santa Fe crosses the one just mentioned, in a north-south direction at Blackwell. The Vernon branch of the St. Louis & San Francisco Railroad crosses the northwestern portion of the county.

The country roads are generally fairly good, except in the rougher parts of the county. Practically all the section lines are opened as roads.

The harder limestones in the eastern part of the county will furnish abundant material for the making of macadam roads.

POPULATION.

Ponca City (3,000), Blackwell (5,000), and Newkirk (2,500) are the three largest towns. All of them are centers for the development of the oil and gas fields. Newkirk is the county seat. Among the smaller towns and villages are Whiteagle (25), Kaw City (600), Uncas (75), Peckham (400), Braman (500), and Tonkawa (1,800). Tonkawa was the seat of the University Preparatory School until July, 1917, when it was discontinued. A government school for Indians is located on a large reservation at Chilocco.

KINGFISHER COUNTY.

LOCATION AND EXTENT.

Kingfisher County is located just northwest of the center of the State. It has an area of approximately 900 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Permian Redbeds region. All the bed rocks belong to the Enid formation, consisting of soft red shales with some sandstones. The surface is rolling, with moderate relief.

The drainage is into Cimarron River, which crosses the county from northwest to southeast. The principal tributaries are Turkey, Cooper, Kingfisher, Campbell, and Ephriam creeks. The rainfall is moderate, averaging about 30 inches annually. Timber occurs only along the streams.

INDUSTRIES.

Kingfisher is exclusively an agricultural county. The principal crops are corn and wheat. Cotton is raised only to a small extent. A large acreage of alfalfa is grown, and the sorghums are used extensively for forage crops. Stock-raising is conducted principally in connection with farming, although there are some considerable pastures. There are no mineral or manufacturing industries.

TRANSPORTATION.

The main line of the Chicago, Rock Island & Pacific Railway crosses the county from north to south, with a branch extending eastward from Kingfisher. The country roads are generally fair, where they receive any attention. The sandy clay soil produced by weathering of the Enid formation makes a road bed which is satisfactory for the greater part of the year, when properly graded.

POPULATION.

The county is well populated, the present estimated population being 20,000, an average of about 22 per square mile. Kingfisher (3,000) is the county seat and principal town. It is the seat of Kingfisher College,

which is supported by the Presbyterian Church. Cashion (300), Reeding (125), Dover (300), and Hennessey (1,800) are railroad towns in the county.

KIOWA COUNTY.

LOCATION AND EXTENT.

Kiowa County is situated in the southwestern part of the State. It has an area of approximately 1,175 square miles.

GEOGRAPHY AND GEOLOGY.

This county is underlaid principally by Redbeds rocks, but considerable areas in the southern and southeastern portions are in the Wichita Mountains, and consist of peaks of granite and related rocks which protrude through the level-lying Redbeds. Physiographically the county lies in the Wichita Mountains and Gypsum Hills region. The surface, except for the peaks of granite, is nearly level, the streams having made only slight indentures into the general surface of the plain.

The drainage of the greater part of the county is into North Fork of Red River, which forms the western boundary. The northeastern part of the county is drained into Washita River, which touches the northeastern part of the county. The rainfall is rather light, averaging about 25 inches per year. Timber occurs only along the streams.

INDUSTRIES.

Agriculture is the important industry. Wheat and cotton are grown in all parts of the county. Corn does well in wet seasons but cannot be depended upon on account of the light average rainfall. The sorghums are grown largely for forage crops. Some oil and gas have been found at Gotebo, in the northeastern part of the county, and drilling has been done in other parts of the county, but without success.

TRANSPORTATION.

The Vernon branch of the St. Louis & San Francisco Railroad crosses the county in a north-south direction and the Quanah branch in a east-west direction, crossing at Snyder, and the Mangum branch of the Chicago, Rock Island & Pacific in an east-west direction. The Kansas City, Mexico & Orient crosses the northwestern part of the county.

Country roads are generally fair. Practically all of the section lines, except in the Wichita Mountain region, have been opened as roads. Granite in the peaks of the Wichita Mountains furnishes an inexhaustible supply of building and road material.

POPULATION.

The county is fairly well settled, the estimated population being 28,500, an average density of 26 per square mile. Hobart (4,500) is the county seat and principal town. It is located at the junction of the Chicago, Rock Island & Pacific and the St. Louis & San Francisco railways. Snyder (1,250), Mountain Park (500), Roosevelt (300), Mountain View (1,000), Lone Wolf (700), and Lugert (150) are other railroad towns and villages in the county.

LATIMER COUNTY.

LOCATION AND EXTENT.

Latimer County is situated in the east-central part of the State. It has an area of approximately 735 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies principally in the Arkansas Valley physiographic region and in the area of Pennsylvanian rocks. The southeastern part lies in the Ouachita Mountain region. In the northern part the rocks consist of alternating sandstones and shales of considerable thickness. These are folded into rather steep folds so that the sandstones produce ranges of rugged hills having a general northeast-southwest drainage separated by valleys underlaid by shale. In the southern part of the county the rocks are of similar nature, although of different age, and the folds are much steeper and the surface much rougher.

The drainage of the northeastern part of the county is east through Fourche Maline into Poteau River; of the southern part the drainage is into Kiamichi River through several small tributaries; and of the southwestern part the drainage is into Canadian River through Gaines Creek and its tributaries. The rainfall is rather heavy, averaging about 40 inches annually. In general, the hills are covered with timber, while the greater part of the shale valleys are prairie land.

INDUSTRIES.

Agriculture receives considerable attention in Latimer County, although it cannot be said to be a strictly agricultural county. Corn and cotton are the leading crops. Very little wheat is raised. Large areas, especially in the southern part of the county, are in pasture. The northern portion of the county lies in the coal region. Several mines are in operation near Wilburton, Redoak, and Hughes.

TRANSPORTATION.

The main line of the Chicago, Rock Island & Pacific Railway crosses the county from east to west, and a branch of the Missouri, Kansas & Texas Railway extends from the western part of the county to Wilburton.

POPULATION.

Wilburton (2,600) is the county seat and is also one of the principal mining towns of the State. The Oklahoma School of Mines was located at this place until July, 1917, when it was discontinued. Red Oak (500), Degnan (.....), and Hughes (300) are also mining towns. The population is rather dense on account of the mining industry. Large areas, especially in the southern part of the county, are very thinly settled.

The present estimated population is 13,200, an average density of 19 per square mile.

LE FLORE COUNTY.

LOCATION AND EXTENT.

Leflore County is situated in the extreme east-central part of the State. It is one of the largest counties of the State, having an area of approximately 1,614 square miles.

GEOGRAPHY AND GEOLOGY.

The northern portion of the county lies in the Arkansas Valley geologic and physiographic provinces, and the southern portion in the Ouachita Mountains. The nature of the rocks and surface is entirely similar to those in Latimer County, which have just been described. The southern portion of the county is especially rough, some of the hills ranging almost to the dimensions of mountains and being so designated locally. Winding Stair, Kiamichi, and Jackfork mountains lie in the southern part of the county.

The drainage is principally into Arkansas River, which forms the northern boundary. Poteau River, a large tributary of the Arkansas, lies almost entirely in this county and has many small tributaries. The southern part of the county is drained into Kiamichi River, which flows to the westward in this part of its course. The southern row of townships is drained south into Little River through the headwaters of Glover Creek and Mountain Fork River. The rainfall is heavy, averaging over 40 inches per year.

INDUSTRIES.

Farming is carried on extensively in the valleys in the northern part. The sandstone hills in the northern part, and practically all the lands in the southern part, are too rough for farming, and are devoted to pasture.

Coal is found in the northern part and is mined at several places, including Fanshawe, Howe, Wister, Poteau, Panama, and Bokoshe. Gas has been produced for some years near Poteau. So far, the largest wells have a daily capacity of about 5,000,000 cubic feet.

TRANSPORTATION.

The main line of the St. Louis & San Francisco Railroad crosses the county in a northeast-southwest direction; and the Chicago, Rock Island & Pacific from east to west; the Kansas City Southern crosses the northeastern part of the county; and the Ft. Smith & Western and the Midland Valley railways cross the northern part of the county from west to east.

POPULATION.

Poteau (2,500) is the county seat and principal town and is located at the junction of the St. Louis & San Francisco and the Kansas City Southern railways. Page (75), Thomasville (200), Heavener (800), Howe (600), Wister (500), Bokoshe (500), Spiro (1,200), Panama (350), and Cameron (210) are other railroad towns. Several smaller towns in the county are supported by the coal mining industry. The population is fairly dense in the northern part of the county, but very sparse in the southern part. The present estimated population is 40,263, an average density of about 24 per square mile.

LINCOLN COUNTY.

LOCATION AND EXTENT.

Lincoln County is situated just northeast of the center of the State. It has an area of approximately 990 square miles.

GEOGRAPHY AND GEOLOGY.

The county is situated near the boundary between the red and non-red Pennsylvanian rocks. In the eastern part the rocks are principally non-red, but toward the west the proportion of the red rocks increases rapidly. For convenience the county may all be placed in the Sandstone Hills region, although the western part merges into the Redbeds Plains. The surface is rolling to hilly, the eastern part being rough with the relief decreasing toward the west.

The drainage is to the east through Deep Fork of Canadian River, which flows eastward across the middle of the county. The principal tributaries are Dry Fork from the north, and Quapaw Creek from the south. The county has moderate rainfall, averaging about 35 inches annually. Considerable areas in the eastern portion of the county are timbered, but the western part is largely prairie.

INDUSTRIES.

Lincoln County is almost exclusively an agricultural county. Corn and wheat are the principal crops, with considerable cotton. Alfalfa does very well, especially in the stream valleys. Stock-raising is carried on extensively in connection with farming, and there are some large pastures.

Many attempts have been made to secure oil and gas in the county, but so far, with little success. The indications are that in time oil and gas will be found in paying quantities in the county. The southern end of the Cushing pool borders the county, as does also the small development near Paden. Recently (in the spring of 1916) a well was drilled near Stroud, which produced considerable quantities of gas and salt water. Red clay shale has been manufactured into brick near Chandler.

TRANSPORTATION.

The county is well provided with railroads, the lines of the Atchison, Topeka & Santa Fe, Ft. Smith & Western, St. Louis & San Francisco, Chicago, Rock Island & Pacific, and the Missouri, Kansas & Texas railways giving connections in all directions.

POPULATION.

The population is fairly dense. The present estimated population is 36,000, an average density of about 39 per square mile. Chandler (2,250) is the county seat and principal town. Meeker (400), Prague (1,100), Davenport (400), Stroud (1,250), Kendrick (200), Agra (400), Tryon (200), Warwick (100), Wellston (600), and Fallis (250) are the important railroad towns.

