I N D E X

INTRODUCTION

COUNTY GEOLOGIES

County	Page	County	Page
Arkansas	1	Lee	101
Ashley	5	Lincoln	105
Baxter	10	Little River	107
Benton	13	Logan	110
Boone	16	Lonoke	113
Bradley	19	Madison	117
Calhoun	22	Marion	120
Carroll	24	Miller	123
Chicot	26	Mississippi	126
Clark	28	Monroe	128
Clay	31	Montgomery	131
Cleburne	34	Nevada	135
Cleveland	36	Newton	139
Columbia	38	Ouachita	143
Conway	40	Perry	147
Craighead	42	Phillips	149
Crawford	44	Pike	151
Crittenden	48	Poinsett	155
Cross	50	Polk	158
Dallas	52	Pope	161
Desha	54	Prairie	163
Drew	56	Pulaski	167
Faulkner	58	Randolph	169
Franklin	60	Saline	171
Fulton	62	Scott	173
Garland	64	Searcy	176
Grant	68	Sebastian	180
Greene	70	Sevier	185
Hempstead	72	Sharp	192
Hot Springs	75	St. Francis	195
Howard	80	Stone	199
Independence	82	Union	205
Izard	85	Van Buren	209
Jackson	87	Washington	215
Jefferson	90	White	220
Johnson	94	Woodruff	223
Lafayette	96	Yell	226
Lawrence	99		

ARKANSAS COUNTY

Arkansas County, situated in the southeast central part of the State, is bounded on the north by Prairie and Monroe Counties; on the south by Desha and Lincoln Counties; on the east by Phillips County, and on the west by Jefferson and Lincoln Counties. It has a land area of 640,000 acres.

This County constitutes a part of the level land of Arkansas. It is wholly within the Gulf Coastal Plain. It is a part of the great rice belt of the State. About one-third of the land is alluvial, about one-eighth timbered, and the rest, prairie land. There are few hills in the County.

The general surface of Arkansas County is a slightly undulating plain sloping from an elevation of about 215 feet above sea level in the northern part to 150 feet in the southern part of the County, and comprising the prairies, which include most of the interstream areas and the flood plains bordering the streams. The prairies are open grassy tracts forming Grand Prairie; they cover the northern part of the County and form interstream areas, a few miles to 10 miles wide, extending southward five or six miles south of Gillett. In the east, the prairies closely border White River, which has cut into their edges in places. The general level of the prairies is 45 to 50 feet above low-water level of the Arkansas and White Rivers.

The gently undulating interstream timbered lands border the shallow valleys and intertongue irregularly with the prairie lands. The flood plains lie a few feet to 30 feet below the level of the prairies, and form poorly drained wooded or cultivated tracts 10 to 12 miles in maximum width. The broadest plains are in the west, bordering the Arkansas River and Bayou Meto, and in the south, where the bottom land of the Arkansas and White Rivers merge into the Mississippi bottom.

The surface of Arkansas County is underlain by Pleistocene alluvium ranging in thickness from 100 to 180 feet, which rests unconformably on strata of Eocene age. The Eocene is estimated to range in thickness from about 2,600 feet in the northwestern to about 4,500 feet in the southeastern part of the County. The Cretaceous strata are estimated to range in thickness from about 400 feet to more than 1,000 feet, with the greater thickness in the southeastern part.

QUATERNARY-PLEISTOCENE AND RECENT: The surface is underlain by Pleistocene alluvium, consisting of clays, sands, and gravels, ranging in thickness from 100 to 180 feet. The materials are irregularly bedded, but, in general, grade downward from fine, compact, gray and reddish clay, through fine sand to coarse water-bearing sands and gravels at the base. The surface distribution of the Pleistocene alluvium is

co-extensive with the interstream areas of the County. The stream valleys are filled with Recent alluvium.

TERTIARY EOCENE: The well records of this area are not sufficiently detailed to distinguish accurately the boundaries between the different formations included within the Eocene. It is estimated that the total thickness of the Eocene strata ranges from about 2,500 feet in the northwestern part to about 4,500 feet in the southeastern part of the County, comprising the following formations: Jackson; Claiborne; Wilcox, and Midway.

The Midway is estimated to be from 500 to 600 feet thick, and to consist of gray, noncalcareous clay and shale, containing an abundance of siderite concretions, with calcareous shale, and, perhaps, limestones in the basal part in southeastern Arkansas County.

The Wilcox formation attains a maximum thickness of not less than 2,000 feet, made up chiefly of sands, clays, and sandy clays, in part lignitic.

The Claiborne reaches a maximum thickness of about 1,500 feet. It consists chiefly of sands and clays, with 300 to 400 feet of glauconitic sand and clay at the base.

The Jackson formation is not readily distinguished in the well records, as most of the wells failed to set pipe through the Pleistocene, which resulted in caving of sands and gravels, obscuring the true character of the Jackson.

CRETACEOUS-GULF SERIES: The Cretaceous rocks underlying this area are known only from the records of two deep wells, both located in the northwestern part of the County. From studies of regional sedimentation and structure, it is believed that these rocks will range widely in thickness, and in lithology from northwest to southeast. The southeastern part is situated in a sedimentary basin, which reached its fullest development farther to the east in Mississippi, and the sediments may be expected to resemble more closely the standard Mississippi, than the Arkansas section.

This sedimentary basin expanded toward the northwest with a consequent overlap of younger strata over the older, resulting not only in a thinning of the total Cretaceous section, but also in a lateral change in the character of the sediments. It is estimated that the total thickness of the Cretaceous from northwest to southeast is believed to be mainly in the Saratoga chalk and Marlbrook marl, equivalents of the Selma chalk of Mississippi, and in the Tokio formation, or its equivalent (the Tuscaloosa formation of Mississippi).

The basement rocks are not definitely known to have been penetrated in any of the deep wells drilled in this area.

The lowest elevation in the County, 142 feet, is at a point four miles north of Benzal, in the southeastern part of the County. Highest elevation, 232 feet, is in the northwest central part at Holdridge, on the St. Louis Southwestern Railway. A few of the representative towns with their respective elevations are as follows:-

Stuttgart	216 feet	St. Charles	199 feet
De Witt	188 feet	Gillett	182 feet
Ark. Post	178 feet		

The first settlement in the State of Arkansas was made at Arkansas Post in Arkansas County by the French in 1686. The County was formed December 13, 1813, then a part of Missouri territory. The first territorial legislature was held at Arkansas Post July 29th. 1819. Arkansas Post is also the site of an Arkansas Newspaper, the Arkansas Gazette having been established there by Wm. E. Woodruff in 1819.

This County is well drained by the Arkansas and White Rivers and their tributaries. The White River forms the boundary all along the eastern part, its tributaries being Big Creek, Lagrue Bayou and Little Lagrue Bayou. The Arkansas River forms the boundary for a portion of the southwestern part, and most of the southern portion of the County. Other streams that contribute to the drainage of the County are Little Bayou Meto, Rattlesnake Bayou, Salt Bayou, Two Prairie Bayou, Mill Bayou and Wabbaseka Bayou.

An important step taken in Arkansas County is that of draining the wet land. There are a number of drainage districts in the County which will drain approximately 12,000 acres of land, the construction of which cost about $200,000.00. This does not mean that Arkansas County is in the swamps, but that the value of the wet land warrants drainage.

The soil of Arkansas County is good--what one would expect on the outskirts of the Mississippi valley. Under normal conditions the County drains fairly well. The eastern edge and southern portion, however, are subject to floods during extreme high water on the White and Arkansas Rivers.

There are two stream gaging stations in the County, both in the vicinity of Stuttgart. Station No. 8 is on Little Lagrue Bayou in the White River Basin, and Station No. 13 is on Bayou Meto in the Arkansas River Basin.

There are few indications of large commercial mineral production in this County. The minerals produced here are clay, sand and gravel for local consumption. Near Stuttgart there is a deposit of red clay used in the manufacture of common brick. Several years ago this was one of the leading items of manufacture in the County. The sands and gravels produced are not taken from deposits underlying the surface, as these are irregularly bedded, and, in general, grade downward from fine, compact gray and reddish clay through fine sand to coarse water-bearing sands, and with gravel at the base. No attempt has been made to work these deposits as it could not be done profitably. The beds and bars of the White and Arkansas Rivers are estimated to contain vast quantities of both sand and gravel, and this is the source of the production of these minerals in the County. The equipment used are pump, power, and drainage boats and barges.

Seven test wells have been drilled in the County in a search for oil and gas, but no commercial production was obtained. The deepest test drilled was 3,235 feet.

Three railroads, one Federal Highway, seven State Highways and two navigable rivers give Arkansas County excellent transportation facilities. The main line of the St. Louis Southwestern Railway crosses the northwestern part of the County, passing through Stuttgart, with a branch line running south from Stuttgart to Gillett, in the south central part of the County. The Chicago, Rock Island & Pacific Railroad traverses the northern portion of the County and runs to Stuttgart. The Missouri Pacific crosses a small portion of the extreme southeastern part of the County.

The White and Arkansas Rivers are navigable on the eastern and southern boundaries of the County, and many tons of freight and agricultural products are shipped in and out of the County via boats and barges.

This County has made wonderful progress in the matter of road construction, which is a most valuable asset to any County. There are now about 500 miles of graded roads, and about $70,000.00 has been spent in the last five years in building roads; 184 miles have been graded, and an average of about $8,000.00 per year is spent in improvements. Federal Highway No. 79 crosses the northwestern part of the County, and State Highways No's 1, 11, 17, 30, 146, 152 and 153 cross and criscross the County in practically all directions.

This County has been included in a mapping program instituted by the State Geological Department, co-operating with the State Educational and Highway Departments, and some excellent base maps are now to be had. U.S.G.S. and M.R.C. quadrangle maps Stuttgart, Varner, Clarendon, De Witt, Indian Bay, Goldman, Henrico and Gillett completely cover the County. Highway and State topographic maps are also available.

ASHLEY COUNTY

Ashley County lies in the southern tier of counties of southeastern Arkansas and adjoins the State of Louisiana on the south. It is bounded on the north by Drew County; on the east by Chicot County, and on the west by Bradley and Union Counties. It has a land area of 601,600 acres.

This County is situated in the Mississippi River bottoms of the Gulf Coastal Plain. The soil is rich and alluvial and very productive. The County is generally level, practically all the land being first and second bottom land. The eastern section of the County is practically all Mississippi River bottom land; the western portion is generally a level prairie and pine forest land, and not so high priced as the land in the eastern part of the County. The semi-uplands of the County afford a red sand type of soil, with a clay subsoil, peculiar to parts of Oklahoma and Texas, which yields crops other than those common to the alluvial soil of the semi-bottom land, which light soil is well adapted to fruits, trucks and vegetables.

A soil survey has been made in Ashley County, and nine soil types have been mapped, viz:-

The Richmond Silt Loam
The Crowley Silt Loam
The Ruston Fine Sandy Loam
The Orangeburg Fine Sandy Loam
The Waverly Silt Loam
The Portland Very Fine Sandy Loam
The Portland Clay
The Vicksburg Silt Loam
The Boeuf Very Fine Sandy Loam

Swamps include the narrow strip of the first bottom occurring along the Saline and Ouachita Rivers and a strip of terrace formation most likely composed of the Waverly and Bouef soils, with interspersed sand and clay depressions. Owing to its inaccessibility, due to the high water, no attempt was made to separate this area into soil types.

Except for a small area in the north central part, where the Jackson formation appears at the surface, Ashley County is mantled by sands, gravels and loams of Quaternary and Recent age. Deep wells have passed through all of the Tertiary and the Cretaceous strata. Three wells have penetrated rocks which are believed to be older than the Cretaceous, and probably of Paleozoic age. These rocks contain no fossils, except small fragments of plant remains which were too fragmentary to be identified. The lithology and induration of these rocks differentiates them from the Trinity sediments, which have been cored in many wells; and, although their age is not determinable, they resemble the Paleozoic much more than the Trinity sediments.

The Comanche series, Cretaceous system, is represented in Ashley County chiefly by the Travis Peak formation of the Trinity Group, but it appears probable that the Travis Peak formation may be underlain by marine beds of Neocomian age in the western part of the County. The Travis Peak formation consists principally of red and brown clays, shales, sandy shales and light-colored to brown sands and sandstones. These beds have been penetrated to a depth of more than 600 feet in the western part of Ashley County, but their total thickness in that part of the County may be 1,400 to 1,500 feet.

The Gulf series, Cretaceous system, increases in thickness from east to west; it is less than 200 feet thick in the southeastern corner, and about 800 feet thick in the western part of the County.

The Tokio-Woodbine, consisting of non-red clays and sands in the lower part, is about 375 feet thick in the northwestern part, but decreases in thickness and lenses out in the eastern part of the County.

The Brownstown marl and the Ozan, are not recognized in Ashley County. The Brownstown marl lenses out in Union County, and the Ozan formation, if present in the western part of the County, is not separable from the upper part of the non-red Tokio-Woodbine section.

The Marlbrook marl consists of thin beds of marl and sandy marl, which becomes increasingly sandy towards the east. It is about 200 feet thick in the western part but decreases in thickness to the east where it is overlapped by the Saratoga chalk and the Nacatoch in the eastern part of the County.

The Nacatoch formation and the Saratoga chalk are not easily separated; they are about 300 feet thick in the northwestern part but decrease in thickness and change laterally in lithology to the east and southeast, where they are represented by the Monroe gas rock.

The Arkadelphia marl is present only in the western part of the County; in the eastern part it is either absent by non-deposition, lateral gradation into the Monroe gas rock, or it has been removed by erosion. It is 50 to 75 feet thick in the western part of Ashley County.

The Jackson formation crops out in a small area on the southern end of Monticello Ridge in the north central part of the County. This formation consists of sands, bluish-gray to greenish-gray clay, in part fossiliferous and glauconitic, inter-bedded with sand.

The Claiborne, which underlies all of Ashley County, is from 1,200 to 1,500 feet thick, with the greater thickness in the northeastern part of the County. The different formational units of the Claiborne, recognized elsewhere in Arkansas, are no doubt present in this area, but none of the deep wells have sampled and cored these sediments.

The Wilcox formation, made up of lignitic sands and clays, ranges in thickness from 600 feet in the western part to 1,000' feet in the northeastern part of the County.

The Midway formation is 400 to 500 feet thick and consists of gray and blue non-calcareous clays in the upper part, and calcareous and fossiliferous clays and shale, in the basal 25 to 50 feet of beds.

Alluvial deposits of Pleistocene and Recent age underlie the surface, except over Monticello Ridge, to depths of 150 to 175 feet.

Ashley County is situated in an area of the Gulf Coastal Plain that has been very productive of both oil and gas, but up to the present time no production has been obtained in this County. A number of test wells have been drilled in the County, one of them to a depth of nearly 6,000 feet, and sands have been encountered which have been productive of both oil and gas in Union County, just west of Ashley. In the past few months a drilling campaign has been started in this area, and most of the operators are drilling much deeper than has before been attempted. So far, each of these deep wells has come in as a producer, and it is not unlikely that Ashley County, with further deep well tests, may prove to be one of the oil and gas producing counties of the State.

The lowest elevation in the County, 63 feet, is about four miles west of the town of White, at U. S. Lock No. 6 on the Ouachita River; highest elevation, 187 feet, is at Mist, opposite Missouri Pacific Mile Post No. 454. A few of the representative towns with their respective elevations are as follows:-

Hamburg	177 feet	Parkdale	117 feet
Crossett	167 feet	Portland	129 feet
Montrose	126 feet		

The western part of Ashley County is drained by the Ouachita River and its tributaries; Saline River, Flat and Brushy Creeks. The Ouachita River forms the boundary of the County in the southwestern part. The Saline River forms the boundary in the northwestern part and empties into the Ouachita a few miles below Stillions. The south central part of the County is drained by Hanks Creek, Overflow Creek and Chemin

A Haut Creek. The eastern part of the County is drained by Bartholomew Bayou, which is also a tributary of the Ouachita River. This has been declared to be the largest and most crooked bayou in the World. It starts its meandering course in the east central portion of Arkansas, in Jefferson County, fifteen miles above Pine Bluff and runs parallel to the Mississippi Valley, emptying into the Ouachita River north of Monroe, Louisiana, flowing a total of 340 miles. In its rambling course, it winds its way through Jefferson, Lincoln, Desha, Drew, Chicot and Ashley Counties and into Morehouse Parish of Louisiana.

This crooked stream of water was named Bartholomew by the French settlers before Louisiana was bought for these United States by President Jefferson. It has been suggested that, under the present regime of improvement by the National Government, Bayou Bartholomew be cleaned out. If this Federal aid project could be devised, it would improve health and would give employment to many Arkansas people, as well as making the Bayou an avenue of traffic as it was in former days. It has been declared navigable from its mouth in Louisiana to Baxter, in Drew County, Arkansas. It is believed that it will not be necessary to do expensive work such as building levees. The banks on either side are much higher than the land level, making it almost impossible to overflow.

With its rivers and tributaries and drainage ditches, Ashley County is apparently well drained under normal flood conditions; but with extreme high water it would overflow, particularly in the southwestern part along the Ouachita River. There are no stream gaging stations in the County. Two additional stations are needed on streams that flow through the County, one at Tillar, Drew County, on Bayou Bartholomew, and one on the Saline River near Warren, Bradley County, Arkansas.