LOGAN COUNTY.

LOCATION AND EXTENT.

Logan County is situated just north of the center of the State, and forms a portion of the west boundary of Lincoln County, which has just been described. It has an area of approximately 740 square miles.

GEOGRAPHY AND GEOLOGY.

The general conditions in Logan County are very similar to those in Lincoln County, except that the rocks belong almost entirely to the Redbeds series. The eastern part of the county is largely timbered sandstone hills, although there are considerable areas of level land with deep, fertile soil. The amount of prairie increases to the west.

INDUSTRIES.

Like Lincoln County, Logan is an agricultural county. Corn and wheat are the principal crops. Large quantities of feed stuffs are raised, and a considerable amount of cotton. Stock-raising is carried on in connection with farming.

TRANSPORTATION.

The county is well supplied with railroads. The Atchison, Topeka & Santa Fe; Missouri, Kansas & Texas; Ft. Smith & Western; and Chicago, Rock Island & Pacific railways radiate in all directions from Guthrie, the county seat.

POPULATION.

Logan County is well settled. The present estimated population is 32,000, an average density of 44 per square mile. Guthrie (12,035) is the principal city. It is becoming known on account of its mineral waters and baths. Waterloo (100), Seward (160), Nevina (.....), Crescent (900), Lovell (225), Marshall (500), Orlando (350), Mulhall (500), and Meridian (200) are the more important railroad towns and villages in the county.

LOVE COUNTY.

LOCATION AND EXTENT.

Love County lies along Red River in the extreme south-central part of the State. It has an area of approximately 520 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies principally in the area of the Lower Cretaceous rocks. The greater part is underlaid by Trinity sand, with a comparatively small area of Redbeds in the northwestern part of the county, and of the Cretaceous limestone in the southeastern part. The surface is rolling to hilly. The limestone and Redbeds areas are principally prairie, but the most of the Trinity sand area is timbered by a scrubby tree growth, principally of black-jack.

The drainage is south into Red River, which forms the southern boundary. The principal tributaries are Mud Creek, which forms a part of the western boundary, Simon Creek, Walnut Bayou, Rock, and Hickory creeks. The rainfall is moderate, averaging about 35 inches.

INDUSTRIES.

Love county is chiefly an agricultural area. The soils on the limestones in the southeastern part of the county are very fertile, although in many places they are too thin and stony to be good farming land. The areas of thin soil are devoted to pasture. The Trinity sand area which covers most of the county has an extremely sandy soil. In the valleys and swales, this soil has sufficient humus to make it productive. On the slopes and hill tops the soil is poor and is easily exhausted, and after it has been farmed a few seasons it blows very badly. Cotton is probably the leading crop, although corn is raised in all parts of the county. Little wheat is raised.

Several wells have been drilled in Love County in search of oil and gas, but so far, no important strikes have been made. The county is in generally favorable territory, although it is impossible to say that oil or gas will be found.

TRANSPORTATION.

Love County has only one railroad, the main line of the Gulf, Colorado & Santa Fe, which crosses the county in a north-south direction. The country roads are rather poor. Transportation is especially difficult over the sandy roads in the Trinity sand regions in dry weather, and over the black clay roads of the limestone region in wet weather.

POPULATION.

The county is fairly well settled. The population as now estimated is 13,000, an average density of about 26 per square mile. Marietta (1,650) is the county seat and principal town. Thackerville (100) and Overbrook (25) are villages on the Gulf, Colorado & Santa Fe Railway. Burneyville (100), Leon (200), and Orr (250) are country villages and trading points in the western part of the county.

MAJOR COUNTY.

LOCATION AND EXTENT.

Major County lies in the northwestern part of Oklahoma and has an area of approximately 990 square miles.

GEOGRAPHY AND GEOLOGY.

The eastern part of the county is underlaid by the rocks of the Enid formation, and belongs to the Redbeds Plains region, while the western part of the county belongs to the Gypsum Hills region. The surface of the county is level to hilly, the eastern part, or the outcrop of the Enid formation, being very flat, while the gypsum region in the western part has a surface of broad, flat-topped hills with narrow, steep-sided canyons.

The drainage is into Canadian River, which forms the northeastern boundary of the county for some distance, then enters the county and flows across the east half in a southeasterly direction. Its principal tributaries within this county are Eagle Chief, Indian, Hoyle, Deep, Gypsum, Cottonwood, Skull, Dry, and Ewers creeks. Rainfall is rather light, averaging about 25 inches per year. Timber is found only along the stream courses.

INDUSTRIES.

Major County is altogether an agricultural county. The level land of the eastern part of the county, and the broad, flat-topped regions in the western part have deep, fertile soils. Considerable areas in the western part are devoted to pastures on account of the light rainfall and comparatively rough surface.

There are no mining or mineral industries. The gypsum represents the only mineral resource of importance, and this has not been developed within the county. Chances for oil and gas are very poor, although it is possible that some structure may be found giving indications of where to drill in search of these substances.

TRANSPORTATION.

Railroad facilities are afforded by the Kansas City, Mexico & Orient, and the Alva division of the Chicago, Rock Island & Pacific Railway which cross the middle of the county in a north-south direction in a few miles of each other. The Enid-Anadarko branch of the Chicago, Rock Island & Pacific Railway crosses the eastern part of the county, and the Vernon branch of the St. Louis & San Francisco Railroad crosses the southeastern portion. The country roads receive little attention, but are generally in fairly good condition, owing to the sandy clay soil and the light rainfall.

POPULATION.

The county is fairly well populated, the present estimated population being 17,000, an average density of 18 per square mile. Fairview (2,300) is the county seat and principal town. Isabella (150), Ringwood (275), Rusk (25), Cleo (450), and Orion (25) are railroad towns in the county.

MARSHALL COUNTY.

LOCATION AND EXTENT.

Marshall County lies in the extreme south-central part of the State, and has an area of approximately 440 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the area of Lower Cretaceous rocks. The rocks are entirely those of the Lower Cretaceous system, which have a gentle dip to the south. Large areas in the northern part are underlaid by Trinity sand, and in the southern part by Woodbine sand. The greater part between these two belts is underlaid by thin limestones and shales which produce a very rich, black soil. The soil in the sandy regions is not so rich as that of the limestone regions, but is in general fairly good agricultural land. The surface is mostly rolling, with hills of some magnitude in the extreme southern and northern portions.

Red River forms the southern boundary of the county, and Washita River the eastern. Most of the northern portion is drained into the Washita through Glasses Creek, and the southern portion is drained directly into Red River through several small tributaries; Horse, Briar, Buncombe, and Rock creeks. The rainfall is fairly heavy, averaging about 35 to 40 inches per year.

Marshall County is one of the leading agricultural counties in southern Oklahoma. Cotton is the most important crop. Considerable areas in the southern part are devoted to pasture.

A small oil pool was developed at Madill several years ago, but has made only a small production. Gas has been found at Lark, in the extreme southern part of the county. Many other attempts have been made to find oil and gas, without success. The whole county must be considered in probable oil and gas territory.

TRANSPORTATION.

The main line of the St. Louis & San Francisco Railroad crosses the county in a general north-south, and the Hope-Ardmore branch in an east-west direction. The country roads receive little attention. The stiff clay of the limestone region is almost impassable in wet weather. There is sufficient limestone in the county to furnish an inexhaustible supply of material for roads, but no use has been made of it.

POPULATION.

Madill (3,500), at the junction of two lines of railroad, is the county seat and principal town. Oakland (400), Kingston (450), Woodville (400), and Aylesworth (75) are railroad villages. The present estimated population of the county is 13,000, an average density of 30 per square mile.

MAYES COUNTY.

LOCATION AND EXTENT.

Mayes County is situated in the northeastern part of Oklahoma and has an area of 684 square miles.

GEOGRAPHY AND GEOLOGY.

The eastern part of the county lies in the Ozark Mountain uplift, and is underlaid by the Boone chert and the rocks of the Chester group. The western portion is underlaid by the Cherokee shales of Pennsylvanian age and belongs to the Prairie Plains region. The surface is quite hilly east of Grand River, but generally level to the west.

Drainage is to the south through Grand River, which crosses the county in a general direction west of south. The principal tributaries in this county are Pryor Creek and its tributaries Choteau, Brushy, Spring, Salina, and Spavinaw creeks. The rainfall is fairly heavy, averaging nearly 40 inches annually. The chert hills portion of the county, that is, that part east of Grand River, is heavily timbered. The part west of Grand River is prairie, except for some low sandstone hills in the extreme western part of the county, and some timber along the streams.

INDUSTRIES

Agriculture is the only important industry of Mayes County. Much of the territory in the chert hills is too rough to be farmed. Over this territory hogs have free range and fatten on the mast. The flat tops of some of the ridges are farmed, as are also the narrow stream valleys. Cotton and corn are the principal crops. West of the river the flat shale lands are farmed to some extent, but are mostly left in the native grasses for pasture or for hay. The making of prairie hay is one of the leading agricultural enterprises and all towns along the railroad are great hay shipping points.

Several wells have been drilled in search of oil and gas, but the territory lies too far to the east to be productive. The principal producing sands of the fields farther west lie above those outcropping in Mayes County.

TRANSPORTATION.

The main line of the Missouri, Kansas & Texas, and the Missouri, Oklahoma & Gulf railroads cross the county in a general north-south direction.

The country roads are fairly good in the more level parts of the county. In the hillier regions they leave the section lines and are merely road ways over the flint hills. The flints of these hills will furnish an inexhaustible supply of material for macadamizing roads.

POPULATION.

The population is only fairly dense, the estimation at this time standing at 16,000, a density of about 23 per square mile. Pryor (2,000) is the county seat and largest town. Choteau (600), Adair (400), Locust Grove (200), Salina (150), Strang (_____), and Pensacola (100) are other important railroad villages.

McCLAIN COUNTY.

LOCATION AND EXTENT.

McClain County lies just south of the center of the State. It has an area of 562 square miles.

GEOGRAPHY AND GEOLOGY.

The entire county lies in the Permian Redbeds region, and for convenience may be considered as belonging in the Redbeds Plains physiographic province. The eastern extension of the county, however, is quite hilly and is underlaid by Redbeds containing a large proportion of sandstone. The surface is rolling to hilly, the hills dying away to the west.

Canadian River forms the northeastern boundary of the county and receives the drainage of the northern part through Walnut Creek. The southern part is drained into Washita River. The rainfall is moderate, averaging between 30 and 35 inches annually. The county is partially timbered, the greater part of the timber lying in the eastern extension of the county.

INDUSTRIES.

McClain County is altogether an agricultural county. Large areas of the hillier parts of the county are devoted to pasture. The stream valleys and flat-topped hills have fertile soil, which produces large quantities of corn and cotton, with lesser quantities of feed. There are no mining or manufacturing industries.

TRANSPORTATION.

Railroad facilities are afforded by the Atchison, Topeka & Santa Fe Railway which crosses the county in a north-south direction, and by the Oklahoma Central branch of the Atchison, Topeka & Santa Fe Railway, which crosses the county in a northwest-southeast direction.

POPULATION.

The county is fairly well settled, the population, as estimated at this time, being 20,982, an average density of about 37 per square mile. Purcell (3,400) is the county seat and principal town. Blanchard (700), Washington (250), Wayne (350), and Byars (500) are the most important railroad towns in the county.

McCURTAIN COUNTY.

LOCATION AND EXTENT.

McCurtain County occupies the extreme southeastern portion of the State. It is one of the largest counties in the State, having an area of 1,900 square miles.

GEOGRAPHY AND GEOLOGY.

The greater part of the county lies in the Ouachita Mountain geological and physiographic region. The southern portion belongs to the Lower Cretaceous area. In the Ouachita Mountain region the rocks consist of very thick sandstones and shales, which are very strongly folded, and in places overturned and faulted. The general structure is that of a large anticline extending northeast-southwest across the county. Very old rocks are brought up in the middle of this anticline with younger rocks on the flanks. These steeply folded rocks pass to the south under the nearly level-lying sands and clays of the Lower Cretaceous. The surface is extremely rough in the northern portion. The resistant sandstones produce ranges of high hills which are known as mountains. Williams and Pine mountains are the highest in this county. The wide belt along Red River is very nearly level.

The drainage is principally into Little River, which crosses the southern part of the county. All the important tributaries of this stream come from the north. Among them are Glover and Lukfata creeks and Mountain Fork. The extreme southern part is drained directly into Red River through several small tributaries. The rainfall is fairly heavy, averaging about 45 inches per year. Nearly the entire county was originally timbered. A large part of the timber was a fine growth of long leaf pine. This has been cut over the greater part of the county, but lumbering is still an important industry.

INDUSTRIES.

Only the southern part of the county is important as an agricultural region, the northern part being entirely too rough for successful farming, except in the narrow stream valleys. Even the flat areas in the northern portion are not farmed. The soil is derived from the shale and is an extremely tight, poorly drained soil, not well fitted for farming. Nearly all the northern portion is range pasture. The soils of the Cretaceous area in the southern part are deep, fertile soils and produce large crops of corn and cotton.

Several reports have been circulated as to the occurrence of lead and zinc in the Ouachita Mountains in McCurtain County. Some nodules of manganese are known to occur, and small quantities of lead and zinc, but so far, no production of either has been made. The indications are not favorable for the occurrence of quantities of minerals, although it is possible that some may be developed.

TRANSPORTATION.

Railroad transportation is afforded by the Hope-Ardmore branch of the St. Louis & San Francisco Railroad, which crosses the southern part of the county. The Texas, Oklahoma & Eastern Railroad extends from Valliant in the southwest corner of the county, eastward to Broken Bow.

Practically speaking, there are no roads in the northern part of the county, except mere trails through the wooded hills. In the southern part the roads receive more attention and are in better condition.

POPULATION.

The population is very sparse in the northern part, but thicker in the southern part. The county has now an estimated population of 25,000, an average density of 13 per square mile. Idabel (3,500) is the county seat and largest town. Bokhoma (100), Haworth (300), Broken Bow (2,000), Valliant (700), and Bismark (.....) are other railroad towns.

McINTOSH COUNTY.

LOCATION AND EXTENT.

McIntosh County lies in the east-central part of the State. It has an area of 740 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the region of Pennsylvanian rocks and in the Sandstone Hills physiographic province. The bed rocks consist of alternating sandstones and shales of Pennsylvanian age, which have a gentle dip to the north and west. This dip, with the slope of the county to the southeast, gives a stairstep topography with ledges of sandstone hills extending in a northwest-southeast direction and separated by valleys underlaid by the shale formations.

The drainage is into Canadian River, which forms the southern boundary of the county. North Canadian and Deep Fork unite near the central part of the county. The extreme southwestern portion of the county is drained directly into Canadian River through Mill Creek. The rainfall is fairly heavy, averaging between 35 and 40 inches per year. The sandstone hills are covered with timber, while the greater part of the shale valleys are prairie land.

INDUSTRIES.

McIntosh is primarily an agricultural county. The rougher part of the county is devoted largely to pasture, and considerable areas of the flat, shale lands are left to grow up in wild grass which is used either as pasture or for hay.

A large number of wells have been drilled in search of oil and gas, but oil has been found only in the extreme northwestern portion of the county. Considerable quantities of gas have been found farther to the southeast.

TRANSPORTATION.

The main line of the Missouri, Kansas & Texas Railway crosses the county in a north-south direction. The Ft. Smith & Western Railroad crosses the southwestern portion and the Missouri, Oklahoma &

Gulf the northwest portion of the county. Country roads are in general poor.

POPULATION.

The county is fairly well settled, the present estimated population being 26,000, an average density of 35 per square mile. Eufaula (3,000) is the county seat. Checotah (2,000), Rentiesville (500), Hitchita (75), Hanna (250), Hoffman (325), and Vernon are railroad towns and villages in the county.

MURRAY COUNTY.

LOCATION AND EXTENT.

Murray County lies in the south-central part of the State. It has an area of approximately 424 square miles.

GEOGRAPHY AND GEOLOGY.

The whole county is included within the Arbuckle Mountain region. The bed rocks consist of granites and a series of limestones, shales, and sandstones of lower Paleozoic age, with some beds of Pennsylvanian rocks in the outlying portions of the county. The surface is quite rough, due to the weathering of the hard and soft strata, which are steeply inclined. Some of the hills have an elevation of about 1,000 feet above their bases.

The drainage is into Washita River, which forms a portion of the western boundary and crosses the southern part of the county. The principal tributaries are Sandy, Rock, Honey, and Big creeks. Mill Creek drains a portion of the eastern part of the county. The rainfall is fairly heavy, averaging about 35 inches annually. In general, the valleys are timbered, while the hills are prairies.

Platte National Park, a government reservation, includes the mineral wells and springs in the vicinity of Sulphur.

INDUSTRIES.

Murray County is primarily an agricultural county, although the thinness of the soil and the rough surface make it not so desirable for farming. Some of the shale valleys between the high hills, and especially the large stream valleys, contain fertile soil. Most of the hilly land is very rocky and is given over to pasture.

Mining for zinc and other metals has been attempted in several parts of the county. Some zinc ore has been produced from mines a few miles west of Davis. The limestone of the Arbuckle Mountains is crushed for concrete rock and ballast south of Dougherty. In the eastern part of the county are several deposits of rock asphalt which have been utilized to considerable extent.

TRANSPORTATION.

The main line of the Atchison, Topeka & Santa Fe Railway crosses the county in a north-south direction, with a branch from Davis to

Sulphur, the county seat. The main line of the St. Louis & San Francisco Railroad crosses the easternmost township, with a branch from Scullin to Sulphur. The country roads in general receive very little attention and are very poor.

POPULATION.

The estimated population at the present time is 14,000, an average density of about 33 per square mile. Sulphur (5,280) is the county seat and principal town and is situated midway between the main line of the Atchison, Topeka & Santa Fe and the St. Louis & San Francisco railways. It is the terminal of branches of both roads. Davis (1,500), Dougherty (300), Hickory (350), and Scullin (75) are other railroad towns in the county.

MUSKOGEE COUNTY.

LOCATION AND EXTENT.

Muskogee County is situated in the northeastern portion of Oklahoma and has an area of approximately 875 square miles.

GEOGRAPHY AND GEOLOGY.

Small areas in the northeastern part lie in the Ozark Mountain region. The southeastern portion is included in the Arkansas Valley region and the western part in the Prairie Plains region. The rocks of the extreme northeastern part are the Boone chert and the rocks of the Chester group. In the remainder of the county the bed rocks are shales and sandstones of Pennsylvanian age. The surface is generally somewhat hilly, being less hilly to the northwest. In general, the sandstone hills are covered with timber, while the broad valleys underlaid with shale are prairie. In the northeastern part of the county is the Ozark Mountain region which is timbered.

Drainage is into Arkansas River, which forms a portion of the northern and eastern boundaries, cuts across the northeastern portion of the county and forms portions of the north and east boundaries. Ash, Cone, Cloud, Spaniard, Greenleaf, and Dirty creeks and Bayou Manard are the principal tributaries in the county. The rainfall is fairly heavy, averaging nearly 40 inches annually.

INDUSTRIES.

Muskogee County contains much fertile land suitable for farming. The rougher parts are largely devoted to pasture. Corn and cotton are the principal crops. A large acreage of potatoes is grown in Arkansas River valley.

Important oil and gas fields are located near Muskogee, Boynton, and Haskell. The Muskogee fields have been producing for several years, while the Boynton and Haskell fields are of more recent development. Small quantities of gas have been found in the northeastern part of the county, but so far this part of the county has produced no

oil. Brick are manufactured from the Pennsylvanian shales at Muskogee and Boynton and formerly at Wainright.

TRANSPORTATION.

The county is well supplied with railroads. The Missouri, Kansas & Texas; Missouri, Oklahoma & Gulf; St. Louis & San Francisco; Midland Valley; and Iron Mountain railroads give connections in all directions.

POPULATION.

The population is fairly dense. The present estimated population is 71,683, a density of 88 per square mile. The apparent density of population is due in large part to the large population of Muskogee. This city, which is the county seat, has an estimated population of 40,000. It is situated at the crossing of the St. Louis & San Francisco; Missouri, Oklahoma & Gulf; and the Midland Valley railways. It is the distributing point for a large section of northeastern Oklahoma, and has several small manufacturing industries. Porum (600), Warner (250), Wainright (250), Fort Gibson (1,500), Haskell (900), Boynton (700), and Webbers Falls (400), are leading towns and trading points in the county.

NOBLE COUNTY.

LOCATION AND EXTENT.

Noble County lies in the north-central part of Oklahoma. It has an area of approximately 760 square miles.

GEOGRAPHY AND GEOLOGY.

The county is entirely in the Redbeds Plains region and is underlaid by red shales, some limestones, and non-red shales and sandstones of Lower Permian age. The surface is rolling to hilly, the greater irregularities being in the southeastern part, where the sandstones are thicker than farther northwest.

The drainage is into Cimarron River, that of the northern part of the county passing through Red Rock Creek, and that of the southern part through Black Bear Creek. The rainfall is moderate, averaging a little more than 30 inches annually. Considerable areas of timber lie in the sandstone hills and along the streams, but the larger part of the county is prairie.