The flood plains of Bayou Bartholomew, in the western part of the County, slope gently from 130 feet in the north, to 110 feet above sea level in the south. They are separated from the Hamburg terrace by a line of low bluffs, or sharp slopes, about 30 feet in height. A series of low bluffs, 30 to 50 feet in height, separates the Hamburg terrace from the flood plains of the Saline and Ouachita Rivers, which form the western boundary of the County.

In the past few years the principal minerals produced in the County have been two kinds of clays (brick and pottery), sand and gravel. There are a number of deposits of alluvial "buckshot" clay found in the western part of the County. These deposits are being worked and used in the manufacture of common brick at Hamburg. Also near Hamburg are deposits of Tertiary clays suitable for common pottery. Clays that can be used in

the manufacture of pottery are exposed in several places in the deep cuts leading into the Saline River and Bayou Bartholomew.

The beds and bars of the Ouachita and Saline Rivers are estimated to contain vast quantities of both sand and gravel. This has been the source of the sand and gravel production for Ashley County. In the past few years there have been about sixty thousand dollars worth of these two minerals commercially produced in the County.

Ashley County has excellent transportation facilities, with five railroads, two Federal Highways and five State Highways. The Missouri Pacific crosses the County from north to south in the eastern part, with a branch line running through the central part of the County, connecting with the Chicago, Rock Island & Pacific and the Ashley, Drew & Northern at Crossett, Arkansas. The Ashley, Drew & Northern runs through the western part of the County from north to south, and the Rock Island enters the County in the southwestern part, with its terminus at Crossett. The Arkansas, Louisiana & Missouri Railway runs south from Crossett into Louisiana. The Louisiana & Pine Bluff Railroad crosses a small portion of the southwestern part of the County.

Federal Highways No's. 82 and 165 and State Highways No's. 8, 13, 52, 133 and 144 give first-class overland service. This County also enjoys water transportation. The Ouachita River, which borders the southwestern part, is a navigable stream and many tons of freight and agricultural products are handled each year by boats and barges which ply up and down this river. In a report of the United States Engineers, the Saline River and Bayou Bartholomew are listed as navigable, but only to snag and dredge boats.

The eastern part of the County is covered by M.R.C. quadrangle maps Wilmot, Lake Village, Eudora and Mist. The southwestern part is covered by U.S.G.S. quadrangles Ingalls and Felsenthal. The central part has not been mapped in detail. Excellent base maps may be obtained of this County as a result of a mapping program carried out by the State Geological Survey. Highway and State topographic maps are also available.

BAXTER COUNTY

Baxter County lies on the northern border of the State, midway between the east and west lines. It is bounded on the north by the State of Missouri, on the west by Marion and Searcy Counties, on the south by Stone County, and on the east by Fulton and Izard Counties. It has a land area of 375,040 acres and lies entirely in the Paleozoic region. The land ranges from rough to rolling, and is underlain with a limestone formation and a clay subsoil which is very productive. The rolling land is generally good for farming purposes.

In the extreme southern part of Baxter County is the Boone formation, consisting of chert and limestone which vary in amount both horizontally and vertically, a feature that makes the subdivision of the beds very difficult. Over large areas, however, the basal member of the formation, the St. Joe limestone, which is free from chert, is well exposed. Chert is found at nearly all horizons of the Boone formation above the St. Joe limestone. All the limestones of the Boone above the lower limestone member, are nearly pure calcium carbonate and are therefore very soluble, so that the ground water has formed in them a net-work of underground drainage channels. Many of these pure limestones are suitable for the manufacture of lime, but they have been utilized for this purpose at very few places. The beds, however, have been quarried at a number of localities, and they yield building stone of high quality.

The Boone formation, exclusive of the St. Joe, ranges in thickness from 300 to 350 feet thick. Below the chert and cherty limestone of the Boone formation lies the St. Joe member, a well marked bed of gray to pink crystalline limestone, easily recognized by its freedom from chert, its color, its texture, and its general contrast with the underlying and overlying beds. The St. Joe ranges in thickness from a feather edge to about 100 feet.

The Cotter dolomite, Ordovician age, consists largely of dolomite rock, but it includes shale, chert and sandstone, though in minor amounts. It is exposed over considerable area of Baxter County. The beds are made up of two kinds of dolomite, a massive, medium-grained, gray rock, which becomes dark on exposure, and a fine-grained, earthy, white to buff rock, known as "Cotton" rock. These two types are inter-bedded with each other and with thinner layers of sandstone or rarely of chert.

The St. Peter formation, Ordovician period, ordinarily rests unconformably upon the upper Everton limestone, but in places it overlies either the Kings River member of that formation or the Powell limestone. The St. Peter formation consists of well-rounded, medium sized, transparent quartz grains, which are cemented by a small amount of calcium carbonate. The rock is massive and friable and is porous, particularly where it is weathered.

The Everton limestone, Ordovician age, is composed of massive, compact blue-gray limestone inter-bedded with some friable white sandstone. The limestone is at most places magnesian. The middle part of the Everton, the Kings River sandstone, is the most wide-spread division of that formation. In its typical development it is a white, friable, finely laminated sandstone composed of well rounded medium sized quartz grains. At its base there are pebbles of chert and limestone which were derived from underlying formations. Its greatest thickness is about 40 feet.

The Powell limestone is exposed in a small area of Baxter County. Most of the Powell limestone effervesces readily with cold dilute hydrochloric acid, a reaction which cannot ordinarily be obtained with rock from the underlying Cotter dolomite.

The Jefferson City dolomite is the oldest formation that has been recognized in Arkansas north of the Arkansas River. It is exposed in the extreme northeastern part of the area of Paleozoic rocks of the Ozark region in Arkansas, principally in Baxter County. The beds consist of gray crystalline dolomite, ordinarily with considerable chert alternating with thin-bedded, fine-grained, lighter dolomite, without chert.

The lowest elevation in the County, 373 feet, is one and one-half miles east of The Missouri Pacific Railroad Station at Berry. Highest elevation, 1,350 feet, is on top of Three Brothers Mountain. A few of the representative towns with their respective elevations are as follows:-

Mountain Home	799 feet	Herron	382 feet
Cotter	440 feet	Cartney	414 feet
Norfolk	454 feet		

The rough rocky ridges, rolling upland and lower plateaus and valleys in this County, are well drained by the White River and its tributaries, chief of which is North Fork; this stream drains the eastern part of the County. Stream gaging stations are maintained on White River, near Flippin, and on North Fork at Henderson. Flow data is available. Floods are not prevalent in this upland country except possibly in the immediate bottoms of White River in times of high flood stage.

Baxter County has attracted much attention as a lead and zinc mining region, and these minerals have been commercially produced here. Considerable prospecting has been done, and there are indications of much larger production.

St. Joe marble, a formation also found here, along White River, has a great variety of color, texture and structure, ranging from a light pink to a dark chocolate, interspersed

with spots of white, gray or pea green. Other non-metallic minerals found in the County are onyx, phosphate rock, and sand and gravel.

There have been no test wells drilled for oil or gas in this County. There are a number of mineral springs here, one of which is the famous Lithia Spring six miles west of Mountain Home.

While the rough, rocky and mountainous surface makes road building costly, Baxter County has a very good system of highways. Good road building material is to be had in many parts of the County. Federal Highway No. 62 passes through the County from east to west, and State Highways No's 5, 101 and 126 intersect it at various points. The Missouri Pacific Railroad parallels White River along the western, southwestern and southern borders.

Good base maps of Baxter County are to be had, the State Geological Department having recently completed these maps. U.S.G.S. quadrangle maps Mountain Home, Yellville and Mountain View completely cover the County. Highway and State Topographic maps are also available.

BENTON COUNTY

Benton County, situated in the northwestern part of the State, is bounded on the north by Missouri; on the east by Carroll and Madison Counties; on the south by Washington County, and on the west by the State of Oklahoma. It has a land area of 360,640 acres.

This County lies in the Ozark Highland division of the Paleozoic region. The most of the County is a high, level plateau; 15 per cent is wooded land in the mountains, 35 per cent open prairie and the remainder rolling land. There are several varieties of soil in the County; The soil from Batesville sandstone, limited in extent, whose fertility is greatly increased by the use of lime; the soil from Boone chert covers by far the larger portion of Benton County, and is a very productive soil when limestones are present. The magnesium limestones afford a very productive soil. Other soils from Fayetteville and Eureka shale. The river bottoms are very productive.

The larger portion of Benton County lies in what is known as the Springfield Plateau of the Ozark region. A small area in the east central part lies in the Salem Plateau. The surface, for the most part rough, contains some areas which are only gently undulating, and which are called prairies locally. The rocks exposed, and those underlying the surface of the Springfield Plateau, are mostly of the Boone formation of the Mississippian period, or age, in the earth's history. This period followed the Devonian period, or the age of fishes. The Boone formation consists mostly of "chert" or flint and limestones. As the chert is a very hard formation and some of the limestones soft and soluble, much of the limestone has been washed and weathered away, leaving the hard chert exposed in different shapes and creating numerous caves and underground drainage channels. There are many different colors of chert, from white, gray and black to shades of brown, blue, green and red.

Among the limestones found here are the St. Joe, Powell and Clifty. Shales also are found here, and the Chattanooga shales exposed at places. All these formations carry fossils.

The above knowledge of the formations here has been obtained by a study of the surface rocks exposed, and also a study of the formations passed through in several test wells drilled in a search for oil and gas. No commercial production has been obtained, although several wells have produced gas in small quantities.

The lowest elevation in the County, 908 feet, is at Sulphur Springs. Highest elevation, 1,820 feet, is on Poor Mountain. A few of the representative towns with their respeative elevations are as follows:-

BOONE COUNTY

Boone County is one of the northern tier of counties, lying between Carroll and Marion Counties, and south of Taney County, Missouri, situated in the Ozark Mountains, with a land area of 389,120 acres.

This County lies in the Ozark region of the "Paleozoic" area of Arkansas. The soil is largely a sandy loam, rich in lime and phosphates. In the valleys the disintegrated limestones furnish a very productive soil. About one-third of the surface is a sandy loam and almost level. Considerable of the remainder is rolling prairie, and only about one-fourth is rough and rugged.

Boone County, with the exception of the northeastern part, lies in the Springfield Plateau of the Ozark region. The northeastern corner of the County lies in another plateau of the same region known as the Salem Plateau. The division between these plateaus, though quite irregular, is well marked by a hard formation of limestones and resistant "cherts" or rock, closely allied to flint. The Springfield Plateau, which is considerably higher than the Salem, stands between 1,000 and 1,500 feet high.

The elevation of the Salem is from 550 to 1,250 feet. The northeastern part of the County, lying in the Salem Plateau, is of the "Ordovician" period. This was the age when great land masses emerged from the water covering the earth's surface. The principal formations exposed, and those that under-lie the surface of this region, are limestones, dolomites and some sandstone. Dolomite is a combination of two silver white metals, calcium and magnesium. Common white marble is a form of dolomite. Some sections of the dolomite over 500 feet thick are found here. Limestones of this area are, at places, 200 feet thick and widely exposed.

The surface of the Springfield Plateau is very rough. The rocks exposed, and those underlying the surface of this area, are mostly of the Boone formation of the Mississippian period, or age. This was an age following the Devonian age, sometimes called the "Age of Fishes" and the "Ordovician" period, or age, during which time large bodies of land arose from the water on the earth's surface.

The Boone formation consists of chert and limestone. The chert is a very hard, abrasive formation, and the limestone much softer and soluble. Much of the limestone has been weathered away, and also washed away by surface streams, leaving the hard chert exposed in various shapes; also creating numerous caves and caverns and under-ground drainage channels. This chert varies in color from white, gray,

mottled gray and black, to shades of brown, blue, green and red. At places the chert contains evidence of fossils, which occur as "casts" or "molds." Below the chert and cherty limestones of this area lie beds of gray to pink crystalline limestone. This varies from a feather edge to about 100 feet in thickness and is known as St. Joe limestone. This limestone carries a large number of fossil molds of a great many varieties which have been studied in detail in determining the age of this formation in the earth's history. Most of the St. Joe limestone rests on a formation known as Chattanooga shale.

The lowest elevation in the County, 510 feet, is at Bull Shoal on the bank of White River. Highest elevation, 2,210 feet, is at Hill Top Post Office. A few of the representative towns with their respective elevations are as follows:-

Harrison	1052 feet	Francis	1,140 feet
Bergman	1191 feet	Omaha	1,354 feet
Myrtle	897 feet		

White River on the north and Buffalo River on the south, and their tributaries completely drain Boone County with the possible exception of the lowlands along the rivers in extreme high water. There are no stream gaging stations in this County.

The mineral resources of Boone County are its most valuable assets, consisting largely of lead, zinc and marble. Some of the richest "strikes" in the north Arkansas mining district have been made in Boone County, and it ranks third in the production of zinc concentrates. There are quarries of building stone at Alpena and Keener, and brick kilns at Harrison.

Boone County has extensive marble formations, but little has been done to exploit the marble industry in this County. There is a glass sand plant at Harrison, Arkansas, the County Seat of Boone County. Gravel is found in commercial quantities but is used within the County.

The Missouri & Arkansas Railroad and the White River branch of the Missouri Pacific afford Boone County fairly good railroad facilities. The Missouri & Arkansas runs from Alpena, in the western part of the County, through Everton in the southeastern part of the County. The Missouri Pacific runs from Omaha, in the northern part, to Zinc in the eastern part of the County. Federal Highways No's. 62 and 65, and State Highways No's. 7, 14 and 43 traverse the County from north to south and from east to west. There is no water

transportation in this County.

U.S.G.S. quadrangle maps Harrison and Yellville completely cover the County. Highway and State topographic maps are also available.

BRADLEY COUNTY

Bradley County, situated in the southern part of the State, is bounded on the south by Ashley and Union Counties; on the west by Calhoun County; on the north by Cleveland County, and on the east by Drew County. It has a land area of 421,790 acres.

This County lies in the lowlands of the Gulf Coastal Plain, and on the outskirts of the Mississippi bottom. The larger portion of the County is a slightly undulating upland, 250 to 300 feet above sea level in the northern part, but sloping southward to only about 100 feet above sea level, where it meets the flood plains of the Ouachita and Saline Rivers. The soil on the bottom lands is rich and very productive. The uplands are rich alluvial and sandy loam, responding quickly to fertilization.

In the western part of Bradley County the uplands present an abrupt change front towards the Saline River. The flood plain of Saline River slopes southward from 140 feet above sea level in the north to 65 feet in the south. The southern part of the County lies within the flood plain of the Ouachita and Saline Rivers.

The southwestern part of Bradley County is mantled with Quaternary deposits which also extend northward along Moro Creek and Saline River to the northern border of the County. The Cockfield formation of Claiborne age crops out in a generally southeast trending belt four to seven miles wide, which extends from the northwestern corner of the County to Sumpter on the Saline River. The Jackson formation crops out in the northwestern part of the County. Deep wells have penetrated all of the Tertiary and most of the Cretaceous sediments in southern Bradley County. Alluvial deposits of Pleistocene and Recent age underlie the southwestern part of the County to a maximum depth of about 100 feet.

The Tertiary sediments, Eocene series, are from 2,200 to 2,300 feet thick in the southern and southwestern part, but increase in thickness to the northeast. They are estimated to total more than 3,000 feet in the northeastern part of the County. The Midway formation maintains its regional lithologic characteristic and a nearly uniform thickness of 450 to 500 feet.

The Wilcox formation consists of lignitic sands and clays which are 600 feet thick in the southern part but increase in thickness to the northeast to an estimated thickness of about 1,000 feet in the northeastern part of the County. The Claiborne sediments increase in thickness in the same direction from 1,000 feet to 1,400 feet.

CRETACEOUS, GULF SERIES: The Gulf series maintains a fairly constant thickness of between 800 and 900 feet, but the formational units vary in thickness and in lithology. The Tokio-Woodbine section decreases in thickness and lenses out in the northern part of the County. The decrease in thickness of the red beds is in part compensated for by the increase in thickness of the upper, non-red member of the Tokio-Woodbine section.

The Ozan formation decreases in thickness and disappears in the eastern part of the County. The Nacatoch formation, Saratoga chalk, and Marlbrook marl increases in thickness to the east. The Arkadelphia marl decreases in thickness to the southeast.

CRETACEOUS-COMANCHE SERIES: The Comanche series, represented by the Travis Peak formation, is believed to underlie most, if not all, of Bradley County. The Travis Peak formation is separated from the overlying Gulf series by an unconformity which, toward the east, brings progressively older beds in contact with the basal beds of the Upper Cretaceous. It is estimated that the Travis Peak is not less than 1,000 feet thick in the western part of the County.

The basement rocks have not been reached in deep wells drilled in Bradley County. They are probably not less than 5,000 feet below the surface in any part of the area.

The lowest elevation in the County, 66 feet, is located 1.9 miles west of Moro Bay, on the Moro Bay-Hampton road. Highest elevation, 383 feet, is at Carey Junction. A few of the representative towns with their respective elevations are as follows:-

Saline	122 feet	Broad	107 feet
Hermitage	145 feet	Moro Bay	94 feet
Warren	205 feet		

The County is well drained by the Ouachita River in the southwest section, the interior being drained by Saline River and Moro Bay and their tributaries. The bottom land is fairly level, while the balance is gently rolling hills which assures perfect drainage. The lowlands in the southern part of the County are subject to floods from the Ouachita and Saline Rivers, as a rule, in early Spring. There are no stream gaging stations in this County.