INDUSTRIES.

Noble County is primarily an agricultural county, and large crops of corn and wheat are produced. Considerable wheat is raised, but relatively less than in the region immediately to the west. Stock-raising receives considerable attention but principally in connection with farming.

The county has been tested for oil and gas in several places and some oil has been found near Otoe, while gas and oil have been found in the northwestern part of the county near Billings.

TRANSPORTATION.

The main line of the Atchison, Topeka & Santa Fe Railway crosses the county in a north-south, and the Tulsa-Enid branch of the St. Louis & San Francisco Railroad in an east-west direction. The country roads are generally in fair condition, especially where they receive anything like the proper amount of attention. The natural sandy clay soil produced by the Redbeds gives a good road bed where it is kept graded.

POPULATION.

The county is fairly well populated, the present estimated population being 16,488, an average density of about 22 per square mile. Perry (4,000) is the county seat and principal town. Morrison (350), Otoe (100), Red Rock (400), and Billings (550) are the leading villages.

NOWATA COUNTY.

LOCATION AND EXTENT.

Nowata County is situated along the Kansas line and is the third county from the eastern Oklahoma boundary. It has an area of approximately 586 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the Limestone Hills region and the surface rocks are limestones, shales, and sandstones of Pennsylvanian age. The surface is level to rolling. The limestones and sandstones, with their gentle westward dip, form east-facing escarpments separated by flats underlaid by shale.

The drainage of the county is south through the Verdigris River which crosses the county. The principal tributaries in the county are Hickory, California, Devil, Lightning, Salter, Big Cedar, and Snow creeks. The rainfall is ample for agricultural purposes, averaging about 37 or 38 inches annually. The county is largely prairie land, although there are extensive belts of timber along stream courses and some of the limestone and sandstone hills are timbered.

INDUSTRIES.

Nowata is primarily an agricultural county, corn being the principal crop. Some wheat is raised but no attempt is made to produce cotton.

Nowata County was the scene of some of the earliest development of the oil and gas industry in Oklahoma, and contains the famous shallow pool which extends from the south end of the county northward along the east side of Verdigris River. Portions of the pool are known as Coody's Bluff, Alluwe, Delaware, and Childers-Nowata pool. In the southwestern part of the county is the Adair pool, which was a large producer for some time. These fields have been pretty well developed and the production is much less than it was years ago. How-

ever, owing to the very slight cost of drilling for the shallow oil the development will undoubtedly be continued for several years to come.

TRANSPORTATION.

The St. Louis Iron Mountain & Southern Railroad crosses the county in a north-south direction, and the Parsons-Oklahoma City branch of the Missouri, Kansas & Texas Railway cuts the northwestern part. The country roads are generally on section lines and in fairly good condition, although they receive little attention.

POPULATION.

The population of the county as estimated at this time is 16,500, giving an average density of 28 per square mile. Nowata (5,684) is the county seat and largest town. Watova (25), Delaware (700). Lenapah (450), and South Coffeyville (200), are the principal railroad towns. Villages of considerable size grew up in the different oil fields at the time of their greatest development, but these have been abandoned in large part.

OKFUSKEE COUNTY.

LOCATION AND EXTENT.

Okfuskee County lies east of the center of the State. It has an area of about 623 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the Sandstone Hills region and the bed rocks are shales and sandstones of Pennsylvanian age. These generally have a slight westward dip. The surface of most of the county is hilly, due to the resistance of the sandstone ledges which rise as east-facing escarpments above the flats which are underlaid by shales.

The drainage is into the North Fork of Canadian River, which crosses the southern part of the county in a general easterly course, and into Deep Fork, which touches the northern part of the county. Both streams have several small tributaries. The county has ample rainfall for agricultural purposes, averaging about 35 inches annually. A large part of the county is timbered, although some of the flats are prairie.

INDUSTRIES.

Except a small production of oil and gas Okfuskee County has no mining or manufacturing industries, and agriculture is the only productive occupation. The lowlands are covered with deep, fertile soil and corn and cotton both produce large crops. The rougher land of the sandstone region is mostly devoted to pasture. The county is probable oil and gas territory, but so far the development has been disappointing.

TRANSPORTATION.

The Ft. Smith & Western Railroad crosses the county in a northwest-southeast direction, and the St. Louis & San Francisco, and Missouri, Oklahoma & Gulf railways cross the southeastern townships.

POPULATION.

The county is well settled. The present estimated population is 22,500, an average of about 35 per square mile. Okemah (2,000) is the county seat and principal town. Weleetka (1,500) is situated at the crossing of the Ft. Smith & Western and the St. Louis & San Francisco railroads. Castle (300), Paden (500), and Boley (negro) (1,500) are the leading villages.

OKLAHOMA COUNTY.

LOCATION AND EXTENT.

Oklahoma County is located near the center of the State and has an area of approximately 720 square miles.

GEOGRAPHY AND GEOLOGY.

The county is entirely in the Redbeds Plains region and is underlaid by sandy shales and sandstones of the lower part of the Permian system. The rocks weather easily and produce a topography of low, rounded hills, especially in the eastern portion where the sandstones are thicker and produce larger hills. The soils are fairly deep and fertile. There are small areas of sand hills along the main streams.

Drainage of most of the county is into North Canadian River, which crosses the county in a winding course, but in a general easterly direction. All the tributaries of the North Canadian are very short. The northern part of the county is drained by the headwaters of Deep Fork and by Christholm Creek, which flows into Cimarron River. The rainfall is moderate, averaging between 30 and 35 inches annually. Timber occurs along the streams and over the sandstone hills, particularly in the eastern part of the county.

INDUSTRIES.

No mining industries have been developed, except the manufacture of the red shale into brick at Oklahoma City. Several tests have been made for oil and gas but without results. Agriculture is the leading industry and all the leading crops are produced in abundance. Live stock raising is carried on extensively.

TRANSPORTATION.

The county is well supplied with railroads. The Atchison, Topeka & Santa Fe; Missouri, Kansas & Texas, and St. Louis & San Francisco railroads give connections in all directions.

POPULATION.

Including Oklahoma City the county is probably the most densely populated of any in the State, and leaving Oklahoma City (92,943) out of the consideration the county has a dense population. The present estimated population is 120,000, giving an average density of about 167 per square mile. Excluding Oklahoma City, the average density

of population is about 40 per square mile. Oklahoma City is the county seat and principal city. It is the State Capital, and has many important wholesale establishments and several manufacturing concerns, including two large packing plants which make it a stock market of considerable importance. Edmond (2,500) is the second largest town in the county and is the seat of the Central State Normal School. Other towns in the county are Luther (320), Spencer (150), Harrah (360), Choctaw (250), Wheatland (125), Council (25), Britton (700), and Arcadia (200).

OKMULGEE COUNTY.

LOCATION AND EXTENT.

Okmulgee County is situated in the east-central part of Oklahoma. It has an area of approximately 684 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the Sandstone Hills region and is underlaid entirely by shales and sandstones of the Pennsylvanian series. Some of the sandstones are of considerable thickness and sufficiently resistant to produce rugged ranges of hills. The thick shales between the sandstones produce broad lowlands or flats between the hill ranges.

The drainage is principally through Deep Fork or Canadian River, which flows southeasterly across the county. It has many small tributaries. Considerable areas in the northern part of the county are drained directly into Arkansas River through several small tributaries. The rainfall is fairly heavy, averaging about 40 inches per year. In general, the sandstone areas are covered with timber, while the shale areas are prairie.

INDUSTRIES.

Okmulgee County is an important agricultural county, although like the other counties in the same region, it is by no means developed to its capacity in this regard. Large areas of prairie land are left to wild grass, either for pasture or hay. The hillier land is mostly in pasture. Corn and cotton both produce very well. Wheat does well, but is not produced as largely as corn and cotton.

The county is and has been for several years one of the leading oil producing counties in the State. The Henryetta-Schulter, Tiger Flats, Beggs, Bald Hill, and Preston pools have proved very productive and longer-lived than some of the pools in the northeastern part of the State. Coal is also found in the county and is mined extensively in the southern part, and also near Henryetta. The cheap fuel supply has resulted in the location of several manufacturing establishments at Okmulgee and Henryetta and in their vicinities.

TRANSPORTATION.

The St. Louis & San Francisco Railroad crosses the county in a north-south direction, with a branch extending eastward from Okmulgee.

The Missouri, Oklahoma & Gulf crosses the southeastern part of the county.

In general the country roads are in poor condition except those leading directly to the principal towns. For example, those between Okmulgee and Henryetta. These are worked sufficiently to make them fairly good highways.

POPULATION.

The county is fairly thickly populated. A large percentage of the population finds employment in the coal, oil, and gas industries, and in the manufacturies located on account of these productions. The present estimated population is 40,000, giving an average density of about 58 per square mile. The population has grown rapidly in the last few years. Okmulgee (15,000) is the county seat and principal town. It is the distributing point for a large farming population and is also a center for the oil and gas industry. It has important glass factories located on account of the supply of natural gas. Henryetta is the second town and is a center of coal mining as well as of oil and gas development. Morris (500), Bryant (.....), Dewar (200), and Beggs (1,100) are the principal villages. Kusa is a new town, with several flourishing industries.

OSAGE COUNTY.

LOCATION AND EXTENT.

Osage County lies in the northern portion of the State, east of the middle line. It is one of the largest counties in the State and has an area of approximately 2,277 square miles.

GEOGRAPHY AND GEOLOGY.

This county was formerly the lands of the Osage Nation and practically all of the county has been allotted to the Indians. Only the town sites and a relatively few isolated tracts are property of others than members of the tribe. The rocks underlying the county are alternating sandstones and shales with, especially in the western part, some limestones. The surface of the entire county is hilly. The thick ledges of sandstone make pronounced ridges and hills.

Drainage is into Arkansas River which forms the southwestern boundary of the county. The western part is drained directly into the river, principally through Buck and Gray Horse creeks. The eastern part of the county is drained into Verdigris through Caney River and Bird Creek, with its principal tributary, Hominy Creek. The rainfall is fairly heavy, averaging about 35 inches annually. Nearly the whole county is timbered.

INDUSTRIES.

While there is much land in Osage County suitable for farming, the industry has received little attention on account of the lands belonging so largely to the Osages. Leasing restrictions are rather severe

and comparatively little of the land is under cultivation. The greater portion of it is pastured.

Osage is one of the important oil producing counties. The eastern part contains portions of the Tulsa and Bartlesville districts, and pools have been developed in Avant, Bigheart, Hominy, Osage, and other localities. The development has been retarded greatly by the leasing restrictions imposed by the Department of the Interior, and there are undoubtedly great areas of probable oil and gas-bearing territory in the county.

TRANSPORTATION.