Bradley County is located on the outskirts of the fuel mineral belt of the State; it has no coal, gas or oil production within its borders. Union County, which adjoins Bradley, is the largest gas and oil producing County in the

State. A number of test wells have been drilled in Bradley County, the deepest to date (November 22nd. 1937) being 5,195 feet, drilled by the Phillips Petroleum Company in the southwest part of the County in Section 28-16S-12W. This test, like a number of others drilled in the County, was dry, while many wells drilled through these same formations in Union County were producers. Recently, a new drilling campaign has been started in Bradley and surrounding counties, and it is planned to drill to possibly 8,000 feet or deeper. It is possible that when the wells that are being drilled at the present time reach the big lime, or Permian formation, they will strike oil and gas as they did in one well drilled in Union County.

The principal minerals being produced at the present time are sand, gravel and clays. The sand and gravel is taken from the beds and bars of the various streams that flow along or within the borders of the County. Moro Creek is the principal source at the present time; there is a gravel pit a few miles south of Banks which is also being worked in a small way from time to time. A deposit of alluvial clay is found in the vicinity of Warren suitable for the manufacture of common brick; this deposit is mined in a small way. There are also a number of pottery or Tertiary clays in the County located at Banks, Alga Bluff, Crawford's Bluff and Johnsville. These can be used in the manufacture of common pottery.

Bradley County is traversed by the Warren & Ouachita Valley Railroad, with direct connection with the Rock Island and a branch line of the Missouri Pacific at Warren, Arkansas. The County is also provided with well paved State Highways No's 4, 8 and 15, running north and south and east and west. In addition to these transportation facilities, the County authorities are carrying out a Farm to Market highway program which, within a few years, will make every part of the County accessible over improved highways to its centers of population. The Ouachita River is navigable, and each year food stuff and other material is shipped in and out of the County by way of this stream.

The southern and southwestern portions of the County are covered by U.S.G.S. quadrangle maps Felsenthal, Ingals and Moro Bay. The central and northern portions have not been mapped in detail.

CALHOUN COUNTY

Calhoun County lies in the second tier of southern counties and about midway of the State from east to west. It is bounded on the north by Dallas County; on the east by Bradley County; on the south by Union County, and on the west by Ouachita County. It has a land area of about 402,560 acres.

This County lies in that portion of the Mississippi valley known as the Gulf Coastal Plain. The northeastern part of the County is upland country, with an altitude varying from 250 to 300 feet that slopes southwestward to about 200 feet, where it meets the wide river terrace which separates the upland area from the flood plain of the Ouachita River.

A knowledge of the formations underlying the surface in this County has been obtained by a study of the exposed formations passed through in several test wells drilled in a search for oil and gas. The rocks penetrated at the deepest depth in some of the test wells drilled are believed to be the "basement" rocks of this area. The formation resting on these basement rocks in this County are of "Comanche" age in the earth's history, belonging to what is known as the "Travis Peak" formation of the "Trinity" group.

The "Comanche" age in the earth's formation was the lower period of the "Cretaceous" era, an era marked sometimes by sedimentary deposits of chalk and coal. The formations here consist chiefly of red clay and sand and are estimated to be about 2,000 feet thick in the southern part of the County, decreasing in thickness to the north and northeast. Marine beds probably underlie these formations in parts of the County.

Resting on the formations of Comanche age is a series of formations known as the "Gulf" series. These range in thickness from 650 feet to 1,000 feet, and consist of gray, black marls and shales, sands, clays and chalks and non-red sands and clays. Above the Gulf series of formations are formations of "Eocene" age, the age of mammals, grasses and land flora. The estimated thickness of these formations range from 1,700 to 2,500 feet, and consist of green and blue sands, clays and marls, "lignitic", or coal-bearing sands and clays, some of which carry casts of fossil remains in the bottom beds. Just below the surface, and resting on the "Eocene" age, are sands, gravel, clays and loams of the "Pleistocene" age, or the most recent age in the earth's history. These have an estimated thickness of 75 feet. Some of the formations encountered in the test wells drilled in this County have contained oil and gas, but not in sufficient quantities for commercial production.

Pottery clays have been found in practically inexhaustible quantities in the series of outcrops on both sides of Champanolle Creek and along larger streams, in the hillsides along the upper part of Locust Bayou, and on the east side of Bayou Two, near its head. Other formations are sand and gravel, and outcroppings of lignite is also shown in the northern part. Sand and gravel are the only two minerals in the County that have been produced commercially. There are no indications of metallic minerals in this County.

The lowest elevation in the County, 90 feet, is three miles southeast of Ebenezer church. Highest elevation, 338 feet, is at Thornton, opposite the St. Louis Southwestern Railway Mile Post No. 315. A few of the representative towns with their respective elevations are as follows:-

Hampton	200 feet	Woodbury	191 feet
Smead	211 feet	Harrell	203 feet
Tinsman	168 feet		

The County is drained by the Ouachita River and Moro Creek and their tributaries. On the average the drainage is quite adequate; however, the lowlands along the Ouachita River are flooded during extreme high water. There are no stream gaging stations in this County.

Calhoun County is served by two trunk line railroads, two Federal Highways and one State Highway. The Chicago, Rock Island & Pacific traverses the eastern part of the County from north to south, and the St. Louis Southwestern crosses the northwest corner of the County. Federal Highways No's. 79 and 167, and State Highway No. 4 cross the County from north to south and from east to west. The Ouachita River, which borders the western and southern parts of the County, is navigable and furnishes first-class facilities for marketing lumber and other products.

U.S.G.S. quadrangle maps Moro Bay and Camden cover the southeastern and northwestern parts of the County. The remainder of the County has not been mapped in detail. Excellent base maps, and Highway and State topographic maps are available.

CARROLL COUNTY

Carroll County, situated in the northwestern part of the State, is bounded on the north by Missouri; on the east by Boone County; on the south by Newton and Madison Counties, and on the west by Benton County. It has a land area of 410,240 acres.

This County lies in the Ozark Highland Physiographic division. The character of the County is that of a plateau, divided into a series of successive ridges by numerous clear creeks.

The area of the County lies in two plateaus, the Springfield Plateau and the Salem Plateau. The division between the two is very irregular, but well marked by an escarpment, or hard formation, of limestone and resistant chert or flint. The Springfield Plateau, standing between 1,000 and 1,500 feet high, is considerably above the Salem, which ranges from 500 to 1,250 feet. The latter plateau is of the "Ordovician" period, or age, in the earth's history, when great land masses emerged from the water covering the earth's surface. The principal rocks exposed, and those that underlie the surface, are limestones, dolomite (a combination of two silver white metals) and some sandstones. Common white marble is a form of dolomite. Some sections of dolomite over 500 feet thick are found in this County, while limestones of the area range up to 200 feet in thickness.

The rocks exposed, and those underlying the surface of the Springfield Plateau, which is very rough, are of the Boone formation of the "Mississippian" period, or the age in the earth's history following the "Devonian" age, sometimes called the "Age of Fishes." This formation is composed of cherts and limestones. As chert is a very hard, flinty formation, and the limestone much softer, surface streams have washed away much of the limestone in places, leaving the chert exposed in various shapes and creating a great number of caves and underground streams. The rock formations here carry evidence of fossil remains in the form of casts or molds. Below these upper formations lie beds of gray and pink crystalline limestone, known as "St. Joe" limestone; and this rests on a formation known as "Chattanooga" shale.

There is evidence of large mineral deposits in Carroll County, consisting of zinc, lead, limestone, phosphate, onyx, marble and building stone. Some of these have been quite extensively worked in the past, but there are still indications of a plentiful supply of these minerals. This County was included in the first geological survey of Arkansas in 1857 by David Dale Owen, first State Geologist. At that early date there were lead mines in the County, and he says, in his first report of a "Geological Reconnaissance of the Northern Counties of Arkansas:" "The lead ores of Carroll County are remarkable for their purity."

There are vast formations of St. Clair and St. Joe marble in Carroll County. The St. Joe marble on Pilot Mountain forms a conspicuous ledge 35 feet thick, and visible for several miles.

The caves near Eureka Springs and Dirst's Cave have beautiful onyx formations. The iron ores occur in the central part of the County, mostly within a radius of three to four miles of Berryville, Arkansas. Building stone is quarried. Eureka Springs is a noted health and recreational resort, and there are many other mineral springs in the County.

During the World War, and shortly after, when lead brought a good price on the World market, hundreds of tons was mined in this County; but since that time, owing to the low price of lead, the high cost of mining, and the lack of transportation facilities, there have been very few mines in operation since the war, and the production has been limited.

The lowest elevation in the County, 929 feet, is at Beaver; the highest elevation, 2,100 feet, is at Bee Bluff. A few of the representative towns with their respective elevations are as follows:-

Eureka Springs	1,463 feet	Green Forest	1,349 feet
Berryville	1,246 feet	Oak Hill	1,123 feet
Maple	1,210 feet		

The County is well drained by the White and Kings Rivers and their tributaries. Being located in the upland part of the State floods are not prevalent, except possibly in the lowlands along White and Kings Rivers. There are no stream gaging stations in this County.

The transportation facilities in this County are very good. The Missouri & Arkansas Railroad traverses the County from the northwest to the eastern part, being paralleled, for the most part, by Federal Highway No. 62. This overland route is known for its many beautiful scenes in a drive across the County. State Highways No's. 21, 23 and 103 run from north to south, and Highway No. 68 runs from the southern part to the eastern part of the County.

U.S.G.S. quadrangle maps Eureka Springs and Harrison completely cover the County. Highway and State topographic maps are also available.

CHICOT COUNTY

Chicot County, situated in the southeastern corner of the State, is bounded on the east by the Mississippi River; on the south by Louisiana; on the north by Desha County, and on the west by Ashley and Drew Counties. It has a land area of 388,480 acres, about one-third of which is second bottom land and two-thirds first bottom land, beginning at the Mississippi River and extending back from 10 to 20 miles to the foot hills. These lands are very productive.

A general knowledge of the different formations underlying the surface of the County has been obtained by a study of the exposed surface formations and also of the formations passed through in test wells drilled in a search for oil and gas. Immediately beneath the surface are found alluvial loams, clays and sands or rocks of the most recent age in the earth's history. This is called the "Pleistocene" age. These formations are estimated to be from 75 to 100 feet in thickness, and rest on formations of the "Eocene" age, or the age of mammals, grasses and land flora. These Eocene formations have an estimated thickness of 2,650 to 3,200 feet in the County, and range in character from sands and sandy clays to gray and blue clays, with casts of fossil remains and shale.

Beneath the Eocene formations lies a formation called the "Gulf Series", consisting of rock called "Monroe" gas rock in the southern part of the County, estimated to be 50 to 100 feet thick and increasing in thickness to about 500 feet in the northern part of the County, where it consists principally of fine-grained sand, with subordinate beds of limestone, shale and marl. The rocks upon which the above formations rest, called the basement rocks, have not been definitely identified as to age.

This County, lying in what is known as the Gulf Coastal Plain, is a flat wooded area, the altitude ranging from 100 to 148 feet. The lowest elevation, 107 feet, is 1.5 miles above Grand Lake. Highest elevation, 148 feet, is at Dermott. A few of the representative towns with their respective elevations are as follows:-

Lake Village	126 feet	Eudora	129 feet
Hudspeth	135 feet	Connerly	124 feet
Chicot	126 feet		

Chicot County is well drained by Big Bayou, Crooked Bayou, Macon Bayou and Boeuf River. A drainage district, comprising the whole County, was formed several years ago, and all land needing it has been drained. However, large portions of the

land in the County has been flooded by the Mississippi River at different times, notably by the 1927 floods; but with this exception the land is well drained and produces enormous crops. There are no stream gaging stations in this County.

Mineral production in Chicot County is not extensive. Brick clay and sand are the only mineral products of which we have any knowledge. Out of some 10 or 12 wells drilled in the County, two or three of them made a small showing of oil and gas, but not in sufficient quantity for commercial use, and the field has been abandoned for the present.

The Missouri Pacific Railroad passes through the northern part of the County. Federal Highways No's 65, 82 and 165, and State Highways No's 8, 35, 142, 144 and 159 give excellent overland transportation.

M.R.C. quadrangle maps McGehee, Lake Village, Refuge, Readland and Eudora completely cover the County. Highway and State topographic maps are also available.

CLARK COUNTY

Clark County is situated in the south central part of the State, between Hot Spring County on the north and Ouachita and Nevada Counties on the south. It has a land area of 564,480 acres. The northern part of the County lies in the Ozark Province of the Paleozoic uplift; the central and eastern parts lie in the Gulf Coastal Plain. The soils of the County are a deep, black land, red sandy loam, gray sandy, chocolate loam and mulatto. All of these soils are already very productive, or can be made so by proper cultivation.

Clark County lies in two distinct areas, the northern part in the Athens-Piedmont Plateau of the Ozark Province, and the central and southern parts lie in the Gulf Coastal Plain. The upper Cretaceous strata, striking northeast and dipping to the southeast, are exposed at the surface in the central part, and the Midway and Wilcox formations of Tertiary age form the surface rocks in the southeastern part of Clark County.

The Midway formation of the Tertiary Eocene Series is exposed in a northeast-trending belt four to six miles wide. The basal 20 to 25 feet of beds consists of slightly calcareous gray and greenish-gray clays which are fossiliferous in the lower part. The upper part consists of gray noncalcareous clay. The Midway formation is overlain by lignitic sands and clays of the Wilcox formation. The truncated edges of the southeastward dipping upper Cretaceous strata form the surface rocks in the central part of Clark County.

The Tokio formation overlaps the Woodbine sand to lie directly on the basement rocks. In the southeastern part of the County, where the Upper Cretaceous underlies the Tertiary strata, the Tokio-Woodbine section is from 150 to 170 feet thick and contains volcanic material in the lower part, which apparently is continuous into volcanic material, exposed at the surface to the west of Clark County.

The Gulf series in the southeastern part of the County ranges in thickness from 600 to 800 feet, with the greater thickness to the south. The sediments, except for the appearance of volcanic material, are essentially similar to sediments exposed at the surface.

Rocks of Comanche age are present only in the southern and southwestern parts of Clark County, where they are represented by red clays and sands of the Travis Peak formation. Their estimated thickness is 500 to 600 feet.

The Paleozoic rocks at the surface in the northern part

slope southward beneath the Cretaceous of the Coastal Plain to depths of 2,500 feet below sea level in the southeastern part of the County.

The lowest elevation in the County, 166 feet, is about four miles south of Whelen Springs along the Missouri Pacific Railroad. Highest elevation, 480 feet, is at Amity. A few of the representative towns with their respective elevations are as follows:-

Arkadelphia	246 feet	Okolona	424 feet
Hollywood	297 feet	Gurdon	207 feet
Summit	318 feet		

The northern part of the County is drained by the Caddo River; the southern part by the Little Missouri River; the western part by Antoine Creek, and the eastern and central portions by the Ouachita River and its largest tributary, Terre Noire Creek. The northern part of the County is high and mountainous, while the lowlands of the Ouachita and Little Missouri Rivers are subject to floods during high water. According to report of the U. S. Engineers, the Ouachita and Little Missouri Rivers are navigable to small snag and dredge boats. There are no stream gaging stations in this County. One is needed, however, on the Ouachita River at Arkadelphia for the purpose of gaging the flow of this stream.

Among minerals produced in Clark County are marls and marly limestone. The Cretaceous chalk beds are suitable for cement materials and compare favorably with the best English chalk. There are also beds of green sand, plateau gravel and Bingen sands, building sands, clays, lime, and cinnebar. Renewed interest has been awakened in the cinnebar mines.

The Midcontinent Quicksilver Corporation, operating near Amity, is turning out quantities of this metal. This Company has a $50,000 plant that has been in operation for several years. The Wheeler mine is one of the few in Clark County, most of this ore being located in Pike County. Mining Engineers believe this field will become one of the greatest quicksilver producing regions in the United States.

There are a number of clay deposits in the County. The principal, or at this time the most profitable, deposits are located at or in the vicinity of Gurdon, Arkadelphia and Whelen Springs where they are used in the manufacture of common brick. Fire brick and drain tile from Tertiary clays are also manufactured at Whelen Springs.

The gravel produced in Clark County is taken from two sources, part of it from a pit located in the vicinity of

Beirne, and part of it from the bars and bed of the Little Missouri River. From the latter comes all of the sand produced in the County.

The main line of the Missouri Pacific Railroad crosses the County from the northeast to the southwest. Federal Highway No. 67 and State Highways No's. 8, 26, 53 and 57 give good overland transportation.

U.S.G.S. quadrangle maps Gurdon and Camden cover the southern portion of the County. The central and northern parts have not been mapped in detail. Highway and State Topographic maps are available .

CLAY COUNTY

Clay County is situated in the extreme northeast corner of the State, in what is known as the lowlands of the Gulf Coastal Plain. It is bounded on the north and east by Missouri; on the south by Greene County and on the west by Randolph County. It has a land area of 418,560 acres.

The surface of the County is generally level, except an elevation known as Crowley's Ridge which runs through the County, and which affords a strip of hill country, with the bottom lands of the Cache, Black and Current Rivers on the west and the rich lands of the St. Francis River on the east side of the Ridge. This Ridge varies in elevation from 60 to 100 feet above the lowlands and is from one to ten miles wide.

Clay County lies in the Mississippi embayment of the Gulf Coastal Plain with the exception of a small area in the extreme northwest corner, which belongs to the Ozark Province of the "Paleozoic" uplift. There are three distinct topographic divisions of the County: "Crowley's Ridge", a broken, hilly area five to ten miles wide and 250 to 550 feet above sea level, extending from the northwest corner southwestward beyond the County line; the "Advance Lowland", a nearly level plain west of Crowley's Ridge, about 250 feet above sea level, and the "Mississippi Lowland" lying to the east of the Ridge.

The formations underlying the surface of Clay County are known from a study of the records of several test wells drilled in a search for oil and gas, and the knowledge gained of these formations is believed to be essentially accurate.

The "Paleozoic" formations, consisting of limestones and dolomites, which are exposed on the surface in the northwest corner of the County, dip to the southeast, uniformly, and are found at depths of 1400 to 1500 feet in the southeast corner of the County. These rocks are known as "basement" rocks of the Gulf Coastal Plain. Above these formations are formations known as "Cretaceous" rocks, or of the "Cretaceous" period in the earth's history. These formations, which underlie most of the County, vary in thickness from 500 feet downward, and consist of hard sands, dark shales and clays, and gray and green sands.

Above these formations of "Cretaceous" age lie formations of the "Eocene" period, or the age of mammals, grasses and land flora. These formations consist of sand and sandy clay, in parts lignitic, with darker clays below. They are estimated to be from 400 to 900 feet thick. Resting on these formations, and just below the surface, are formations of the

"Pleistocene", or "Recent" period in the earth's history. In that division of the County, known as Crowley's Ridge, the "Pleistocene" formations consist of light yellow to dark brown "Loess" like clays. To the west, in the Advance Lowland division of the County, are found alluvial sands, clays and gravels of the "Pleistocene" age from 150 to 200 feet in thickness.

The Mississippi Lowland division of the County, to the east of Crowley's Ridge, is also underlain by 150 feet of alluvial sands, clay and gravel of "Pleistocene", or"Recent" age. In some of the test wells drilled in the County, oil and gas-bearing sands have been found, but none carried a large enough quantity for commercial production.

The lowest elevation in the County, 262 feet, is one mile west of west Kennett. Highest elevation, 441 feet, is three miles northwest of Piggott. A few of the representative towns with their respective elevations are as follows:

Piggott	202 feet	Corning	290 feet
Knoble	282 feet	Rector	277 feet
St.Francis	298 feet		

Clay County has ample drainage. In addition to the St. Francis, Cache, Black and Current Rivers and their tributaries, there are fourteen drainage districts in the County which will drain every section of land that needs drainage. Three special drainage districts embracing 175 miles of ditches, drain all the land that needs drainage in about half of the County. With this adequate drainage, it is unlikely that Clay County will be subject to floods except in cases of extreme high water. There are no stream gaging stations in the County.

There are a number of mineral deposits in Clay County, among which are clays (both brick and pottery), gravel, sand, lignite, and ochre. At and in the vicinity of Rector, Piggott and Pratt, there are a number of red clay deposits. This clay is used in the manufacture of common red brick at the above named places. There are also deposits of Tertiary clays on Crowley's Ridge near Piggott and Greenway, and common pottery is manufactured at these points.

Crowley's Ridge, in northeastern Arkansas, contains immense quantities of gravel which is frequently exposed in road cuts and in a few of the railway cuts. In many instances the gravel extends to the top of the Ridge. Crowley's Ridge extends through Greene, Craighead, Poinsett, Cross, St. Francis and Clay Counties. All of these Counties produce large quantities of gravel . In the past few years, Clay

County's commercial gravel production has been over $250,000. This County could be one of the largest producers of sand in this section of the State, as the beds and bars of both Black and St. Francis Rivers are estimated to contain vast quantities of sand. The commercial production at the present time is just for local consumption.

The lignites of the Crowley's Ridge region, are all of Tertiary age. They occur in the form of outcrops along the streams and in gullies, with an occasional bed appearing in wells. The thickness of these lignite beds is exceedingly variable; usually they are less than five feet thick. It is also noticeable that the vertical distribution of the several beds is irregular, some of them occurring high up in the hills, while others are at their base or below it. So far as traced, all of these beds are independent of each other, having been formed at different times. They are generally in lenticular shapes, most of which cover but a few acres and many of them but a few hundred square yards. Their chemical analyses show that the Clay County lignites are the best. These deposits, or beds, have never been worked in Clay County.

Ochre is used as a coloring matter for tinted paints, and paints made with it as a base are often used for forming coats. It finds its most extensive use, however, as a filler in the manufacture of linoleum. There are deposits of yellow ochre at and in the vicinity of Piggott. These deposits have been worked in a small way from time to time.

The transportation facilities of Clay County consist of three trunk line railroads, two Federal Highways and three State Highways. The Missouri Pacific Railroad passes through the west central part of the County from north to south; the St. Louis Southwestern traverses the eastern part and the St. Louis & San Francisco crosses the northwest corner of the County. Federal Highways No's. 62 and 67, and State Highways No's. 1, 39 and 90 cover the County in practically every direction. The St. Francis River on the east and the Black River on the west are both navigable streams to small boats.

M.R.C. quadrangle maps Reyno, Knoble, Rector, Piggott, Kennett and Marmaduke completely cover the County. Highway and State topographic maps are also available.

CLEBURNE COUNTY

Cleburne County is situated in the north central part of the State in what is known as the "Paleozoic" or upland region of the State, about half way between Little Rock and the Missouri State line. It has a land area of 381,440 acres. The County is generally level and rolling, with some hills and mountains in the northern part. The soil of the valleys and lowlands is a strong alluvial top soil with a clay subsoil. The soil of the rolling hills is that which is found all over the State under the same circumstances, with probably more of the disintegrated limestone in it. The plateaus contain many rich and valuable farms.

This County lies in two divisions of the "Paleozoic" uplift area. The northern half of the County lies in the Boston Mountains, and the southern half in the Arkansas valley. The surface rocks of most of the Boston Mountain area are a sandstone, called the "Atoka" formation. This part of the County is rough and mountainous. Gorges 500 to 1,000 feet deep, which lie between steep ridges and jagged spurs, are common. The southern part of the County, which lies in the Arkansas valley area, is a gently undulating plain 300 to 600 feet high. Many ridges rise above this plain, however, as well as some broad-topped mountains. The surface rocks here consist of sandstones and shales. At some places in the County the division between the two areas above is marked by an abrupt escarpment; at other places, the Boston Mountains merge insensibly into the Arkansas valley plain.

Some knowledge of the formations beneath the surface in Cleburne County has been obtained by a study of the records of several test wells drilled here in a search for oil and gas. The Atoka sandstone, which is exposed at the surface in most of the County, is 1,400 to 1,700 feet thick. Interbedded with this sandstone are black and drab clay shales, massive gray to brown sandstone, with white quartz pebbles in the base.

Beneath the above formations lie a group of formations known as the "Morrow" group, consisting of shales, flaggy sandstones and brown sandy limestones; these average 50 to 275 feet in thickness; the entire Morrow group of formations probably having a total thickness ranging up to 400 feet. The Atoka sandstones and the Morrow group of formations are of the Pennsylvanian period, or the age marked by deposits of coal. Underlying these formations are found formations of the Mississippian period, an age just preceding the Pennsylvanian period. The formations found at this depth consist of sandstones, limestones, shales and chert, the latter a very hard, flinty formation. Some of the limestones and cherts found at this depth are of two earlier periods in the age of the earth called "Devonian" and "Silurian".

The total average thickness of these formations is estimated to be about 1,000 feet. Beneath these, are formations of a still earlier age called "Ordovician", or an age marked by the emergence of great bodies of land from the water on the earth's surface. Of course, all these formations found beneath the surface of the County, vary greatly in thickness as well as placement; and this variation can be roughly compared to the variation in the surface structure, ranging from rough mountainous country, with deep jagged ravines, to gently undulating hills.

The test wells drilled in the County were all northeast of Heber Springs, with the exception of one well which was drilled southwest of Heber Springs, and which was carried to a depth of 4360 feet with no commercial production. A trace of coal was found at a depth of less than 100 feet, but no attempt has been made to develop this mineral.

The lowest elevation in the County, 275 feet, is at Hiram. Highest elevation, 1360 feet, is on Pond Mountain. A few of the representative towns with their respective elevations are as follows:-

Heber Springs	364 feet	Quitman	593 feet
Higden	403 feet	Miller	285 feet
Edgemont	441 feet		

Cleburne County is well drained by Little Red River and Wolf Bayou and their tributaries; and as it is located in the upland section of the State, where hills and mountains prevail, particularly in the northern part, there is little danger of floods. Stream gaging station No. 9 is on Little Red River near Heber Springs.

The non-metallic mineral products found in Cleburne County are sandstones, brick clays, black marble, stone and gravel. The development of stone and gravel has been quite extensive and large profits have been made out of these minerals. Some lead and iron are to be found, but not in paying quantities.

The transportation of Cleburne County consists of the Missouri & Arkansas Railroad and State Highways No's. 5, 16 and 25. There is no water transportation in the County.

U.S.G.S. quadrangle maps Mountain View and Batesville cover the northern and central portions of the County. The southern part of the County has not been mapped in detail. Highway and state topographic maps are available.

CLEVELAND COUNTY

Cleveland County is situated in the south central portion of the State, due south of Little Rock, in the physiographic division, known as the Gulf Coastal Plain. It has a land area of 385,920 acres, and the soil varies from a hill loam to rich alluvial soils in the bottoms.

A knowledge of the formations underlying the surface in this County has been obtained by studies of the logs of test wells drilled here to different depths. In the western and northwestern parts of the County a formation known as the "Claiborne" is exposed at the surface, while in the remainder of the County, except on the flood plains of the streams traversing the area, a formation known as the "Jackson" is at the surface. These formations are of the "Eocene" age. Weathering of the Jackson formation has produced the "red lands" of this County. The formations above consist of sands, clay, sandy marls and lignitic sands and clays. These are, in part, covered at the surface with alluvial sands, gravels, clays and loams of "Pleistocene", or "Recent," age.

These formations are from 1,000 to 1,800 feet in thickness. Beneath them are formations called Wilcox and Midway, averaging 1,000 to 1,900 feet in thickness, and consisting of lignitic sands and clays, and gray to blue clays carrying casts of fossil remains in the lower beds. These formations rest on formations of the "Gulf Series" of the "Cretaceous" system. The "Gulf Series" immediately preceded the "Eocene" age, and are marked by deposits of chalk and coal.

Included in the "Gulf Series" of formations are the Nacatoch sand and Saratoga chalk, Marlbrook and Arkadelphia marl, and the Woodbine-Tokio formations. These formations range from gray to black marls and shales, carrying casts of fossil remains, "Calcareous" sands, clays, and sandy limestone, with chalky marls and shales.

In the bottom beds are found sands, with thin beds of clay and brown sand. These formations have a total thickness ranging from 400 to 1,200 feet, and rest on what are called the "Pleistocene," or basement rocks. These rocks are found at estimated depths ranging from 2,500 feet upward, and are the oldest formations penetrated in the County.

The lowest elevation in the County, 151 feet, is at Dwight. Highest elevation, 236 feet, is at Rison. A few of the representative towns with their respective elevations are as follows:-

Kingsland	213 feet	Pool	149 feet
Kedron	206 feet	Chowan	171 feet
Como	200 feet		

The Saline River and its tributaries drain the north and east portions of the County, while several small creeks, tributary to the Ouachita River, drain the southwest portion. Floods are not prevalent, and no stream gaging stations have been established in the County.

The minerals of Cleveland County consist of brick clay, sand and gravel; and it is believed that a small portion of the northwest quarter of the County is doubtless underlain by lignitic deposits, though no attempt has been made to develop this material, to our knowledge. Clay is being made into pressed brick at Kingsland.

There have been a number of test wells drilled in Cleveland County in a search for oil and gas. Some very good showings have been made of both, but not in paying quantities, and drilling operations in the County have been discontinued, at least temporarily. However, the County is located in an oil and gas area where drilling has been quite extensive, and it is highly probable that further explorations may be made at some future date to more definitely determine the possibilities of these minerals in paying quantities.

Cleveland County has good transportation facilities. It is traversed from the northeast to the southwest by the St. Louis Southwestern Railway. Federal Highways No's 79 and 167, and State Highways No's 8, 15 and 35 pass through the County. According to report of the United States Engineers, Saline River is a navigable stream to small boats.

The extreme northeast corner of the County is covered by Noble Lake M.R.C. quadrangle. The balance of the County has not been mapped in detail. Highway and State topographic maps are available.

COLUMBIA COUNTY

Columbia County, situated in the southwestern part of the State, is bounded on the north by Nevada County; on the south by the State of Louisiana; on the west by Lafayette County, and on the east by Union County. It has a land area of 502,400 acres.

This County is a dissected upland area situated on a broad ridge between the Ouachita and Red Rivers, and lies in the Gulf Coastal Plain. The surface of the County is generally rolling; the northern portion being slightly more rolling, and the southern part more level.

A distinguishing feature of the surface of the County is a broad ridge which forms the drainage divide between the Ouachita and Red Rivers and traverses the area from the north central part nearly to the southeastern corner of the County. The general level of the ridge is between 350 and 400 feet high; and westward the land slopes gently to merge with the broad flood plain of Dorcheat Bayou. Sands, gravels, clays and loams of "Pleistocene", or "Recent", age in the earth's history are at the surface, and extend to a depth of about 40 feet below. Also the rocks of the "Claiborne" formation are exposed on the surface of the entire County, with the exception of the southwestern part. Immediately beneath these formations lie the Wilcox and Midway formations, consisting of lignitic clays and sands, gray and blue clays, carrying casts of fossil remains in the lower beds. These are of the "Eocene" age in the earth's history, or the age of mammals and grasses. The total thickness of these formations is estimated to range from 1,600 to 2,000 feet.

The above formations rest on other formations of the "Gulf" series. These consist of gray shales, marls, chalks, sandstones and thin limestones in the upper strata, with lignitic sands and clays, sandy shale and red beds in the lower strata. The "Gulf" series range in thickness from about 1,100 feet in the northeastern to 1,650 feet in the southwestern part of the County. These formations are of an age in the earth's history marked by a deposit of chalk and coal. Underlying the "Gulf" series of formations are strata of the "Trinity" group, consisting of impure limestones, gray to green shales, inter-bedded with a very hard formation known as anhydrite, and with red clays and sandstones and marine limestone in the bottom beds. These formations are estimated to range upward from 2,000 feet in total thickness.

The above information on the strata beneath the surface of the County has been obtained by a study of the records of a great number of test wells drilled in all parts of the County in a search for oil and gas-bearing formations.

The lowest elevation in the County, 206.50 feet, is at Magnolia. Highest elevation 352 feet, is at Waldo. A few of the representative towns with their respective elevations are as follows:-

McNeill	322 feet	Taylor	247 feet
Emerson	310 feet	Macedonia	300 feet
Milner	216 feet		

The northern part of Columbia County is higher and slopes toward the southern part. There are no large streams, and little danger of floods. It is drained by the Dorcheat and Cornie Bayous and their tributaries. There are no stream gaging stations in this County.

Besides the producing wells in the Stephens field, in the northwest corner of the County, more than 100 "wildcat" test wells have been drilled in various parts of the County.

Among the non-metallic mineral products of the County are surface clays used for common brick; also deposits of pottery clays are found. Following up of the deeper creek beds and the examination of shallow well beds should lead to the discovery of other deposits.

The St. Louis Southwestern Railway runs diagonally through the northern part of the County. Federal Highways No's 79 and 82 and State Highways No's 3, 19, 57 and 132 cover the County in practically all directions, with Magnolia as their terminus.

This County lies in a section of the State not covered by quadrangle maps. Base maps, recently completed by the Geological Survey, and also Highway and State topographic maps are available.

CONWAY COUNTY

Conway County is near the central part of the State, lying between Van Buren County on the north; Perry County on the south; Faulkner County on the east, and Pope County on the west. It has a land area of 360,320 acres.

This County lies between the foot hills of the Ozark Mountains on the north and the Petit Jean Mountain on the south. The center of the County is crossed by the "Pigeon Roost" Mountains, a large flat-topped ridge, with an average width of about four miles on which are fertile uplands. The soils of the area have been classified into nine types, five of which are residual upland, and four, alluvial bottom soil. The upland soils have been correlated with the Fayetteville series and the bottom soils with the Wabash series.

The northern part of the County is rough and rugged on the surface, while the southern portion, along the Arkansas River, consists of lower, level bottom lands.

Exposed, and underlying the surface of this County, is a formation known as the "Atoka" sandstone. This formation is estimated to range from 1,500 to 9,000 feet in thickness, and consists of variable sandstones, dark to black shales, and some thin beds of coal. The Atoka formation is of the Pennsylvanian period, or the age marked by large deposits of coal.

Large surface irregularities in the area in which this County lies, such as the four mile ridge extending across the County, are indications of irregularities in the formations beneath the surface. In recent years, "Igneous" rocks of volcanic origin have been found in a few places in the County, notably near Morrilton. These rocks are similar to the volcanic rocks found in Pike County which bear diamonds; but a preliminary study has not determined the reason for their existence here, and no diamonds are found in this County.

Several test wells have been drilled in Conway County near Morrilton, but no oil-bearing sands were encountered; and since this County is far removed from oil producing territory in the State, the possibilities for this mineral in commercial quantities are not promising.