The Parsons-Oklahoma City branch of the Missouri, Kansas & Texas Railway crosses the county in a northeast-southwest direction, and the Midland Valley Railroad in a northwest-southeast direction, crossing at Nelagony. The country roads are on section lines only in the level portions. They receive very little attention and are generally in wretched condition.

POPULATION.

The population is only moderately sparse. The present estimated population is 20,176, an average density of about 9 per square mile. Pawhuska (5,000) is the county seat and largest town. It is the Osage capital and center of all tribal affairs. Osage (350), Hominy (760), Nelagony (25), Bigheart (300), Avant (250), Foraker (450), Burbank (150), and Fairfax (820) are the leading villages.

OTTAWA COUNTY.

LOCATION AND EXTENT.

Ottawa County lies in the extreme northeastern part of the State, with Missouri forming the eastern, and Kansas the northern boundary. It has an area of 477 square miles.

GEOGRAPHY AND GEOLOGY.

The southeastern half of the county lies in the Ozark Mountain region, and the northeastern half in the Prairie Plains. The rocks of the Ozark Mountain region are the Boone chert, and shales and limestones of the Chester age, which produce a hilly surface. The rocks in the Prairie Plains region are sandy shales with thin sandstones of Pennsylvanian age and give an almost level country.

The drainage is south through Grand River, which is formed by the junction of Neosho and Spring rivers near the center of the county. Sycamore Creek is the principal stream in the eastern part of the county. The rainfall is fairly heavy, averaging about 40 inches annually. The portion of the county in the Ozark Mountains is rather heavily timbered, while the northwest or Prairie Plains portion is prairie.

INDUSTRIES.

The smoother portion of Ottawa County is an agricultural region. Corn does well. Wheat is raised to a small degree. No attempt is made to raise cotton. Large areas are left to the native grasses for pasture and hay. The Flint Hills in the southeastern part of the county, are, in general, too rough for good farming land. Some of the broader, flat-topped hills have a fairly deep and fertile soil. The narrow stream valleys in this region are all in cultivation.

The northern part of the county lies in the Joplin lead and zinc district and other important mines are located north of Miami. Mining is also done at Quapaw and Peoria. The mining camps of Ottawa County are among, at present, the leading camps of the Joplin district.

TRANSPORTATION.

The main line of the St. Louis & San Francisco Railroad crosses the county in a general east-west direction, with the Kansas City branch extending north from Afton. The Missouri, Oklahoma & Gulf crosses the county in a north-south direction.

On the level lands the country roads are on section lines and are generally fairly good, even with the small amount of attention received. In the hillier regions the roads are merely natural roads and trails through the hills.

POPULATION.

As a whole, the county is well settled, although the population in the hills in the southeastern part of the county is very sparse. The present estimated population is 26,000, an average density of 54 per square mile. Miami (6,000), the county seat and principal town, is the center of the lead and zinc industry. Commerce (2,500), Afton (1,300), Wyandotte (260), Quapaw (200), and Peoria (150) are the leading villages.

PAWNEE COUNTY.

LOCATION AND EXTENT.

Pawnee County lies northeast of the center of Oklahoma and has an area of approximately 600 square miles.

GEOGRAPHY AND GEOLOGY.

The greater portion of the county is underlaid by shales and sandstones, with some limestones of Pennsylvanian age. The extreme western part is in the Redbeds Plains area. The surface is rolling to hilly, with ridges which are capped by limestone and sandstone separated by broad shale flats.

Arkansas and Cimarron rivers unite at the southeastern corner of the county. Arkansas River forms all the northeastern boundary. The larger part of the county is drained into Arkansas River through Black Bear Creek. The rainfall is generally ample for agricultural purposes, averaging nearly 35 inches annually. The sandstone hills are timbered, but there are large areas of prairie land on the shale flats and in the western part of the county.

INDUSTRIES.

The leveler regions of the county have a soil sufficiently deep and fertile for all the staple crops. Corn and wheat are the principal crops, and some cotton is raised. The Cleveland oil field in the northeastern part of the county is one of the most important pools in the State. Drilling has been done at several other localities, but so far, no other large fields have been developed.

TRANSPORTATION.

The lines of the St. Louis & San Francisco; Missouri, Kansas & Texas; and the Atchison, Topeka & Santa Fe railroads afford good railroad facilities for the whole county. Country roads are only fair in the county, but there is sufficient limestone to macadamize all the country roads.

POPULATION.

The county is well populated, the present estimated number of inhabitants being 20,000, an average density of 33 per square mile. Pawnee (2,500) is the county seat and principal town, and is located at the junction of the Atchison, Topeka & Santa Fe and the St. Louis & San Francisco railroads. Other towns and villages in the county are Quay (200), Meramec (300), Hallett (150), Jennings (450), Cleveland (1,500), Ralston (600), and Skedee (300).

PAYNE COUNTY.

LOCATION AND EXTENT.

Payne County lies to the south and west of Pawnee County and general conditions are much the same. It has an area of approximately 710 square miles.

GEOGRAPHY AND GEOLOGY.

The greater portion of the county lies in the Redbeds Plains. The entire county is hilly, but the western portion is more level than the east. Cimarron River crosses the southern part of the county and receives the drainage of practically the whole area. It has several small tributaries, the more important ones entering from the north.

INDUSTRIES.

Payne County is primarily an agricultural county and large crops of corn and wheat are produced. Stock-raising is an important industry, but it is carried on principally in connection with farming.

Oil and gas have been found at Yale, and just east of the county line lies the important Cushing field. Drilling has been done at several other places.

TRANSPORTATION.

Two lines of the Atchison, Topeka & Santa Fe and one of the Missouri, Kansas & Texas railways cross the county. Country roads

are fairly good and the county contains sufficient limestone to provide macadam material for all the roads.

POPULATION.

The population is about the same density as in the adjoining counties. The present estimated population is 26,250, an average density of 37 per square mile. Stillwater (5,200) is the county seat and principal town. It is the seat of the State Agricultural and Mechanical College. Other railroad towns are Perkins (50), Ripley (400), Cushing (4,500), and Yale(800).

PITTSBURG COUNTY.

LOCATION AND EXTENT.

Pittsburg County lies in the southeastern part of the State. The area is approximately 1,375 square miles.

GEOGRAPHY AND GEOLOGY.

The greater part of the area is in the Arkansas Valley region, with the southeastern portion in the Ouachita Mountain region. In the Arkansas Valley region the bed rocks consist of sandstones and shales of great thickness. These are thrown into a series of folds with a general northeast-southwest trend. The resistant sandstone ledges, which are rather steeply inclined, produce rugged hills, giving the entire county a rather rough topography. The topography of the portion of the county lying in the Ouachita Mountains is even rougher than that in the Arkansas Valley region.

The drainage of the greater part of the county is into Canadian River, which forms the northern boundary. Gaines Creek is the principal tributary of Canadian River. The extreme southeastern part of the county is drained southeast into Kiamichi River, and the extreme southwestern part into Boggy Creek.

INDUSTRIES.

The stream valleys have fairly fertile soil and some of the broader, flat-topped hills are good farming territory, but the greater part of the territory is too rough for farming purposes. The hillier regions are entirely devoted to pasture. Cotton and corn are the principal farm crops.

Pittsburg is the leading coal producing county in the State, and McAlester and the villages near it are the center of the coal mining industry. Some gas has been obtained, but so far no oil has been found, although several wells have been drilled in a search for it.

TRANSPORTATION.

The main line of the Missouri, Kansas & Texas Railway crosses the county in a north-south direction, and has a branch eastward from McAlester. The main line of the Chicago, Rock Island & Pacific Rail-

way crosses east to west, with a branch extending from Haileyville. The Ft. Smith & Western crosses the northern part of the county.

The country roads in general receive little attention and are in poor condition. Section lines are opened as roads only in the leveler portions of the county.

POPULATION.

The density of the population is about the same as in some counties having better agricultural industries. This is largely on account of the mining population. The present estimated population is 50,000, an average density of about 36 per square mile. McAlester (18,000) is the county seat and principal town. It is located at the crossing of the Missouri, Kansas & Texas and the Chicago, Rock Island & Pacific railways, and is the center of the coal mining industry. Canadian (500), Crowder (550), Indianola (500), Featherston (100), Hartshorne (3,000), Haileyville (2,250), Alderson (800), Krebs (3,000), Adamson (250), Pittsburg (500), and Savana (350) are other railroad towns and villages. Most of them have coal mines.

PONTOTOC COUNTY.

LOCATION AND EXTENT.

Pontotoc County is located southeast of the center of the State. It has an area of approximately 720 square miles.

GEOGRAPHY AND GEOLOGY.

The southern part of the county is included in the Arbuckle Mountain geologic and physiographic regions. The greater part of the county lies in the area of Pennsylvanian rocks which form the Sandstone Hills region. The rocks in the Arbuckle Mountain region consist principally of limestones with thinner shales and sandstones. In the Pennsylvanian area they are thick sandstone separated by shales. The surface of the whole county is quite hilly, with the relief of the southern portion exceeding that of the northern.

Canadian River forms the northern boundary but receives the drainage of only about one-third of the county, which is drained through Sandy Creek and its tributaries. The southeastern and eastern portions of the county are drained to the southeast through the headwaters of Blue River and Boggy Creek. The rainfall is fairly heavy, averaging a little more than 35 inches annually. Nearly all of the county is timbered, except where the timber has been removed. There are some prairies on the limestone formations in the southern part of the county, and in some of the shale valleys in the northern part.

INDUSTRIES.

Pontotoc County has much good agricultural land, although considerable portions of it are too rough for farming. The Canadian River valley, with an average width of some 3 or 4 miles, is a rich, fertile soil.

The high limestone prairies in the southern part of the county are devoted almost entirely to pasture.

Oil has been found in small quantities near Allen in the extreme northeastern part of the county, and gas has been produced in some quantity near Ada. A large asphalt deposit has been worked extensively near Ada. The limestones and shales of the Arbuckle Mountains have been utilized for Portland cement in a large plant at Ada. Glass sand is being produced near Roff.

TRANSPORTATION.

The main line of the St. Louis & San Francisco Railroad, the Atoka-Oklahoma City branch of the Missouri, Kansas & Texas, and the Oklahoma Central division of the Atchison, Topeka & Santa Fe traverse the county, radiating in all directions from Ada, the county seat.

POPULATION.

The county is fairly well populated, the estimated population at present being 27,500, an average density of 37 per square mile. Besides being the county seat, Ada is the principal town. It is the seat of the East Central State Normal School. Vanoss (125), Fitzhugh (200), Roff (100), Stonewall (500), Francis (950), and Tyrola (20), are the more important railroad towns.

POTTAWATOMIE COUNTY.

LOCATION AND EXTENT.

Pottawatomie County lies just east of the center of the State and has an area of 820 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies near the boundary between the Sandstone Hills and the Redbeds Plains regions. The rocks are probably all of Pennsylvanian age, but the higher rocks, those outcropping in the western part of the county, are red, while those outcropping in the eastern part are non-red. The rocks consist almost entirely of shales, with some sandstones. An important bed of conglomerate or gravel is known in the eastern part of the county. The sandstone beds are of sufficient thickness and extent to produce a fairly rough topography, although the relief is much less than in the counties immediately to the east.

North Fork of Canadian River crosses the northern part of the county, Little River the central portion, and Canadian River forms the southern boundary. The rainfall is moderate, averaging about 35 inches annually. The eastern portion of the county is largely timbered, while a large portion of the western part is prairie.

INDUSTRIES.

Pottawatomie is an important agricultural county, the soils over the greater part of the county being deep and fertile. The valleys of the

North Fork of Canadian River, Little River, and Canadian River contain much high grade farming land. All of the important crops of the State are raised in considerable amounts. Alfalfa is made a specialty in this county.

Several attempts have been made to find oil and gas, but so far the only locality which has shown any indications of commercial quantities of either substance is near Maud, in the southeastern part of the county. One well drilled near here showed up favorably and gave promise of being a small oil well. Development has not been continued on account of litigation over the leases and it is impossible to say what the future of this locality will be.

TRANSPORTATION.

The main line of the Chicago, Rock Island & Pacific and the Atoka-Oklahoma City branch of the Missouri, Kansas & Texas railways give transportation facilities in an east-west direction, and the Eastern Oklahoma branch of the Atchison, Topeka & Santa Fe in a north-south direction. The Chicago, Rock Island & Pacific also has a branch from Shawnee to Asher.

POPULATION.

Pottawatomie County is rather thickly settled, having an estimated population at this time of 45,000, an average density of 55 per square mile. Shawnee (18,138) is the principal town. It is an important trading center and has several small manufacturing concerns. It is the seat of the Baptist College and also of the Catholic University. Tecumseh (1,700) is the county seat. Wanette (650), Asher (400), Maud (500), Earlsboro (400), McComb (170), McLoud (650), and Aydelotte are the more important small towns and villages.

PUSHMATAHA COUNTY.

LOCATION AND EXTENT.

Pushmataha County lies in the southeastern part of the State and has an area of about 1,430 square miles.

GEOGRAPHY AND GEOLOGY.

With the exception of a small area in the southwestern corner the county lies in the Ouachita Mountain region. The bed rocks consist of shales, sandstones, and cherts, which have been steeply folded and considerably metamorphosed. The alternation of hard and soft rocks dipping at steep angles produces a very rough topography. The hills are rugged and, as a rule, covered with large blocks of sandstone. The stream valleys are narrow. On some of the big shale formations there are broad, flat areas, but these have a very thin, non-productive soil. Jackfork Mountain and Potato Hills are the highest elevations in the county.

The drainage is principally into Little River, which crosses the county in an almost semicircular course, entering the county at the northeast corner and leaving it near the southern boundary. The principal tributaries of the Kiamichi are Jackfork, Buck, Ten Mile, and Cedar creeks. The eastern part of the county is drained south into Red River through Little River and its tributaries, the principal ones of which are Cloudy, Terrapin, and Black Fork. The rainfall is fairly heavy, averaging about 40 inches annually. Practically the entire county is timbered, except where timber has been cut from small areas for farming. Over most of the county there was originally valuable forests, principally of long leaf pine. Some of these remain, although much of the better timber has been cut.

INDUSTRIES.

Agriculture is the occupation of nearly all the population, but a very small percentage of the land is tillable. In general, only the stream valleys are farmed and these only in a small way. The valley of the Kiamichi supports much the greater part of the population. The hilly land is generally pasture, although even this industry is not prosecuted to the extent to which it might be.

Reports have been made from time to time concerning the finding of lead, zinc, and copper, and even of gold and silver in the county, but so far, no metals have been found in quantity. Undoubtedly some small nuggets of manganese have been found, and traces of copper, gold, and silver, but it is extremely improbable that any important deposits of any of these metals exist in the county.

Asphalt of very high grade has been found near Jumbo in the western part of the county and near Tuskahoma in the north central part of the county. This asphalt is a highly metamorphosed form, containing a high percentage of fixed carbon. It cannot be used in road paving, but is utilized in the manufacture of varnishes, waterproofing, and other materials. The presence of asphalt has led to some prospecting for oil and gas, but none has been found and it is highly improbable that any deposits of either substance will be found in the steeply tilted rocks of this region.

TRANSPORTATION.

One of the lines of the St. Louis & San Francisco Railroad crosses the county, following the Kiamichi River. There are practically no country roads. In general, the surface is too rough for the section lines to be opened as roads and the transportation of the county is along winding trails through the hills and woods.

POPULATION.

The county is very sparsely settled. The present estimated population is 18,000, an average density of about 12 per square mile. Antlers (1,430) is the county seat and principal town. Other towns and

villages in the county are Albion (150), Cohn, Kiamichi, Tuskahoma (100), Clayton (200), Stanley, Dunbar, Rattan, and Corinne.

ROGER MILLS COUNTY.

LOCATION AND EXTENT.

Roger Mills County lies in the extreme western part of the State and has an area of approximately 1,150 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the High Plains region and the rocks consist of sandstones and shales of the extreme upper part of the Permian Red-beds, with considerable areas of Tertiary sands and gravels and some Recent sand hills. The surface is rolling to hilly. The streams have cut rather deep canyons into a high plain, producing a broken topography consisting of narrow canyons separated by broad, flat-topped hills.

Canadian River forms the northern boundary of the county, but receives the drainage of only a narrow belt. The greater part of the county is drained eastward through Washita River, which crosses the county. It has many small tributaries. The extreme southern portion is drained southward through tributaries of North Fork of Red River. The rainfall is light, averaging about 22 inches annually. The county is practically without timber.

INDUSTRIES.

Roger Mills is primarily an agricultural county, although the rainfall is so light that dependence cannot be placed on some of the crops grown farther east. Corn is grown only to a small extent, its place being taken almost altogether by the sorghums. Wheat is grown largely and cotton is grown successfully in the southern part of the county. Broomcorn is an important crop. There are no mining nor manufacturing industries.

TRANSPORTATION.

The county has only a few miles of railroad, the Clinton, Oklahoma & Western penetrating from the east as far as Strong City, and the Wichita Falls & Northwestern division of the Missouri, Kansas & Texas touching the southeastern part. A small independent railway connects Strong City with Cheyenne, the county seat.

POPULATION.

The population is rather scant, being estimated at this time at 13,000, an average density of 11 per square mile. All the towns of the county are small. Strong City (.....), Hammon (600), and Carpenter (50) are railroad towns in the county.

ROGERS COUNTY.

LOCATION AND EXTENT.

Rogers County is located in the northeastern part of the State and has an area of about 730 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies in the region of Pennsylvanian rocks and in the Prairie Plains and Limestone Hills regions. The eastern part is underlaid by the Cherokee shale formation and is a level plain. In the western part of the county there are some important ledges of limestones which produce strong, east-facing escarpments. Outliers of this limestone produce rounded knobs, which are in many places given local names.

The drainage is southward through Verdigris River, which crosses the county. Within the boundaries of the county it receives the water of Little Verdigris River and of Bird Creek, its two main tributaries. The tributaries from the eastern side of the Verdigris in this county are all small. The rainfall averages between 35 and 40 inches per year. Nearly all the county is prairie. Some of the hills are covered with a scant growth of timber and heavy growths occur in some of the stream valleys.

INDUSTRIES.

Nearly all of Rogers County is tillable and it is becoming an important agricultural county. As yet, however, large areas are left to wild grass for hay or pasture. Corn is the principal farm crop. Cotton is raised only to a very small extent.

Rogers County has been an important producer of oil and gas. The southern end of the "shallow field," which lies west of Chelsea, and the Collinsville, Oolagah, and Inola pools have been the most important.

Artesian mineral water is known at several localities and is used extensively for medicinal purposes at Claremore.

TRANSPORTATION.

The St. Louis Iron Mountain & Southern Railroad crosses the county in a north-south, and the St. Louis & San Francisco in a northeast-southwest direction. The Tulsa branch of the Atchison, Topeka & Santa Fe touches the extreme western part. The country roads are not very well kept, but are generally in fairly good condition.

POPULATION.

The county is thickly settled. The present estimated population is 25,000, an average density of 34 per square mile. Claremore (5,100) is the county seat and principal town. It is situated at the junction of the St. Louis & San Francisco and Iron Mountain railroads, and is the seat of the Eastern University Preparatory School. The town has achieved considerable reputation as a health resort on account of the mineral waters. Collinsville (1,500) is in the western part of the county and is important on account of the oil and gas production, and especially on account of the large zinc smelters and brick plants which have been located there because of the fuel supply. Catoosa (400), Inola (425), Chelsea (1,500), Oolagah (260) and Talala (350) are other small towns and villages.

SEMINOLE COUNTY.

LOCATION AND EXTENT.

Seminole County is situated east of the center of the State and has an area of 630 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Sandstone Hills region and is underlaid by alternating sandstones and shales. The sandstones are quite resistant to weathering and produce a rough topography. The hills lie in ranges with a northeast-southwest trend, corresponding to the strike of the rocks.

North Fork of Canadian River forms the northern boundary, and Canadian River the southern boundary. The northern part of the county is drained into North Fork principally through Wewoka Creek, while the southern part is drained into Canadian River through Little River. The rainfall is moderate, averaging about 35 inches annually. As a rule the sandstone areas in the county are timbered, while the shale flats are prairie. There is no valuable timber.

INDUSTRIES.

While much of the county is too rough for agricultural purposes, there are large areas with soil sufficiently thick and fertile to be very productive. Owing to the ownership of the land, which belongs principally to the Seminole Indians, the county has been very backward in its development.

There are no mining or manufacturing industries, although several attempts have been made to find oil and gas. Some oil was found near Wewoka, but not in sufficient quantity to encourage further development.

TRANSPORTATION.

The main line of the Chicago, Rock Island & Pacific Railway crosses the county in an east-west direction. The Atoka-Oklahoma City branch of the Missouri, Kansas & Texas Railway touches the southwestern portion, and the main line of the St. Louis & San Francisco the southeastern portion. The country roads in general are not improved and are very poor.

POPULATION.

Seminole County is fairly thickly settled, having an estimated population at this time of 20,250, an average of 32 per square mile. Wewoka (1,100) is the county seat and principal town. Sasakwa (250), Konawa (800), and Seminole (500), are other railroad towns and villages in the county.