The lowest elevation in the County, 279 feet, is at Morrilton. Highest elevation, 1750 feet, is on top of Iron Ore Mountain. A few of the representative towns with their respective elevations are as follows:-

Cleveland	771 feet	Plummerville	292 feet
Germantown	307 feet	Menifee	287 feet
Blackville	329 feet		

Conway County is adequately drained by the Arkansas River and its tributaries, and by Point Remove Creek, which has a large tributary system. Other streams in the County which contribute to the drainage, are Cadron Creek, Cypress Creek and Prairie Creek. Floods rarely occur in the County except in the southern part along the Arkansas River bottoms which is flooded during extreme high water. There are no stream gaging stations in this County.

The mineral products of Conway County are limestone, sandstone, fire and pottery clays, sand and gravel. Clays, from which the iron has been dissolved, are available for the manufacture of coarse pottery. Such clays are to be found on the second bottom land of the Arkansas River, Point Remove and Cadron Creeks.

The Missouri Pacific Railroad crosses the County in the southern part from east to west. Federal Highway No. 64, and State Highways No's 9, 92, 95 and 124 furnish adequate overland transportation.

U.S.G.S. quadrangle map Morrilton completely covers the County, with the exception of the extreme southwest corner, which is covered by U.S.G.S. quadrangle map Dardanelle. Highway and State topographic maps are also available.

CRAIGHEAD COUNTY

Craighead County, situated in the northeastern part of the State, is bounded on the north by Greene County, on the east by Mississippi County, on the south by Poinsett County, and on the west by Lawrence and Jackson Counties. It has a land area of about 439,680 acres.

This County lies in the Gulf Coastal Plain. The surface is low and practically level, with the exception of Crowley's Ridge, which runs through the center of the County. Some of the area of the ridge is broken, but the greater part is in the form of rolling hills. About seven eighths of the level surface of the County is alluvial soil and very fertile, while the other one eighth is prairie.

A distinguishing feature of Craighead County is Crowley's Ridge, a belt of hilly land extending north and south through the County, rising to a minimum elevation of 200 to 225 feet above the lowlands to the east and west. From the northern boundary of the County southwest, to a point three or four miles south of Jonesboro, the ridge is 10 to 12 miles wide, narrowing at this point to a width of one-half mile to four miles. To the west of Crowley's Ridge the land is included in the "Advance lowlands," a gentle undulating plain, while to the east are the Mississippi lowlands.

The surface of Craighead County is covered with alluvial sands, clays and gravels, chiefly of "Pleistocene," or "Recent" age; but two formations of an earlier age, the "Eocene," crop out on the flanks of Crowley's Ridge. These are known as the Lafayette and Wilcox formations and consist of sand, gravel, clay and lignite. These formations range from 60 feet to 1,200 feet in thickness. A gray to dark-gray clay, called the Midway, underlies these formations to a depth of 100 feet to 400 feet. Beneath the above formations are found the "Gulf Series." These are of the Cretaceous system, an age marked by deposits of chalk and coal. The "Gulf Series" consist of shales, sandy shales, sands, chalks and limestone, and range from 200 feet to 600 feet in thickness. The Cretaceous strata above rests on a floor of basement, or "Paleozoic", rocks, ranging in depth from 700 feet in the northwest corner to 2,800 feet in the southeast corner of the County.

The lowest elevation in the County, 213 feet, is at Deep Landing on the St. Francis River. Highest elevation, 408 feet, is three miles southwest of Jonesboro on the northeast side of the highway. A few of the representative towns with their respective elevations are as follows:-

Jonesboro	336 feet	Lake City	230 feet
Nettleton	249 feet	Bono	262 feet
Monette	236 feet		

The County is drained by the Cache River and its tributaries on the west side of the ridge, and by the St. Francis River and its tributaries on the east side of the ridge. The extreme eastern part of the County is flooded during high water which overflows the St. Francis River. Neither of these streams is navigable except possibly to small boats. There are no stream gaging stations in the County.

The only mineral products of mention in Craighead County are clays, sand and gravel, the development of which has run to over a million dollars in the past few years. Crowley's Ridge in eastern Arkansas contains immense quantities of gravel which is frequently exposed in road cuts and in a few of the railway cuts. The gravel beds of Crowley's Ridge are of varying thickness, being deposited on a surface which indicates very considerable erosion at a period prior to their deposition. The gravels are made up mainly of a light colored chert, are generally well rounded or water-worn, rarely angular and always well polished. When in place they are always rudely assorted, cross-bedded and mingled with more or less sand. The gravel is considerably above the general level of the country, reaching often to the very tops of the highest hills.

The clay deposits in the County are at, and in the vicinity of Jonesboro; these deposits are used by the Jonesboro Brick Company in the manufacture of dry-pressed brick. The capacity of this plant is 6,500,000 pressed brick per year.

The sand produced in the County is taken from the beds and bars of the Cache and St. Francis Rivers.

Craighead County is especially favored with railroad facilities and access to the markets. The St. Louis & San Francisco, the St. Louis Southwestern, the Missouri Pacific, the Jonesboro, Lake City & Eastern, and the Bonnerville Southern, all run within its borders. The highways in the County have been wonderfully improved within recent years. Federal Highway No. 63, and State Highways No's 1, 18, 39, 91, 135 and 141 radiate over the County. There is no means of transportation by water in this County.

M.R.C. quadrangle maps Alicia, Marked Tree, Sedgwick, Dee, Jonesboro, Weiner, Leachville and Tuckerman completely cover the County. Highway and State Topographic maps are also available.

CRAWFORD COUNTY

Crawford County, situated in the northwestern part of the State, is bounded on the north by Washington County; on the south by Sebastian County; on the east by Franklin County, and on the west by the State of Oklahoma.

This County lies in the Boston Mountain area of the Paleozoic region. It has river bottom lands, creek bottom lands and uplands which change from the level flat lands to the rolling lands of the hills, and finally the mountain lands of the north. There are four distinct characters of soil in Crawford County. The soils of the Boston Mountain Plateau, not including the lowlands, lower plateaus and ridges of the Ouachita region along the Arkansas River, are predominantly Fayetteville soils. Associated with these are Hanceville soils and two groups which have been designated as Jamestown and Winslow soils.

There is a strip from two to six miles wide and twenty two miles long, of black, waxy river bottom land along the southern boundary. It is all level, deep, black soil and free from stone. The land lying directly north and adjoining this strip of bottom land is a plateau of chocolate and light colored soil on a red clay foundation. It drains well, but is not steep; there is some stone in places. The balance of the County lies to the north of this, and is broken, rough and mountainous.

This County lies in two divisions of the "Paleozoic" uplift. The northern part of the County is in the Boston Mountain section of the Ozark Plateau, while the southern part lies in the Arkansas valley of the Ouachita Province. The surface ranges from low bottom lands in the south to rugged mountainous country in the north. The surface formations, and those immediately underlying the surface in the southern part of the County, in the Arkansas valley area, consist of alluvial sands, gravels and clays which are of the "Pleistocene" or "Recent" age. In the northern part, the surface soil is immediately underlain with sandstones and sandy shales which outcrop in many places. Beneath these formations are found shales and sandstones of the "Pennsylvanian" period, an age marked by deposits of coal; and beds of coal are found beneath the surface here. These formations rest on strata of the "Mississippian" period, consisting of hard shales, sandstones and limestones.

A general knowledge of the underground rock has been obtained by a study of the logs of test wells drilled in the southern part of the County in a search for oil and gas. Gas-bearing sands have been penetrated here and large commercial gas production obtained. Natural gas production in this County has proven very profitable, and it is now one of

the largest gas producing fields in the State. This being a dry gas it is used very extensively for fuel.

The lowest elevation in the County, 235 feet, is at Alma. Highest elevation, 2,241 feet, is at the Bidville School. A few of the representative towns with their respective elevations are as follows:-

Van Buren	435 feet	Rudy	1,250 feet
Lancaster	622 feet	Armada	977 feet
Chester	842 feet		

Crawford County is well drained by the Arkansas and Mulberry Rivers and their tributaries, which are Cave Creek, Lee Creek, Jones Fork and Frog Bayou. The only part of the County that is subject to floods are the lowlands along the Arkansas River in the southern part of the County during extreme high water. There are three stream gaging stations in the County. Gaging Station No. 9 (as given in the Annual Report of the State Geological Department for the year 1935) is located on the Arkansas River at Van Buren, Arkansas. Gaging Station No. 11 is located on Lee Creek at Van Buren, and gaging station No. 12 is located on Jones Fork at Mountainburg, Arkansas.

There are two natural gas producing areas in Arkansas, (1) the area in the western end of the Arkansas valley, east and south of Fort Smith, including Scott, Sebastian, Johnson, and Crawford Counties, and (2) the area in southwestern Arkansas, which includes Union, Ouachita and Columbia Counties. The gas produced in these two areas originates in two entirely different series of rocks. The western Arkansas fields obtain gas from the Atoka shales of Pennsylvanian age, while the south Arkansas fields are supplied from the upper Cretaceous beds of the Coastal Plain.

The producing gas fields of Crawford County are known as the Kibler-Williams and Alma fields. Both of these fields derive their production from the Atoka formation which underlies the productive coal measure beds and makes up the surface of the eastern portion of the Arkansas River valley of the State. The Kibler field, which makes up the northern portion of the Kibler-Williams area, is located in southern Crawford County on the productive coal measure beds. The field was discovered in November, 1915, and covers an area of about 5,600 acres. There are two producing sands in this area which are encountered between approximately 1,115 and 1,500 feet, and 1,950 and 2,400 feet respectively. The first sand has a thickness of about 200 feet, and the second a thickness of 135 feet. The porous zones in the upper sand are about 30 feet in thickness and those in the lower sand

36 feet. The open flow on the largest wells in this field from the shallow sand, was about 3,000,000 cubic feet per day, and from the deep sand, about 21,000,000 cubic feet per day. The daily average production is about 4,000,000 cubic feet per day. The gas is used in Van Buren and Fort Smith for domestic and industrial purposes.

The Williams field was discovered in December, 1918, and makes up the southern portion of the Kibler-Williams area in southern Crawford County. The gas is produced from the Atoka sandstone and shale formation. The Williams field covers an area of about 7,600 acres and the two producing horizons are directly related to those of the Kibler field, but are 200 feet deeper. The shallow sand is encountered at approximately from 1,315 to 1,700 feet and the deep sand from 2,150 to 2,600 feet, and have thicknesses of approximately 200 and 135 feet respectively. The initial rock pressure of the gas in this field, when it was first discovered, was 220 pounds in the shallow, and 265 pounds in the lower sand. The present day rock pressure is about 100 pounds in each sand. The daily average of this field is between 8,000,000 and 10,000,000 cubic feet, and the gas from this field is also used in Van Buren and Fort Smith for domestic and industrial purposes.

The Alma field was discovered in October, 1922, and is located about two miles north of the Kibler-Williams area in southern Crawford County, near Alma. The production comes from the Atoka formation. The field covers an area of about 1,500 acres, and, as in the Kibler-Williams fields, there are two producing sands. The largest wells in this area have an open flow of about 30,000,000 cubic feet per day. The daily average production is about 2,900,000 feet from 30 wells, seven of which are from the shallow sand and 23 from the deep sand.

In addition to the Crawford County wells mentioned, there has been a recent extension of the Alma field covering probably 6,400 acres, and known as the Smelter area; this is now being developed. There is also a westwardly extension from the Williams field which covers about 2,000 acres, and this is also being developed.

Since this County has natural gas, the cheapest and best of fuels, a number of glass factories have located here. With the establishment of these factories at Van Buren, a more convenient market is afforded the valuable glass sands of the State. It is said that the Van Buren plants use more than 2,000 tons of sand a month. On April 3rd. 1937, the Arkansas Smelting Company of Van Buren reopened the smelting plant formerly operated by the American Mine & Smelting Company.

The plant is located just east of Van Buren, and has been idle since 1927. Efforts to reopen this plant have been made several times since it was closed ten years ago.

The non-metallic minerals to be found in Crawford County consist of the very finest of shale for manufacturing building and vitrified brick, drainage tile, and forms of hollow ware, is found here in ~~ex~~inexhaustible quantities. These shales produce building brick in color, and of an evenness that gives them high quality. Potters clay of a very fine quality is found near Van Buren. There are also large deposits of sand and gravel in this County, taken from the bars and bed of the Arkansas River.

There are some coal deposits in the eastern part of Crawford County, which is an eastern extension of the Oklahoma coal fields. There are no statistics available, however, as to the extent of the development of this product.

Crawford County is served by two trunk line railroads, two Federal and two State Highways. The St. Louis & San Francisco Railroad crosses the County from north to south, passing through Armada, Mountainburg, Chester, Rudy, and Van Buren, with a branch line connecting with the Missouri Pacific Railroad at Smelter, Arkansas. The Missouri Pacific crosses the County from the east to the southwest, and passes through Mulberry, Dyer, Alma, Smelter and Van Buren. Federal Highways No's. 64 and 71, and State Highways No's. 59 and 90 furnish excellent overland transportation. Federal Highway No. 71, running north from Alma, is one of the most beautiful scenic drives to be found in the United States. The Arkansas River, on the northern boundary, is navigable to small boats and barges.

U.S.G.S. quadrangle maps Winslow and Fort Smith completely cover the County. Highway and State topographic maps are also available.

CRITTENDEN COUNTY

Crittenden County lies in the eastern part of the State along the Mississippi River, just opposite the City of Memphis. It is bounded on the north by Poinsett and Mississippi Counties; on the east by the Mississippi River; on the south by St. Francis and Lee Counties, and on the west by Cross and St. Francis Counties. It has a land area of about 272,480 acres.

This County lies wholly within the Gulf Coastal Plain. The soil is a rich alluvial loam of the St. Francis Basin, and is one of the most productive in the world.

The surface rocks throughout this County consist of alluvial sands, gravels and clays of Pleistocene, or Recent age, and range up to 200 feet in thickness. Underlying these formations are strata of the "Eocene" age. These formations, consisting of sands and clays, partly lignitic, and gray to dark-gray clays in the bottom beds, range from 1,800 to 2,800 feet in thickness.

Beneath these formations are found dark gray shales, gray to greenish-gray sands, sandy shales and chalk. These are known as the "Gulf Series" of formations and are of an age known as "Cretaceous," marked by deposits of chalk and coal. The "Gulf Series" has a total thickness ranging from 700 to 900 feet. These formations rest on the basement, or "Paleozoic," rocks, the oldest formations yet penetrated in the County.

The above knowledge of the strata underlying the County has been obtained by a study of the records of several test wells drilled in the County in a search for oil and gas-bearing formations.

The lowest elevation in the County, 195 feet, is at Armstrong Bar. Highest elevation, 270 feet, is 0.75 miles west of Memphis at Harahan Bridge. A few of the representative towns with their respective elevations are as follows:-

Earle	224 feet	Marion	227 feet
Crawfordsville	221 feet	Turrell	219 feet
Hulbert	217 feet		

Crittenden County is well drained in the eastern portion by the Tyronza River. Big Creek, which empties into the Mississippi River, drains the north central part, and Black Fish and Fifteen Mile Bayous, which are tributaries of the Mississippi River, drain the southern and eastern parts of the County. During high water the County is flooded on the west by the St. Francis River and on the east by the Mississippi River. Prior to the erection of the St. Francis levee, a large portion of the County was subject to an annual overflow. There are no stream gaging stations in this County.

The only mineral product in the County is clay, and it is not in sufficient quantity for commercial production.

Two trunk line railroads, the Chicago, Rock Island & Pacific and the St. Louis & San Francisco and a branch of the Missouri Pacific cross the County, putting all sections within easy reach of the Memphis markets. Federal Highways No's 61, 63, 64, 70 and 79, and State Highways No's 75 and 147 lead from practically all sections of the County into Memphis. The Mississippi River gives this County the advantage of water transportation.

M.R.C. and U.S.G.S. quadrangle maps (Deckerville M.R.C., Edmonson M.R.C., Horseshoe M.R.C., and Memphis M.R.C., and U.S.G.S.) completely cover the County. Highway and State topographic maps are also available.

CROSS COUNTY

Cross County is situated in the eastern part of the State and joins Poinsett County on the north, St. Francis County on the south, Crittenden County on the east and Woodruff and Jackson Counties on the west. It has an approximate land area of 396,180 acres.

This County lies in the Gulf Coastal Plain, on the outskirts of the Mississippi River bottoms, and is generally level. The whole of the east side of the County is a portion of the great St. Francis Basin. About 128,000 acres of the section is alluvial and the most fertile to be found in the State.

Cross County is divided into three distinct subdivisions as to surface: Crowley's Ridge, the Advance Lowland and the Mississippi Lowland. Crowley's Ridge, a belt of hilly land three to six miles wide, extends north and south through the center of the County, and rises 120 to 150 feet above the lowlands to the west, known as the Advance Lowlands, and those to the east, the Mississippi Lowlands. The formations immediately beneath the surface in the County consist of alluvial sands, gravels, clays and loams of "Pleistocene," or "Recent" age. The bottom 50 feet, or core of Crowley's Ridge, is composed of sands and clays, in part lignitic, which are of "Eocene" age, or the age of mammals, grasses and land flora. The total thickness of these formations of "Eocene" age in this area varies from about 900 feet in the northwestern to 2,300 feet in the southeastern part of the County. Beneath the "Eocene" strata underlying Cross County, is a series of formations known as the "Gulf Series"; these are of the "Cretaceous" system, or an age marked by deposits of chalk and coal. This series of formations consists of dark gray to black shales, gray to green sands and sandstones, and gray to green shale and impure chalk. They range from 300 to 700 feet in thickness.

All of the above formations rest on what are known as "Paleozoic", or basement, rocks, which are found at a maximum depth of about 350 feet in the southeastern corner of the County.

The lowest elevation, 200 feet, is at River Front. Highest elevation, 284 feet, is at Cherry Valley. A few of the representative towns with their respective elevations are as follows:-

Wynne	265 feet	Cherry Valley	284 feet
Parkin	207 feet	Fair Oaks	219 feet
Vandale	277 feet		

This County is well drained by the St. Francis, Tyronza

and L'Anguille Rivers and their tributaries. The St. Francis and the Tyronza Rivers flow through the eastern part and the L'Anguille River through the western part of the County. Excellent water is obtainable throughout the County at a depth of from 35 to 100 feet. There are a number of beautiful lakes in the County. The lowlands are subject to floods from the three rivers, as a rule in early Spring, after an abnormal fall of rain. While there are no stream gaging stations in this County, information concerning the flow of St. Francis River may be obtained from the two gaging stations located just over the County line of Cross County on the St. Francis River at Marked Tree, Poinsett County, Arkansas.

The principal minerals produced in this County are clay (brick), sand and gravel. The higher portion of Crowley's Ridge is made up mainly of loess soil which forms excellent brick clay. The lower portions of the Ridge contain fire clays of good grade. Pottery clays probably lie in the more deeply exposed portions of the Ridge, which are made up of Tertiary beds. However, there is only one of the above mentioned clays being used in the County, brick clay. There is a brick kiln near Wynne, Arkansas.

Crowley's Ridge contains immense quantities of gravel, which is frequently exposed in road cuts and in a few of the railway cuts. In many instances the gravel extends to the tops of the Ridge. There are four large gravel pits located in the County, and each year thousands of tons of gravel are taken out of these pits and shipped throughout the State. There are no fuel minerals produced in the County.

The railroad facilities in Cross County add materially to its opportunities. The main line of the Missouri Pacific runs north and south on Crowley's Ridge. The Memphis branch of the Missouri Pacific runs east and west across the County, and the St. Louis Southwestern, "Cotton Belt" route, runs a little farther north through a general farming belt. Federal Highway No. 64, which crosses the County through the central part, and State Highways No's 1, 39, 42 and 75 give the County excellent overland transportation. According to report of the U. S. Engineers, the St. Francis River is navigable to small boats.

M. R. C. quadrangle maps Tilton, Hunter, Vanndale, Wynne, Princedale and Whitmore completely cover the County. Highway and State Topographic and County base maps are also available.

DALLAS COUNTY

Dallas County, situated in the south central part of the State, is bounded on the north by Hot Spring and Saline Counties, on the west by Clark County, on the east by Grant and Cleveland Counties, and on the south by Calhoun and Bradley Counties. It has a land area of 434,560 acres.

This County is a dissected upland area lying in the Gulf Coastal Plain. In the central part are broad, flat ridges forming the drainage between the Ouachita and Saline Rivers. The area adjacent to the ridges is dissected into more or less rugged hills, which, as they slope toward the Ouachita and Saline Rivers, become gently undulating. A ridge of hills runs through the County a little north of the center, and in a southeasterly direction, which divides the Ouachita and Saline River bottoms. The soil is of variations of the stiff clays and sandy loam uplands, to the rich alluvial bottoms. On the hills there is much sand and yellow clay. The soil of the uplands is a sandy alluvial, a red sandy clay, and sometimes a whitish clay. Along the Ouachita and Saline Rivers and their tributaries, there is a rich belt of strong alluvial soil, known as "buckshot," which is very productive.

Alluvial sands, clays and gravels underlie the surface of the County to a minimum depth of 50 feet; but the gravels found in the ridges are thought to be of an older formation than those of the flood plains, which are of "Pleistocene," or "Recent" age. Beneath these formations are found formations of the "Eocene" age, a period marked by the appearance of large mammals, grasses and land flora.

These "Eocene" strata consist of sands, clays and marl, in part lignitic, and gray to blue clay, with shale in the bottom beds carrying casts of fossil remains. The total thickness of these formations is estimated to be from 450 to 2,500 feet. Immediately beneath the "Eocene" formations are found a series of formations known as the "Gulf" series. This series, ranging from 400 to 700 feet in thickness, and consisting of gray to black shales and marls, calcareous sand, sandy shales and micaceous sand and sandstone, are of the Cretaceous system, or an age marked by the deposits of coal and chalk. The basement rocks, or formations, on which all the above strata rest, consist chiefly of quartz, sandstone, and hard, dark shales, and are found at depths ranging from 500 feet to 3,000 feet below sea level.

The lowest elevation in the County, 148 feet, is at Ouachita. Highest elevation, 480 feet, is at Tulip. A few of the representative towns with their respective elevations are as follows:-

Fordyce	148 feet	Dalark	242 feet
Princeton	244 feet	Manning	246 feet
Carthage	297 feet		

The County is adequately drained by the Ouachita and Saline Rivers. The lowlands along the rivers overflow during extreme high water, and most of the fertile lands are situated in this area. There are no stream gaging stations in this County.

The principal mineral production in Dallas County is that of gravel. It is used for road building purposes and consists almost entirely of chert, quartz and novaculite pebbles, and range from Lower Cretaceous to Quaternary.

Traces of two different kinds of Kaolin are found in Dallas County: Kaolin (clay) white, of fair refractoriness, outcrops in the Tertiary strata in the S.E. quarter of Sec. 10, T. 7, S. R. 17 W., and on Little Cypress Creek in the northwest corner of the County. Kaolin (aluminum silicate) has recently been discovered about 20 miles west of Fordyce. This is a valuable type of clay and very useful in the manufacture of brick, hollow tile, stoneware, and perhaps pottery, provided it holds its color and texture after burning. A more complete test will have to be made before the full value of the clay can be determined.

Pottery clays of excellent quality are abundantly and widely distributed in this County, and are easily accessible in practically unlimited quantities. They may be found in the exposures of the Tertiary deposits along the banks of creeks and in cuts.

Several test wells for gas and oil have been drilled in the County. The basement rocks recorded in these wells consist chiefly of quartzitic sandstone and hard, dark shales. Some of these test wells passed through the same sands which have been productive of gas and oil in other areas, and this should not be overlooked in summing up the future possibilities of this County.

The rail transportation of Dallas County consists of the St. Louis Southwestern Railway (Cotton Belt Route), the Chicago, Rock Island & Pacific Railroad, and some timber roads.

Federal Highways No's 79 and 167, and State Highways No's 7, 8, 9 and 48 give good overland transportation. There are no navigable streams in the County.

U.S.G.S. quadrangle map Camden covers the southwestern part of the County. The rest of the County has not been mapped in detail. Highway and State Topographic maps are available.

DESHA COUNTY

Desha County, situated in the southeastern part of the State, is bounded on the north by Arkansas and Phillips Counties; on the south by Chicot County; on the west by Lincoln and Drew Counties, and on the east by the Mississippi River, which forms a greater part of the eastern boundary. It has a land area of 478,080 acres.

This County lies in the Gulf Coastal Plain, and within the deepest part of the Desha Basin, a sedimentary basin developed principally in Eocene time. The County is generally level, with a few rolling hills in the western portion.

The soil of the County is of an exceptionally good quality, being almost entirely alluvial. The Arkansas, White and Mississippi Rivers touch the County, all of which add to the fertility of the soil. Generally, the soil is of a character that will produce well,any southern crop.

The general surface of Desha County is a gentle, undulating plain, sloping from an elevation of 175 feet above sea level in the northern part to 145 feet in the southern part of the County. The entire surface of the County is underlain by alluvial sands, clays and gravels of Pleistocene, or Recent age, and range from 100 to 200 feet in thickness.

Underlying the above formations are sands and clays, in part lignitic, with gray and dark-gray clays and shales in the bottom beds. These are of "Eocene" age. These "Eocene" formations reach their maximum thickness beneath the surface of the County, and are estimated to range from 3,000 to 5,000 feet thick. Beneath these formations are the "Gulf" series of formations, consisting of gray and black shales, fine textured sands and sandstone, with shales, marls and chalk, and perhaps red shale in the lower beds. These are of an age marked by deposits of chalk and coal. They are estimated to range from 400 to 1,000 feet in thickness. The basement rocks, on which all the above formations rest, are thought to range in depth from 4,000 to 6,000 feet below sea level.

The lowest elevation in the County, 97 feet, is at Arkansas City. Highest elevation, 178 feet, is at Lacona Landing. A few of the representative towns with their respective elevations are as follows:-

McGehee	149 feet	Watson	155 feet
Dumas	164 feet	Kelso	150 feet

The river and drainage system of this County consists of the White and Arkansas Rivers and their tributaries, Dayton

Bayou, Boggy Bayou and Cypress Creek. The Arkansas River flows from the northwest, down through the northern part of the County, and winds gradually down to where it empties into the Mississippi River in the east central part of the County. The White River flows through the northeastern part of the County, and the Mississippi River flows along the greater part of the eastern boundary.

The Cypress Creek drainage canal provides the largest drainage system in the world, and completely drains all wet lands. The lands of the County never overflow except when the Mississippi or Arkansas River levees break, which rarely occurs. However, this one feature has operated against an enhanced value of the real property. There are no stream gaging stations in this County.

Very few minerals are produced in Desha County, the largest production being that of sand and gravel. There is no coal, oil or gas produced in the County.

Three branches of the Missouri Pacific Railroad, Federal and State Highways and three rivers, all navigable streams, give Desha County good transportation. One branch of the Missouri Pacific enters the County from the northwest, passing through Gould, Dumas, Walnut Lake, Winchester, Tillar, McGehee and Dermott. Another branch enters the County from the northeast and passes through Yancopin, Watson, Kelso, Rohwer, McGehee and Arkansas City; with the third branch entering the County in the southern part, passing through Dermott and Halley. Federal Highways No's 65 and 166, and State Highways No's 1, 4, 35, 54 and 138 cross the County from north to south and from east to west.

The Arkansas and White Rivers, which flow within the borders of the County, and the Mississippi River, which forms the eastern boundary, afford this County good water transportation, and each year many tons of material is shipped both in and out of the County.

M.R.C. quadrangle maps Rotan, Redfork, Big Island, Lamont and McGehee completely cover the County. Highway and State topographic maps are also available.

DREW COUNTY

Drew County is situated in the southeastern part of the ~~County~~ STATE 40 miles west of the Mississippi River. It is bounded on the north by Lincoln County; on the east by Desha and Chicot Counties; on the south by Ashley County, and on the west by Bradley County. It has a land area of 542,080 acres.

This County lies in the Gulf Coastal Plain. The surface of the County may be roughly divided into three parts; The bottoms of Bayou Bartholomew on the east; the Saline River bottoms on the west, and the Dividing uplands in the center.

The soils of the County are of two principal kinds: The loamy alluvial soils in the Bartholomew and Saline bottoms, and the sandy loam of the uplands. The bottom soil will produce well any southern crop. Another type of soil is found in the prairies which will yield exceptionally well with good cultivation. The hill lands are a loamy soil with a clay foundation; they are easily cultivated and produce in abundance.

The chief distinguishing feature of the surface of the County is a ridge known as Monticello Ridge, which trends north-south through the west central part of the County. This ridge ranges in width from about 8 miles in the southern part to 12 miles in the northern part of the County, and its highest elevation is 300 feet above sea level.

To the east of Monticello Ridge is a gently south-eastward sloping terrace, known as Hamburg Terrace, while the area west of the ridge lies in the flood plain of the Saline River. The surface of the County, with the exception of Monticello Ridge, is underlain with alluvial sands, gravels and loams of Recent, or Pleistocene age, to a depth of 200 feet. Formations exposed, and those underlying the surface on Monticello Ridge, are of Eocene age. These formations consist of sands and clays, in part lignitic, and bearing casts of fossil remains, gray to blue clays and shales, carrying casts of fossil remains in the lower beds. In thickness these formations range upward to 3,000 feet. Underlying the above formations are the "Gulf" series, or formations, of the "Cretaceous" system, a period in the earth's history marked by deposits of chalk and coal.

The "Gulf" series consist of gray and black shales, fine-grained sandstones, chalks, and red clay in the bottom beds. They are estimated to range upward to 1,600 feet in thickness. The basement rocks, underlying the above strata, have not been reached in any of the few test wells drilled in the County in a search for oil and gas.

The lowest elevation in the County, 127 feet, is about 2,000 feet east of Jerome. Highest elevation, 273 feet, is at Monticello. A few of the representative towns with their respective elevations are as follows:-

Paradise	250 feet	Tillar	154 feet
Wilmar	148 feet	Florence	200 feet
Collins	168 feet		

Bayou Bartholomew on the east, and the Saline River on the west, with their tributaries, drain the level country, which is bisected by dividing uplands near the center. The eastern part of the County is in the lowlands, and is flooded during high water of the Mississippi River. There are no stream gaging stations in this County.

There is very little mineral production in this County. On and near the border of the highland there is some gravel production. These gravels consist almost entirely of chert, quartz and novaculite pebbles. There is also a showing of "buckshot" clays over the flood plains of the streams. This alluvial and leached "buckshot" is used near Monticello for making common brick. There is no indication of metallic minerals in this County.

Two branches of the Missouri Pacific Railroad, and the Ashley, Drew and Northern Railroad, with two Federal and two State Highways, give Drew County fairly good transportation. One branch of the Missouri Pacific crosses the extreme northeast corner of the County, while the other branch traverses the County from west to east. Federal Highways No's 65 and 165, and State Highways No's 4 and 25 afford good overland service. There is no water transportation in this County.

M.R.C. quadrangle maps Rotan, Cominto, Red Fork, Lake Village, McGehee and Mist cover the eastern part of the County. The western portion has not been mapped in detail. Highway and State topographic maps are available.

FAULKNER COUNTY

Faulkner County, situated in the geographical center of the State, is bounded on the north by Van Buren and Cleburne Counties; on the east by White County; on the south by Pulaski County, and on the west by Perry and Conway Counties. It has a land area of 416,640 acres.

This County lies in the Paleozoic uplift. The County is generally level, with some rolling lands and hills. The bottom lands adjacent to the streams are very fertile.

The County lies in two sections of the Ouachita Province. The northern part is in the Arkansas valley area, while the southern portion is in the Fourche Mountain area. Exposed, and underlying the surface of the County, is found a formation known as "Atoka" sandstone. This formation consists of dark to black shales, variable sandstones and some beds of coal, and is estimated to range from 1,500 to 9,000 feet in thickness. The Atoka sandstone is of the "Pennsylvanian" period, an age marked by large deposits of coal.

In the southern part of the County formations known as the "Jackfork" and "Stanley" lie beneath the Atoka sandstones. These formations of the "Mississippian" period consist of light gray, coarse-grained, massive sandstone, green clay shales, black cherty shales, and thin black cherts. They are estimated to range from 6,000 to 7,000 feet in thickness.

A great many of the surface irregularities and hills are indicative of the underlying structures here. From the records of a few test wells drilled in the County, the above estimated knowledge of the underground formations has been verified. No commercial production was found in any of the wells drilled, but good showings of oil and gas were made, and some of the structures here hold out promise for future development.

The lowest elevation in the County, 270 feet, is on the east curb of U. S. Highway No. 65 bridge over Palarm Creek, near Palarm Station. Highest elevation, 804 feet, is 17.9 miles east of Wooster, 141 feet south of well on Williams' farm. A few of the representative towns with their respective elevations are as follows:-

Conway	313 feet	Wooster	314 feet
Damascus	704 feet	Mayflower	287 feet
Preston	276 feet		

The County is drained by numerous streams; the principal of which are Cadron and Palarm Creeks. A large tributary system gives adequate drainage for the County.

A number of minerals have been discovered, but none of

them have been mined. Zinc, lead, manganese, and a few of the rarer minerals are known to occur in the County. "Buckshot" clays are abundantly distributed over flood plains of the streams, and pottery clays very probably exist along certain flat creek bottoms, such as Palarm Bayou, East Cadron Creek, and Bayou Meto. These clays have the major portion of the iron removed by the leaching action of the water on them. They are available for the manufacture of rough pottery.

Ths Missouri Pacific Railroad runs through the southwest corner of the County. Federal Highways No's 64 and 65, and State Highways No's 25 and 36 are the overland transportation routes. There is no water transportation in the County.

U.S.G.S. quadrangle maps Little Rock and Morrilton cover the extreme southern and southwestern portions of the County. The rest of the County has not been mapped in detail. Highway and State topographic maps are available.

FRANKLIN COUNTY

Franklin County is situated in the western part of the State, in the second tier of Counties from the Oklahoma State Line, and adjoining Crawford and Sebastian Counties. It has a land area of 387,840 acres.

The northern part of the County lies in the Boston Mountain area of the Ozark Plateau, and the central and southern parts in the Arkansas Valley area of the Ouachita Province; both being in the "Paleozoic region".

The County is divided into two parts by the Arkansas River. That portion immediately north of the river is largely rolling, and the northern section forms a spur of the Boston Mountains which enters from the north, and is mountainous. The portion south of the river is largely a level prairie with a few rolling hills.

The soil varies from a red clay in the mountains, to a dark loam in the bottoms. Generally, the prairies are underlain with clay and shales. Sandstone of the Pennsylvanian formation is the prevailing rock in the hills which forms, by disintegration, the yellow lands of the valleys.