SEQUOYAH COUNTY.

LOCATION AND EXTENT.

Sequoyah County lies in the east-central part of the State and has an area of approximately 693 square miles.

GEOGRAPHY AND GEOLOGY.

The extreme northern portion of the county lies in the Ozark Mountain uplift, but the greater portion is included in the Arkansas Valley region. Over most of the county the rocks are sandstones and shales of Pennsylvanian age, which are folded into gentle folds. The dip of the rocks is not steep, being usually less than 3 degrees. However, the sandstones are not sufficiently thick to produce an extremely rough topography. Some of the hills are known by local names as Brushy and Wild Horse mountains. The northern part of the county in the Ozark uplift has also a very rough topography.

Arkansas River forms the southern boundary and receives the drainage of the county. Illinois River drains the western portion. Vian and Sallisaw creeks, and Big Skin Bayou are the other principal tributaries of the Arkansas. The rainfall is fairly heavy, averaging over 40 inches annually. Nearly the entire county is timbered, except the prairies in the Arkansas Valley.

INDUSTRIES.

Much of the surface of Sequoyah County is too rough for farming purposes, but the valley of Arkansas River and those of the large creeks have a deep, fertile soil which is farmed extensively. The broad, flat-topped sandstone hills and ridges are also farmed and are productive except in unusually dry seasons. Corn is the principal crop and cotton is grown extensively. Wheat and the other small grains are grown only to a very small extent.

The southern part of the county has been prospected to some extent for oil and gas, and small quantities of gas have been found near Vian, but not enough to be of any importance. Only the extreme southern part of the county can be considered as probable oil and gas territory. A bed of marble was formerly quarried at Marble City, but it has not been worked for a few years.

TRANSPORTATION.

The St. Louis, Iron Mountain & Southern Railroad crosses the county from east to west, and the Kansas City Southern from north to south. Country roads are generally very little worked. They are located on the section lines only in the smoother parts of the county.

POPULATION.

The present estimated population is 30,000, an average density of 42 per square mile. Sallisaw (3,000) is the county seat and principal town and is situated at the junction of the Iron Mountain and Kansas City Southern railways. Muldrow (700), Marble City (300), Gore (320), Vian (900), and Gans (350) are the leading villages.

STEPHENS COUNTY.

LOCATION AND EXTENT.

Stephens County is located in south-central Oklahoma. It has an area of approximately 900 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Redbeds Plains region and is underlaid by rocks belonging to the lower portion of the Permian Redbeds. In the extreme southeastern corner some of the sandstones are non-red. The sandstones are relatively of more importance in the eastern part than in the western, so that the surface is quite hilly in the eastern part with the relief decreasing to the west.

Drainage of the northeastern part of the county is east through Wild Horse Creek and its tributaries into Washita River. The southern part is drained directly into Red River through tributaries of Mud and Beaver creeks. The rainfall is rather light, averaging about 25 inches annually. The sandstone hills in the southeastern part of the county are covered with a scrubby growth of oak timber, but a large portion of the county is prairie.

INDUSTRIES.

Agriculture is the great industry of Stephens County, and except in the most hilly parts the soils are deep and productive. All of the important crops of the State do well in the county, and are raised to considerable extent. The growing of peanuts has been made a specialty in the southern part of the county.

A considerable amount of prospecting for oil and gas has been done, especially in the eastern part of the county. Gas has been found east of Duncan and also at Loco, in the southeastern part of the county. The capacities of the wells so far brought in have been sufficient to encourage further prospecting. Some asphalt deposits are known in the southeastern part of the county, which has been taken as an indication of the presence of petroleum in the deeper rocks.

TRANSPORTATION.

The county has only one line of railroad, the main line of the Chicago, Rock Island & Pacific, which crosses the county in a north-south direction. The country roads receive little attention, but, except in the hillier parts of the county, are generally in fairly good condition.

POPULATION.

The present estimated population is 23,000, an average density of 25 per square mile. Duncan (4,000) is the county seat and principal town. Comanche (1,400) and Marlow (2,000) are important towns on the Chicago, Rock Island & Pacific Railway.

TEXAS COUNTY.

LOCATION AND EXTENT.

Texas County is the middle one of the three counties made by the division of old Beaver County, Oklahoma Territory. It has an area of approximately 2,065 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the High Plains region and the surface rocks are sands and clays of Tertiary age, except where the streams have cut down into the underlying Redbeds. The surface is a high, rolling plain into which the streams have cut deep and narrow canyons. Drainage is east to Beaver Creek, which crosses the county. It has several tributaries in the county, none of which are of great importance. The rainfall is light, averaging 20 inches annually.

INDUSTRIES.

A large part of the county is in pasture. The rainfall is too light for most of the crops which are raised farther east. The county is an agricultural and grazing region exclusively. Wheat is grown successfully, and several kinds of sorghums and alfalfa can be raised for feed crops.

TRANSPORTATION.

The Chicago, Rock Island & Pacific Railway crosses the county in a northeast-southwest direction. The country roads receive little attention, but on account of the light rainfall and the sandy clay soil, they are generally in good condition as a rule, much better than the country roads in many more thickly settled counties in the eastern part of the State.

POPULATION.

The county is without timber and is rather sparsely settled. The estimated population at this time is 18,000, an average density of 8 per square mile. Guymon (1,600) is the county seat and principal town. Goodwell is the seat of the Panhandle State School of Agriculture. Hooker (550) and Tyrone (250) are other villages on the Chicago, Rock Island & Pacific Railway.

TULSA COUNTY.

LOCATION AND EXTENT.

Tulsa County lies in the northeastern part of the State. It has an area of about 565 square miles.

GEOGRAPHY AND GEOLOGY.

This county is included in the area of Pennsylvanian rocks and in the Sandstone Hills physiographic province. The rocks are principally sandstones and shales of Pennsylvanian age, although some limestones occur in the northern part of the county. The surface is generally

rough, with east-facing ranges of sandstone hills separated by flats or valleys underlaid by shale.

The drainage is into Arkansas River, which crosses the county from northeast to southwest. Bird Creek drains the northern part. The county receives abundant rainfall, averaging about 35 inches annually. As a rule the sandstone hills are timbered, while the areas underlaid by shale are prairie.

INDUSTRIES.

For its size, Tulsa is an important agricultural county, principally on account of the deep, fertile soil of the Arkansas Valley. Corn and cotton are the principal crops. Wheat and other small grain are raised only in a very small way.

For several years Tulsa has been one of the leading counties in the production of oil and gas. Parts of Glenn pool, Jenks, Red Fork, Dawson, Owassa, and the large Bird Creek pools lie in the county.

TRANSPORTATION

The Midland Valley; Atchison, Topeka & Santa Fe; St. Louis & San Francisco; and the Missouri, Kansas & Texas railway lines center at Tulsa and give transportation facilities in all directions. Some of the more important country roads are kept in fairly good shape. but as a rule receive very little attention and are in poor condition.

POPULATION.

The average density of population in the county is rather high, on account of the large population of the city of Tulsa and the large number of oil field quarters in different parts of the county. Tulsa (30,575) is the county seat and the center of the oil and gas industry in the county. It is the seat of Henry Kendall College. The population of the county as estimated at this time is 84,000, an average density of 148 per square mile. This includes the population of Tulsa.

TILLMAN COUNTY.

LOCATION AND EXTENT.

Tillman County is situated in the southwestern part of the State. It has an area of approximately 733 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Redbeds area south of the Wichita Mountains. The surface rocks are red shales with some sandstones. The streams have cut fairly deep valleys in the general plain, but the sandstones are not sufficiently thick or resistant to produce a very rough topography.

The drainage is south into Red River, which forms the southern boundary of the county. North Fork of Red River forms the western

boundary. A greater part of the county is drained into Red River through Deep Red Run. The rainfall is rather light, averaging a little less than 25 inches annually. The county is practically without timber.

INDUSTRIES.

The soft shales and sandstones in Tillman County weather into deep, productive soil, and it is an important agricultural county. Cotton and wheat are the leading crops. Corn is grown considerably, but more dependence is being placed on the sorghums for feed crops.

TRANSPORTATION.

The Vernon branch of the St. Louis & San Francisco Railroad and the Wichita Falls & Northwestern division of the Missouri, Kansas & Texas Railway crosses the county, intersecting at Frederick.

POPULATION.

The county is fairly well populated, having an estimated population at present of 24,905, an average of 33 per square mile. Frederick (5,000) is the county seat and principal town. Other railroad towns and villages are Davidson (400), Grandfield (1,000), Manitou (500), and Tipton (450).

WAGONER COUNTY.

LOCATION AND EXTENT.

Wagoner County lies in the northeastern part of the State and has an area of approximately 545 square miles.

GEOGRAPHY AND GEOLOGY.

The extreme eastern portion lies in the Ozark Mountain region. The underlying rocks are limestones and shales of the Chester group, of Mississippian age. The greater part of the county is in the Prairie Plains region and is underlaid by shales and sandstones of Pennsylvanian age. The sandstones are more numerous and of greater thickness in the southern than in the northern part of the county. The surface of the county is, for the most part, level to rolling. In the southwestern part are some sandstone hills, and in the extreme eastern part some hills capped with limestone.

The drainage is into Arkansas River, which forms the southern boundary. Grand River forms the eastern boundary and Verdigris River flows southeast across the county. The Grand and Verdigris flow into the Arkansas near the southeastern corner of the county. Rainfall is plentiful, averaging about 40 inches. Timber is abundant in the extreme eastern part, and the sandstone hills in the western part are scantily covered. The larger part of the county, however, is prairie.

INDUSTRIES.

Arkansas and Verdigris rivers have wide valleys with deep, fertile soil, making Wagoner one of the leading agricultural counties of the

eastern part of the State. Cotton, corn, and potatoes are the principal crops in the valley lands. The upland prairies are devoted principally to pasture and hay lands. Oil and gas have been produced in the western part of the county, and in small quantity, near Wagoner in the eastern part.

TRANSPORTATION.

The Muskogee-Tulsa branch of the Missouri, Kansas & Texas Railway crosses the southern part of the county; and the main line of Missouri, Kansas & Texas Railway; the Missouri, Oklahoma & Gulf, and the Iron Mountain railways cross the eastern part.

POPULATION.

The county is thickly settled. The present estimated population is 84,000, an average density of 154 per square mile. Wagoner (4,500) is the county seat and principal town. It is located at the intersection of three railroads. Porter (650) and Coweta (1,200) are the principal towns.

WASHINGTON COUNTY.

LOCATION AND EXTENT.

Washington County is situated along the Kansas line east of the middle of the State. It has an area of approximately 440 square miles.

GEOGRAPHY AND GEOLOGY.