The topography of Franklin County ranges from low bottom lands in the south, to rugged mountainous country in the north. The surface formations, and those immediately underlying the surface in the southern part of the County, in the Arkansas valley area, consist of alluvial sands, gravels and clays of "Pleistocene" or "Recent" age. In the northern part the surface soil is immediately underlain with sandstones and sandy shales which outcrop in many places. Beneath these formations are found shales and sandstones of the "Pennsylvanian" period, an age marked by deposits of coal; and beds of coal are found beneath the surface here. These formations rest on strata of the "Mississippian" period, consisting of hard shales, sandstone and limestone.

A study of the logs of test wells drilled in the central and southern parts of the County in a search for oil and gas, gives a general knowledge of the underground rock. These test wells did not show any oil, but gas-bearing sands were penetrated, and considerable commercial gas production obtained.

The lowest elevation in the County, 355 feet, is 3.5 miles east of Alix, two poles west of telegraph mile pole No. 453, on the Missouri Pacific Railroad. Highest elevation, 2,371 feet, is at Fly Gap, Lookout Tower, 1.75 miles northeast of intersection of State Highway No. 23. A few of the representative towns with their respective elevations are as follows:-

Ozark	450 feet	Denning	419 feet
Altus	537 feet	Charleston	510 feet
Branch	463 feet		

This County is well drained by the Arkansas and Mulberry Rivers and their tributaries. The Arkansas River flows through the central part, and the Mulberry River through the north central portion of the County. The only lands subject to overflow are those along the Arkansas River at flood stage. There are no stream gaging stations in the County.

The principal commercially mined minerals in this County are coal and gas. The entire section of the County, beginning a few miles south of the Arkansas River, is underlain with coal. Another coal belt is found just north of the river. The great coal fields of Arkansas surround this section in Franklin, Logan, Sebastian and Johnson Counties. The mines at Denning are the most important in the County.

Other mineral products are clays, lime, stone, dolomites and iron; but none of these are produced commercially. The clays are unevenly distributed in this area, and are of little commercial value. The iron ores in this part of the State, aside from any question of quality, are in too small quantities to be profitably worked. During the years 1930 and 1931 there was some gravel produced commercially.

The transportation facilities in Franklin County are very adequate. It is served by two branches of the Missouri Pacific Railroad and by Federal and State Highways. One branch of the Missouri Pacific traverses the County through the central portion; and, for the most part, it parallels the Arkansas River and passes through Altus, Ozark and Webb City. The other branch runs through the southern part of the County, passing through Charleston and Branch, paralleling State Highway No. 22, which is a paved concrete highway, leading down the valley from Fort Smith, and is one of the most picturesque drives in the State. Federal Highway No. 64 crosses the County from west to east.

U.S.G.S. quadrangle maps Magazine Mountain, Fort Smith, Watalula and Winslow completely cover the County. Highway and State Topographic maps are also available.

FULTON COUNTY

Fulton County, situated in the northern part of the State, is bounded on the north by Missouri, on the east by ~~Randolph~~ SHARP County, on the south by Izard and Sharp Counties, and on the west by Baxter County. It has a land area of 400,000 acres.

This County lies in the Salem Plateau, a section of the Ozark highlands, which is a part of the Paleozoic uplift. The County is generally rolling, with some hills and considerable valley land. The soils of the hills are of limestone formation, and in the valleys the soil is a dark loam, derived from the decaying limestone, with a very dark red clay subsoil under it all.

The surface of Fulton County is underlain with a limestone formation and a clay subsoil. The formations underlying the surface, and partially exposed, are of the Ordovician period. This was a period marked by the emergence of great masses of land from the water which covered the earth's surface. These formations consist of limestones, sandstones, some shale and dolomite. The limestones of this formation range from white, pink, gray, dark-gray to blue, blue-gray and drab in color; and from fine to coarse-grained in texture. These formations are estimated to range up to 2,000 feet in total thickness.

The lowest elevation in the County, 423 feet, is at Many Islands. Highest elevation, 1,000 feet, is at Bexar and Byron. A few of the representative towns with their respective elevations are as follows:-

Mammoth Spring	548 feet	Salem	663 feet
Viola	692 feet	Wild Cherry	918 feet
South Fork	500 feet		

Fulton County has the unique distinction of having the largest spring in the World (Mammoth Spring) and the second largest hydro-electric plant in the State. Mammoth Spring flows like a great river from the side of a low rocky ridge; the water being clear and has an even temperature of 60 degrees fahrenheit. The discharge is estimated at 9,000 barrels a minute, and so large an amount of carbonic acid is held in solution that the surface of the wonderful fountain is in a continual state of effervescence.

This spring is the source of Spring River, and the Arkansas-Missouri Power Company has built two dams and power plants on the river from which electric power is generated for the city of Mammoth Spring and vicinity.

The County is well drained by numerous small streams, none of which are navigable. None of the area is subject to floods. There are no stream gaging stations in the County.

This County lies in the outskirts of the "mineral belt" in Arkansas, and the formations beneath the surface are evidence of mineral deposits consisting of carbonate of zinc, iron, silver, and gold in very small quantities. Development of any of these minerals has been very slow owing to poor transportation facilities and the rough and rugged surface.

There have been attempts to develop oil and gas in this County, but without success.

The St. Louis & San Francisco Railroad crosses the eastern section of the County, passing through Mammoth Spring. The overland transportation is Federal Highway No. 62 and State Highway No. 9.

The western part of the County is covered by U.S.G.S. quadrangle map Mountain Home. The rest of the County has not been mapped in detail. State topographic and geologic maps, county base maps and highway maps are available.

GARLAND COUNTY

Garland County, situated in the west central portion of the State, is bounded on the north by Perry and Yell Counties, on the east by Saline County, on the north by Hot Spring County, and on the west by Montgomery County. It has a land area of 403,840 acres.

This County lies in the Ouachita Province of the Paleozoic region. It is entirely within the hill and mountain country, but the slopes and plateaus contain much fertile soil, with thousands of acres of rich alluvial soil along the stream beds.

The lowest elevation in the County is 335 feet at Spring Lake. The highest elevation, 2000 feet, is at Ouachita Pinnacle and Blue Mountain.

A few of the representative towns with their respective elevations are as follows:-

Hot Springs	608 feet	Gladstone	804 feet
Alapco	405 feet	Gulpha	450 feet
Meaford	526 feet		

Garland County is crossed by the Ouachita River into which flow many clear mountain brooks from both north and south. The Ouachita River and its tributaries provide excellent drainage for the entire County. Since the construction of the Remmel and Carpenter Dams, floods are practically unknown. Discharge measurements of the Ouachita River are made at both of the above mentioned dams.

The principal formation exposed on the mountains in this County, is Arkansas novaculite. In the basins, the formations exposed consist of shales, sandstone, small amounts of limestone and chert.

The quartz veins and crystals in the Crystal Mountains, in small areas, are of the Cambrian Age, and are very interesting and have attracted much attention. The most profitable minerals in Garland County are slate and whetrocks (the latter from the novaculite formations) which are being quarried and shipped in considerable quantities.

CHERT:	Large deposits (Big Fork Chert) mined for road building at Hot Springs.
CLAY (BRICK)	Alluvial and residual clays and carboniferous shales used for common red brick at Hot Springs. Saline County Tertiary clays, also found in Garland County, used for fire brick at Benton, Arkansas.

CLAY (KAOLIN)	Used to form a base for porcelain.
CLAY (POTTERY)	Residual clays from "Paleozoic" shales at Hot Springs and on Cedar Mountain, formerly used for pottery.
FLUORSPAR:	The mineral "Fluorite," a transparent or translucent mineral of many colors and use, to promote fusion or state of fluidity or flowing from heat of metals or minerals.
GALENA (LEAD ORE)	This has been found sparingly near Blakely Creek.
MALACHITE:	A native green basis carbonate of copper, is found at Hot Springs, a ledge several feet in thickness in a stream bed on Cedar Street.
MICA (BIOTITE)	This mineral is found at Potash Sulphur Springs, but is not mined. It is a group of mineral silicates that readily separate, and is popularly called "isinglass."
PYRITE:	This mineral is found two miles west of Hot Springs on the south slope of West Mountain, probably suitable for sulphuric acid.
QUARTZ:	Clear crystals found in Blakely Mountains, and used for ornaments and lenses. With the exception of water, this is the commonest of minerals.
RECTORITE:	The deposits of this mineral are about a foot in thickness and found in association with sandstones.
SANDSTONE:	Building and crushed stone, quarried at Hot Springs, and produced commercially.
SILVER:	With pyrite,fluorite and chalcedony, is found near Lawrence, but not in commercial quantities.
SYENITE (OR GRAY GRANITE)	This is found at Potash Sulphur Springs, but not produced commercially.
TRIPOLI (OR POLISHING POWDER)	This mineral occurs as decomposed NOVACULITE (Whetstones) in Hot Springs, but not mined commercially.

WAVELLITE: A basin phosphate of aluminum found near Hot Springs, but no production.

BARITE: (HEAVY SPAR) This is a native sulphate of Barium, or an alkali. Not mined commercially.

QUARTZ CRYSTALS: Quartz crystals of wonderful lustre and form, are found in many parts of Arkansas, notably in the vicinity of Hot Springs, Garland County, in the Crystal Mountains, which it is said has furnished some of the largest and most beautiful quartz crystals in the World. Cavities in the rocks are beautifully coated with these sparkling gems, many of them of rare color and shape; some of them with liquid cavities. They are non-mineral bearing, and are valuable chiefly as curios or ornaments, being known as "Hot Springs diamonds" because of their manufacture into trinkets and jewelry for sale as souvenirs to visitors at Arkansas' famous health resort.

The hot springs, 46 in number, flow from the west slope and from the foot of Hot Springs Mountain, within a small tract of two or three acres. The daily discharge is about one million gallons, at an average temperature of 140 degrees fahrenheit. The water is controlled and dispersed by the Government to bath houses at a fixed charge per tub of $30.00 per year. Every bath house using water is subject to the rules and regulations made by the Interior Department, the enforcement of which is in a resident superintendent appointed by the same Department.

Twenty-three bath houses dispense the baths to the visiting public. There are nearly 600 tubs, and a total of over one million baths given annually. According to statement of Mr. George Bolton, Assistant Superintendent of the National Park at Hot Springs, more paid baths were given in March, 1937, than in any month since 1929, the total being 97,434, and an increase of 13,572 over March, 1936. The record for baths in one month was in March 1929, with 105,104. During the first three months of this year, all of which have shown increases over the same months of the previous year, 211,286 baths were given; or an increase of 34,922 over the same three months of 1936.

This County has ample transportation facilities. Two trunk line railroads, the Missouri Pacific and Chicago, Rock Island & Pacific have terminals at Hot Springs. Motor bus transportation and trucking facilities are offered over Federal Highways number 70 and 270, and State Highway number 7.

The United States Geological Survey quadrangle maps Hot Springs, Hot Springs and vicinity and Benton cover the County, except the southwest corner which has never been mapped in detail. Base maps, Highway and State Topographic and Geological maps are available.

GRANT COUNTY

Grant County, situated in the south central part of the State, is bounded on the north by Saline County, on the east by Jefferson County, on the south by Dallas and Cleveland Counties, and on the west by Hot Spring County. It has a land area of 407,680 acres.

This County lies in the physiographic province known as the Gulf Coastal Plain, and it is adequately drained by the Saline River and numerous creeks. The higher lands, consisting of light sandy loam underlaid with red clay and gravel, present a gently rolling surface that drains well without destructive erosion. In the broad valleys of the Saline River and Hurricane, Denison, Lost and Francois Creeks, the soil is a dark rich alluvium, and with good cultivation will produce abundantly all southern crops.

The flood plain of the Saline River slopes gently to the southeast, and is about three miles wide in the northwest part of the County, and widens out to about six miles in the southeast part of the County. This flood plain is underlain with sand, gravel and loams of the Recent Age. Beneath these alluvial deposits are found several formations of the Eocene Age, consisting of dark lignitic sands, clays and marls.

The lowest elevation in the County, 219 feet, is at Vicks. Highest elevation, 358 feet, is 2.7 miles north of Walnut Ridge school.

A few of the representative towns, with their respective elevations are as follows:-

Leola	261 feet	Poyen	230 feet
Prattsville	250 feet	Sheridan	237 feet
Nydia	245 feet		

Purely local floods rarely occur. General floods however, well cover the flood plain of the Saline River and its tributary creeks.

A considerable portion of this County is in forests, most of which are privately owned and are protected from fire through an agreement with the State Forestry Commission. The balance of the land is used for agricultural purposes.

Little can be said of minerals in this County. Some gravel has been mined for local road construction, and a small amount of pottery clay has been used in local pottery plants. Numerous test wells for oil and gas have been drilled in Grant

County and some showing has been made, but only in very small quantities. These tests, however, have encountered the same formations which have been productive in other nearby Counties and there is a possibility that systematic exploration might result in finding oil in commercial quantities.

The transportation facilities of this County are very good. The Missouri Pacific Railroad and the Chicago Rock Island & Pacific Railroad cross the County. The highway system consists of Federal Highways number 167 and 270 and State Highways number 35, 46 and 113. There are no navigable streams in the County.

The United States Geological Survey quadrangle map Pastoria covers the extreme northeast edge of the County. The rest of the County has not been mapped in detail. Good base maps, Highway and State Topographic maps are available.

GREENE COUNTY

Greene County, situated in the northeastern part of the State, is bounded on the north by Clay County, on the east by the St. Francis River, on the south by Craighead County, and on the west by Randolph County and Lawrence Counties. It has a land area of 359,040 acres.

This County lies entirely within the Gulf Coastal Plain. The whole of the east side is in the great St. Francis Basin. The County is divided by Crowley's Ridge, which is about 200 feet higher than the surrounding country. The soil on the ridge is a dark clay loam, with enough sand intermixed to make it work easily, while the bottom lands are covered by a dark alluvium. The lowest elevation in the County, 242 feet, is at Brighton. Highest elevation, 525 feet, is six miles northeast of Lorado in front yard of farm house. A few of the representative towns with their respective elevations are as follows:-

Paragould	283 feet	Marmaduke	273 feet
Halliday	279 feet	Redhill	377 feet
Bard	248 feet		

The County is well drained, on the west by the Cache River and its tributaries, and on the east side of Crowley's Ridge by the great St. Francis Basin. More than two-thirds of the area is bottom land, only a small portion of which is subject to occasional overflows; and possibly only about one seventh of the entire area is affected when the water reaches flood stage. There are no stream gaging stations in the County.

The surface of Greene County, lying entirely within the Gulf Coastal Plain, is marked by a belt of hilly land 8 to 12 miles wide, extending northeast and southwest through the center of the County, known as "Crowley's Ridge." To the west of Crowley's Ridge is a gentle, undulating plain known as the Advance lowland, while to the east all the country is in the Mississippi lowlands.

With the exception of a small area on the flanks of Crowley's Ridge, the surface is mantled by sands, gravels and clays of "Pleistocene", or "Recent" age to a depth ranging up to 175 feet. Underlying the above formations to a total estimated depth of 1200 feet, are lignitic sands and clays and bluish-gray clays of the "Eocene" age. This was an age marked by the appearance of mammals, grasses and land flora.

Beneath this strata of "Eocene" age are found gray to green sands and shales, calcareous sandstones and marls which attain a maximum thickness of 400 to 500 feet, and are known as the "Gulf" series of the "Cretaceous" era. The basement, or "Paleozoic" rocks, upon which all the above formations rest, probably consist of limestone and dolomites similar to those which crop out in the Ozark Mountains to the west of Greene County.

This County produces a small quantity of glass sand, brick and pottery clays, but none of these are mined commercially. Crowley's Ridge contains immense quantities of gravel which is frequently exposed in road and railway cuts. In many instances the gravel extends to the top of the ridge. Tons of gravel are shipped from this County every year.

No metallic minerals are found here and there are no productive oil and gas wells in the County. Six test wells have been drilled in the County in a search for oil and gas, but the showing of neither was sufficient to justify further explorations and future possibilities for these minerals are yet to be determined.

Greene County is especially favored with good transportation facilities. The Missouri Pacific and the St. Louis Southwestern and their branch lines cover all parts of the County. State Highways No's 1, 25, 34, 39, 90, 135 and 141 give good overland service. There are no Federal Highways in this County, and no water transportation.

M.R.C. quadrangle maps Walnut Ridge, Jonesboro, Marmaduke, Leachville, Gainesville, Sedgwick, Reyno, Knobel, Rector, and Kennett completely cover the County. Good base maps prepared by the State Geological Survey and also Highway and State Topographic maps are available.

HEMPSTEAD COUNTY

Hempstead County lies in the southwestern part of the State, south of Pike County, and north of Lafayette County. It has a land area of 465,320 acres.

This County lies entirely in the Gulf Coastal Plain. It is one of the earliest settled Counties in the southwestern part of Arkansas. The famous black lands of the Ozan region attracted the early pioneers, and since these early days Hempstead County has held a high place among the Counties of Arkansas.

The general surface of the County is moderately rolling, approaching the level near the streams. The soils of the County are black lands, red gravelly lands, some limestone formations, and some sandy with a clay subsoil. The black lands are the most valuable and fertile; the red gravelly lands are next in point of value and fertility. The flat prairie lands have been found to be very productive with improved cultivation. These soils are all underlain with red clay and gravel peculiar to all the hill country of this section. In the creek and river bottoms a deep, dark alluvial is found. There are 33 types of soils that have been mapped in this County. These are grouped in 20 series. About 75 per cent of the soil material is residual in origin, and the remainder alluvial; the fine sandy loam and clay types predominate.