The county is situated entirely in the Limestone Hills region, and is underlaid with shales, limestones, and sandstones of Pennsylvanian age. These outcrop in belts extending nearly north and south, and the harder beds produce eastward-facing escarpments above the level lands underlaid by the shale formations.

Drainage is south through Caney River, which flows south across the county. It has many small tributaries wholly or in part within the county. The rainfall is ample for agricultural purposes, averaging about 35 inches per year. Nearly all the county is prairie.

INDUSTRIES.

The shales which underlie most of the county produce a fairly deep soil of moderate fertility. The greater part of the county is tillable and produces good crops. Much land is left in native grasses for pasture and hay.

Washington County was one of the earliest developed oil and gas regions in the State. The fields have been worked for several years and the production has declined considerably, but is still important. Important industries have been located in the county on account of the cheap fuel supply. Shale is manufactured into brick at Bartlesville and a large Portland cement plant has been operated at Dewey for several years.

TRANSPORTATION.

The Tulsa branch of the Atchison, Topeka & Santa Fe Railway crosses the county in a north-south direction, and the Parsons-Oklahoma City branch of the Missouri, Kansas & Texas Railway crosses the northern part.

POPULATION.

The present estimated population is 24,000, an average of about 54 per square mile. Bartlesville (15,000) is the county seat and principal town. It is situated at the junction of the two railways, is an important center of the oil and gas industry, and has large zinc smelters. Dewey (1,600) is connected with Bartlesville by an interurban railway and has a large cement plant. Vera (400), Ramona (1,000), Ochelata (600), and Copan (350) are other villages.

WASHITA COUNTY.

LOCATION AND EXTENT.

Washita County is situated in the southwestern part of the State. It has an area of approximately 1,006 square miles.

GEOGRAPHY AND GEOLOGY.

The county lies entirely in the Permian Redbeds region and in the Gypsum Hills physiographic province. The bed rocks consist of red shales and thin sandstones, with lenticular beds of gypsum belonging to the Greer formation. The surface is rolling.

The principal part of the drainage is south, through Washita River, which crosses the eastern part of the county. The southwestern part is drained southward into North Fork of Red River through Elk Creek. There is no timber in the county except along the streams. The rainfall averages about 25 inches per year.

INDUSTRIES.

Washita is an important agricultural county. Wheat and cotton are the principal crops. Corn is grown extensively, but sorghums are largely depended upon for feed. Alfalfa is the important hay crop. Stock-raising is conducted in connection with farming. There are no mineral or manufacturing industries.

TRANSPORTATION.

A branch line of the St. Louis & San Francisco Railroad crosses the county from north to south, and the main line of the Chicago, Rock Island & Pacific crosses the northwestern corner. The county is also crossed by the Kansas City, Mexico & Orient Railway.

POPULATION.

The present estimated population of the county is 25,700, an average density of 25 per square mile. Cordell (2,750) is the county seat and principal town. Bessie (300), Sentinel (900), Rocky (400), Ca-

nute (300), and Foss (550) are other railroad towns and trading points in the county.

WOODS COUNTY.

LOCATION AND EXTENT.

Woods County lies in the northwestern part of Oklahoma. It has an area of approximately 1,255 square miles.

GEOGRAPHY AND GEOLOGY.

The eastern part of the county is in the Redbeds Plains region and is underlaid by the soft shales and sands of the Enid formation. The western part of the county is in the Gypsum Hills region. The gypsums of the Blaine formation form a concentric outcrop facing Cimarron and Salt Fork of Arkansas River. These gypsums and the sandstones above them produce a very hilly topography.

Drainage is into Cimarron River, which forms the southwestern boundary, and into Salt Fork of Arkansas River, which crosses the northwestern part of the county. The rainfall is rather light, averaging about 25 inches annually. Timber occurs only in very small quantity along the streams.

INDUSTRIES.

Agriculture is the important industry. Wheat is the leading crop. Corn is grown, but on account of the light rainfall is not dependable. Kafir and milo maize are used extensively for feed crops. A plaster mill was erected at Alva a few years ago but has been operated only a short time. The gypsum was shipped from a quarry in Woodward County.

TRANSPORTATION.

The Atchison, Topeka & Santa Fe Railway crosses the central part of the county in a northwest-southeast direction, and branch lines of the Chicago, Rock Island & Pacific and the St. Louis & San Francisco railways extend into the county.

POPULATION.

The present estimated population is 17,623, an average density of about 14 per square mile. Alva (4,500) is the county seat and principal town. It is the seat of the Northwestern State Normal School. Waynoka (1,200), Eagle, Capron (200), Brink, and Hopeton (75) are other railroad towns in the county.

WOODWARD COUNTY.

LOCATION AND EXTENT.

Woodward County lies in the northwestern part of Oklahoma and has an area of approximately 1,233 square miles.

GEOGRAPHY AND GEOLOGY.

This county lies in a part of two physiographic provinces—the Gypsum Hills region in the eastern part and the High Plains in the western part. Each of these general areas has been modified by mantles of sand. The surface rocks in the county are Permian, Cretaceous, and Quaternary. The Permian rocks cover the largest area in the county, comprising all of the eastern and northeastern parts except that covered by the sand hills. The Enid, Blaine, Woodward, and Greer formations of the Permian are exposed. Tertiary rocks occupy an area of about 85 square miles in the southwestern part of the county. They are for the most part clay, sand, and gravel. The Quaternary rocks outcrop along the valley of Cimarron River, in the northeastern part of the county along the valley of North Fork of Canadian River. The Quaternary materials consist of alluvium and dune sand and comprise a total area of about 740 square miles.

The most prominent gypsum hills are in the Blaine formation and produce eastward-facing bluffs and escarpments occupied by massive gypsum ledges. The northern part of Woodward County is drained by Cimarron River and streams tributary to it. The central and southern parts are drained by North Fork of Canadian River and its tributaries.

INDUSTRIES.

Agriculture is the important industry, with wheat as the leading crop. Some corn is grown, but the sorghums, kafir, and milo are used largely as feed crops. There are no mining or mineral industries with the exception of the quarrying of gypsum at one or two localities.

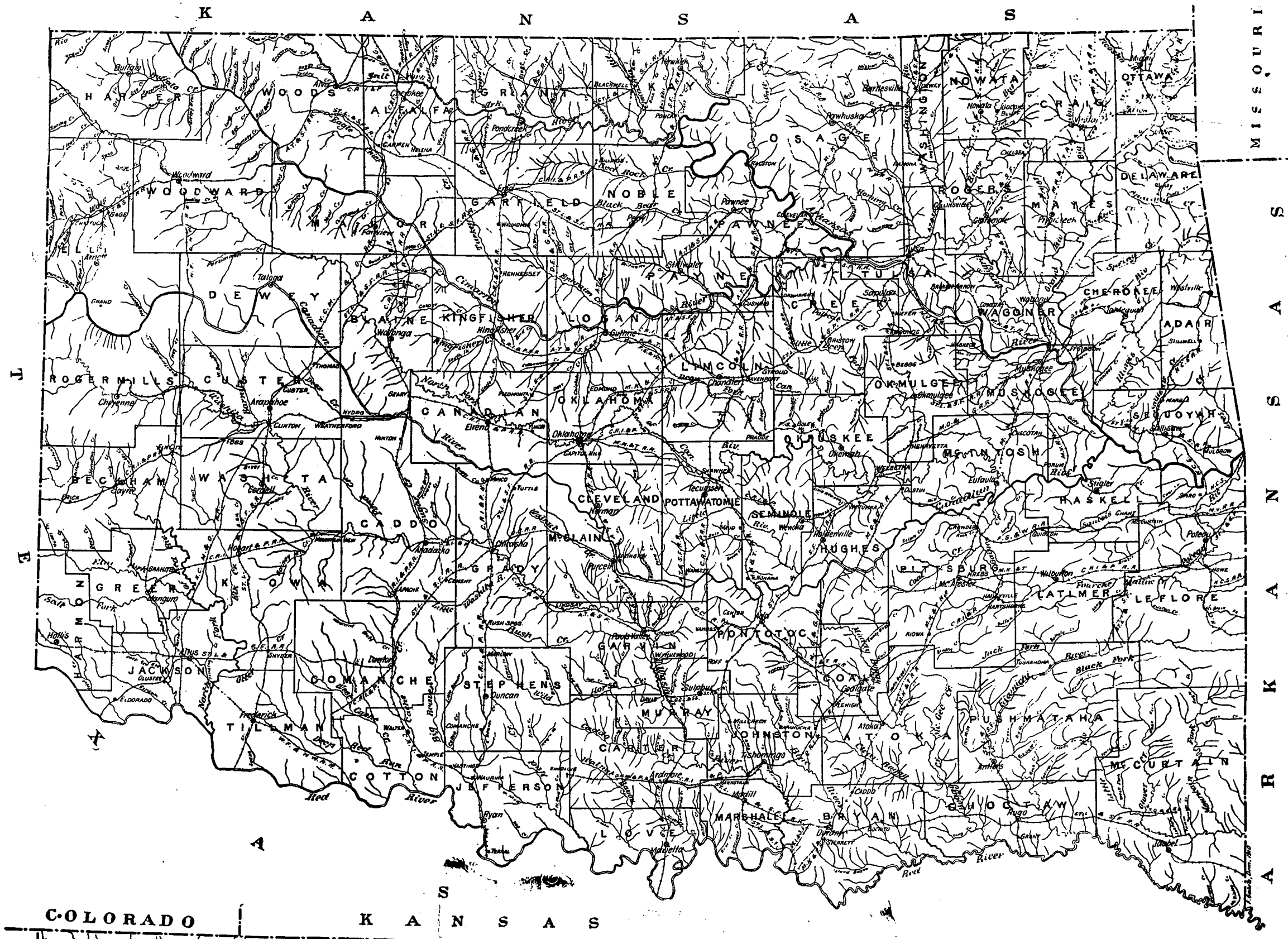
TRANSPORTATION.

Woodward County has two railroads. It is crossed in a northeast-southwest direction by the Atchison, Topeka & Santa Fe Railway, and in a southeast-northwest direction by the Wichita Falls & Northwestern Railway. These roads cross at Woodward, the county seat.

POPULATION.

The present estimated population is 18,000, an average density of about 14 per square mile. Woodward (6,000) is the county seat and principal town. Quinlan (400), Mooreland (500), Curtis (200), Alston, Kline, and Asylum are small railroad towns in the county.

PLATE I.



MAP OF OKLAHOMA. SHOWING PRESENT BOUNDARIES, COUNTY LINES. PRINCIPAL DRAINAGE FEATURES. CHIEF CITIES AND TOWNS. AND TRANSPORTATION LINES.