The surface rocks in the central and northern parts of the County consist of gray to black marls and shales, and gray sandy shales. These are of the "Cretaceous" age, or an age marked by deposits of chalk and coal. The formations exposed in the southern part of the County are the "Midway" and "Wilcox," consisting of lignitic sands and clays and gray to blue non-calcareous clays. These are of an age in the earth's history known as the "Eocene" age, a period marked by the appearance of mammals, grasses and land flora. These formations are estimated to have a total thickness of 1,800 feet at some points in the County. Beneath these are a series of formations known as the "Gulf" series, consisting of gray to black shales and marls, light colored chalks and gray clays, with an estimated thickness of 1,000 to 1,600 feet.

The above formations rest on the "Comanche" or (Trinity) group, or series, of formations. These consist of impure limestone, shale, thin beds of sand and red clay, and a very hard formation known as "anhydrite," which rests on Marine limestone, shales, and sand in the bottom beds.

The lowest elevation in the County, 265 feet, is at Fulton in the southwestern part of the County. Highest elevation, 450 feet, is at Bolton.

A few of the representative towns with their respective elevations are as follows:-

Hope	357 feet	Washington	374 feet
Mc Nab	312 feet	Guernsey	291 feet
Ozan	370 feet		

The Little Missouri River in the northern part, Little River in the western part and Red River in the southwestern part and their tributaries give the County ample drainage. Floods are not prevalent in the County except along the river bottoms. There are no stream gaging stations in this County.

The mineral products of Hempstead County are lime marl, shell marl, green sand, chalk, lignite and sand, with excellent brick and pottery clays. The chalk in this County was formerly used in the manufacture of Portland cement at White Cliffs, Sevier County. The brick clays are used at Hope, Doyle, and Springhill, in the manufacture of brick; also the Tertiary clays found in this County are used in the manufacture of jug ware, etc. at Springhill. Saline County Tertiary clays, used for fire brick at Benton, Arkansas, also occur in Hempstead County, but are not mined in commercial quantities.

There have been some fifty wells drilled in this County in a search for oil and gas, with considerable showing of both, although not in commercial quantities.

There is an abundance of pure water in all parts of the County. The Lithia, Shover and Long Springs are located here, and all have healing qualities.

Hempstead County has good transportation facilities. The main line of the Missouri Pacific Railroad crosses the County from the southwest to the northeast, passing through Fulton, Sheppard, Hope and Emmet. A branch of the Missouri Pacific runs through the central part of the County, connecting with the main line at Hope. The St. Louis & San Francisco traverses the County from east to west. The Prescott & Northwestern Railroad covers the northeast corner of the County, and the Graysonia, Nashville & Ashdown Railroad runs through the northwest section. The Louisiana & Arkansas Railroad covers the southeastern part of the County, connecting with the Missouri Pacific at Hope.

Federal Highway No. 67 and State Highways No's 4, 24, 29, 32, 55 and 73 traverse the County in different directions, all centering at Hope. According to report of the United States Engineers, the three rivers flowing within the borders of Hempstead County are navigable to snag and dredge boats.

The eastern edge of the County is covered by U.S.G.S. quadrangle map Gurdon. The rest of the County has not been mapped in detail. Highway and State topographic maps are available.

HOT SPRING COUNTY

Hot Spring County, situated in the south central part of the State, is bounded on the north by Garland County; on the east by Grant County; on the south by Clark and Dallas Counties, and on the west by Pike County. It has a land area of 392,320 acres.

The western and northwestern parts of the County lie in the Ouachita Province of the Paleozoic area. The southeastern part is in the Gulf Coastal Plain. The County is generally level, with a few rolling hills. The soils are red gravelly clay loam, a rich alluvial soil of river bottom lands, and sandy loam of the higher country.

The surface rocks of the western and northwestern parts of the County in the Ouachita Province consist of sandstones, shales and novaculites of Paleozoic age. Those of that part of the County lying in the Gulf Coastal Plain consist of sands and clays of the Eocene age.

The Paleozoic rocks, which form the surface in the western part of the County, gradually dip under the sediments of the Gulf Coastal Plain to the east and southeast, until they are buried to an estimated depth of 1,000 feet in the southeast corner. The rocks at the surface in the Coastal Plain area consist of sands and clays belonging to two formations known as the Midway and the Wilcox.

Most of the Gulf Coastal Plain area in the County is underlain by a series of formations known as the Gulf series. These are of an age in the earth's history marked by deposits of chalk and coal.

Hot Spring County, lying in an area marked by the disappearance of the Paleozoic formations under those of the Gulf Coastal Plain, and on account of the overlapping and variation of the exposed formations, is one of the most interesting Counties in the State for geological study.

Magnet Cove has long been known to mineralogists as a locality for many rare and beautiful, as well as useful, minerals; and there is hardly a cabinet of minerals in the World that does not contain numerous specimens from this renowned district. This small area is of great interest on account of the number of varieties of rock found there, and of the many instances in which the association of the rocks is such that an insight into their genetic relations may be obtained.

In describing this locality, Doctor Branner, State Geologist, says: "The Cove is the relic of an ancient basin of thermal springs". The proof of this is apparent in the mounds within the basin and in the special character of the

deposits of which these mounds are composed. One of these mounds, made up of ferrous dolomite (brown spar) partly altered to ankerite near the surface, and connected with the outcrops of siliceous dolomite, occurs upon the snow form in section 19, 3 S., 17 W. At the southern base of this exposure is a large deposit of very coarsely crystalline calcite intermingled with crystalline, ash-gray siderite.

About the middle of the Cove there is a deposit of magnetite, the fragments of which cover some 40 acres. This mineral occurs in fragments scattered over the surface and imbedded in the soil; it does not seem to be in place. It is claimed that the deposit is not merely superficial, though no one appears to have any knowledge of a solid bed of the material.

(The magnetite of Magnet Cove is in the form of lodestone and will attract pieces of iron,as does an ordinary magnet).

On the outcrop side of the ridge, north of the Cove, there are many deep pits or basins of various sizes, all of which have a comparatively narrow wall of pealite; the structure of which shows that it was accumulated by slow accretion. In every case there is a gulch leading off from the bowl in such a way as to make it clear that each spring acted as a feeder to a stream of its own. Anyone who has given attention to the subject in such a region as the Yellowstone Park will at once recognize here the infallible signs of the same kind of activity.

The lowest elevation in the County, 199 feet, is at Witherspoon. Highest elevation, 1,000 feet (estimated) is at Bonnerdale. A few of the representative towns with their respective elevations are as follows:-

Malvern	311 feet	Butterfield	388 feet
Cove Creek	274 feet	Victor	216 feet
Donaldson	299 feet		

The County is well drained by the Ouachita River and its tributaries. General floods rarely occur in this County. There are two stream gaging stations in the County; one at Remmel Dam and the other at Rockport, both on the Ouachita River.

Magnet Cove is one of the geological wonder spots of the World, having hetreogeneous deposits of 150 different minerals. Of these we list a few below:

Brookite is found in abundance as good museum specimens

in several places with quartz.

Magnetite (magnetic iron ore) is found here in loose fragments. This mineral is an iron oxide and is an important ore of metallic luster, strongly attracted by a magnet. It sometimes possesses polarity and is then called "loadstone", and is like a magnetic needle.

Octahedrite is found sparingly with Brookite and Rutile here. Octahedrite is a form of titanium dioxide, occurring in crystals, or is found in Octahedrous, which is a solid having eight plane faces.

Quartz, or clear crystals, found here,are used for ornaments and lenses; also smoky quartz found here,is used for jewelry.

Sunstone found here, is either pink or gray, and is cut for ornaments.

Syenite is quarried at Diamond Jo in the Cove, and is suitable for ornamental interior use.

Vesuvanite is a brown to green mineral, a silicate of aluminum and calcium, with some iron and magnesium; this mineral looks like crystal.

Wavellite found here is associated with the upper novaculite beds at Magnet Cove, and is a basic phosphate of aluminum.

There are promising prospects of lead and zinc in the western part of the County. There have been traces of gold and silver found in the County. The silver, with lead, zinc and copper ores, is found at Point Cedar in the southwestern part of the County.

There are granites, limestone, novaculite and igneous rocks, some iron deposits and mineral springs in the County. This County has the only barite deposit in the State. Barite is a chemical element of the alkaline--earth group.

Opal and many semi-precious stones are also found in this County.

In the past few years, however, the principal mineral production has been Bentonite, clays (brick and raw) Rutile, stone, sand and gravel. In the vicinity of Malvern and Perla, there are large deposits of this clay and mammoth brick plants.

The Bentonite in this County is found near Durian Switch

in S.E.¼ of S.E.¼ Sec. 18, T. 5 S., R. 16 W., and can be used in the manufacture of medical dressing, in gypsum wall plaster, as a filler; in the manufacture of paper and soap, and as an adulterant in drugs and candies. It is also used as a bleaching agent in the refining of oils, as a facial and beauty clay and as a filler for rubber.

Probably the most commercially important mineral deposits are the extensive beds of excellent clays for potters' work, and fire and brick clays.

The alluvial clay is used in the manufacture of common and pressed brick, and the white plastic clay is used in the manufacture of white front and paving brick.

There are also fire and pottery clays found in the County; the former is used in the manufacture of fire brick, while the latter burns a light cream color and is used for common pottery.

Rutile is a mineral consisting of titanium dioxide and is usually reddish brown and of a brilliant metallic luster. It usually contains a little iron. Titanium is a mineral, and a moderately rare one. There are only a few places in the World where it is found in quantities that pay to mine it, and one of these places is Magnet Cove. At Magnet Cove, the Titanium Corporation of America, has a plant in which titanium is washed out of "rutile," a kind of broken down rock. The mineral looks like coarse gun-powder, but is much heavier. A good deal of it goes to steel mills in the East, where it serves this valuable purpose; a small amount of it melted in with steel, prevents gas bubbles from forming in the metal, which improves the quality of the steel and enables manufacturers to get higher prices for it.

Titanium also appears on the market in paint. A curious thing in this employment of the mineral, is that while it comes from the Magnet Cove plant as shiny, black crystals, it makes a paint which is snow white. Here the Scientist has unriddled another of the wonders that Mother Nature hid in so much of Her handiwork. He discovered that when the black titanium crystals are broken down into a non-crystalline form, the mineral is a pure, silvery white. - - So, the tough steel frame of your car, or the gleaming whiteness the painter gives your house, may be due in part to this odd material at Magnet Cove, which was deposited in the rocks there aeons ago by the action of melting heat deep in the earth. And in other ways too, you may be indebted to Magnet Cove titanium, for the mineral is used in dyes, in coloring pottery and in making artificial teeth.

There has also been considerable stone, sand and gravel

produced in the County. The stone is quarried at Butterfield, and the sand and gravel is dredged from the Ouachita River.

Probably the chief industrial enterprises in the County consist of the brick and pottery manufacturing plants, each of which is extensive.

Transportation facilities of Hot Spring County are very adequate, with two trunk line railroads and two highway systems. The Missouri Pacific Railroad passes through the County from the northeast to the southwest. The Chicago, Rock Island & Pacific covers the northeastern portion. Federal Highways No's. 67 and 270 and State Highways No's. 7, 9, 51 and 84 cross and cris-cross the County in practically every direction.

Highway and State topographic maps are available. The County is not mapped in detail by quadrangles.

HOWARD COUNTY

Howard County, situated in the southwestern part of the State, is bounded on the north by Polk and Montgomery Counties, on the south by Little River and Hempstead Counties, on the West by Sevier County, and on the east by Pike County. It has a land area of about 385,280 acres.

The northern part of the County lies in the Athens-Piedmont Plateau area of the Ouachita Province, or what is known as the "Paleozoic" region, while the southern part is in the Gulf Coastal Plain.

The surface of the County in the northern portion is generally rolling, and somewhat mountainous in the extreme northern part. The south half of the County is practically level. The principal soils are a red loam and a yellow loam. There is a considerable amount of black alluvial land in the southern portion of the County, and a strip of sandy loam in the foothills which is very productive. The County includes four distinct groups of soils: Upland soils, derived from the weathering of sandstone and shale; upland soils of sedimentary origin; terrace, or old alluvial soils, and first bottom, or recent alluvial soils. The soils are separated into thirty-four types, representing twenty-one series, in addition to rough stony land. Generally, all the land of Howard County is very productive, or can be made so by proper cultivation.

The lowest elevation in the County, 300 feet, is at Mineral Springs, Allbrook and Saratoga Springs. Highest elevation, 1,600 feet, is on Prior Mountain.

A few of the representative towns with their respective elevations are as follows:-

Nashville	373 feet	Dierks	422 feet
Umpire	839 feet	Centerpoint	591 feet
Mineola	942 feet		

Howard County has adequate drainage. The Saline River flows along the western boundary, and with its tributaries, which are Messer Creek, Mine Creek and Blue Bayou, drains the western and central portions of the County. The Cossatot River drains the northwestern part, and Fallen Creek and Muddy Fork, tributaries of the Little Missouri River, drain the northeastern part of the County. Floods rarely occur in the County except along the Saline River bottoms. There are no stream gaging stations in this County; two stations are needed, however: One on the Cossatot River and one on the Saline River, both near Lockesburg.

The rocks at the surface in the Ozark Province area are sandstones and shales belonging to the "Jackfork" sandstone and "Stanley" shale of "Paleozoic" age. The rocks dip under the sediments of the Gulf Coastal Plain toward the south, and are estimated to lie at depths ranging up to 2500 feet along the southern boundary of the County. Exposed in a belt six to nine miles wide, extending across the north central part of the County, are found formations of the "Comanche" series, sometimes called the "Trinity" group. These consist of impure limestones, gray to green sands and shales, and limestones in the bottom beds. This Trinity group is estimated to range from 600 to 800 feet in total thickness in the northern part to 1,500 to 2,000 feet thick in the southern part of the County.

In the remaining part of the County, the surface rocks exposed, in addition to those already named, are of the "Cretaceous" age, a period marked by deposits of chalk and coal. These "Cretaceous" formations consist of gray to dark-gray shales, marls and light colored chalks, with some lignitic sands and clays.

The principal minerals in Howard County are chalk and gravel. The chalk is used in the manufacture of cement, and millions of barrels of cement have been marketed. Gravel is also mined in large commercial quantities. Of the other minerals known to exist, but not mined in large quantities, are iron, antimony, manganese, celestite, cervsite (lead carbonate), and brick clay; gypsum found in Pike County and mined at Tokia, with extension beds 15 feet in thickness extending westward into Howard County; shell marls and white novaculite, the latter commercially known as Arkansas stone and whetstones.

The central and southern parts of Howard County enjoy excellent transportation facilities. The northern portion of the County has no railroads and no highways of consequence. Three main line railroads, with two branches of the Missouri Pacific, serve the central and southern parts of the County. The De Queen & Eastern Railroad enters the County in the western part and runs to Dierks, Arkansas. The Graysonia, Nashville & Ashdown, enters the County in the southwestern part, and passes through Paraloma, Schaal, Mineral Springs and into Nashville, the County Seat, and the largest town in Howard County. The Prescott & Northwestern, enters the County in the eastern part and runs only to Nashville. Nashville is also the terminus of the two branches of the Missouri Pacific. Federal Highway No. 70, and State Highways No's 4, 24, 27, 55, 73 and 128 serve practically all parts of the County with the exception of the extreme northern part.

U.S.G.S. quadrangle maps De Queen, Caddo Gap and Caddo Gap No. 2 cover the northern part of the County. The southern part has not been mapped in detail. Highway and State topographic maps are available.

INDEPENDENCE COUNTY

Independence County, situated in the north central portion of the State, is bounded on the north by Izard, Sharp and Lawrence Counties; on the south by White County; on the east by Jackson County, and on the west by Stone and Cleburne Counties. It has an approximate land area of 478,680 acres. The greater portion of this County lies in the Salem and Springfield Plateaus and the Boston Mountain area of the Ozark Province, or what is known as the Highland region, while the lesser part of the County, a strip three to six miles wide, bordering the County on the east, and an area a few miles wide extending up the valley of White River as far as Batesville is included in the Gulf Coastal Plain. This portion of the County is level and an excellent farming country. The uplands consist of rolling hills with level plateaus, and the mountains are comparatively rough.

The soils of Independence County are a valuable asset. The upland country, which has a clay sub-soil, is admirably adapted to fruits; the bottom lands are best suited to staple crops. The presence of some disintegrating limestone and phosphate adds much to the fertility of the land.

The lowest elevation in the County, 217 feet, is at Arnolds Ferry Station; the highest elevation, 850 feet, is on Deane Mountain. A few of the representative towns with their respective elevations are as follows:-

Batesville	265 feet	Cushman	734 feet
Magness	270 feet	Sulphur Rock	308 feet
Newark	242 feet		

The County is well drained by the White and Black Rivers and their tributaries of which Cura, Dota and Salado Creeks and Pott Bayou are the largest. White River crosses the center of the County, while Black River forms the eastern boundary. There are numerous clear water springs in all parts of the County.

The older Coastal Plain formations exposed in this area are sands interbedded with laminated clays and lenses of shale and marl of the "Cretaceous" age.

Limestones appear in terraces along the margin of the Ozark Province. Unclassified formations underlie the remainder of the Coastal Plain area in Independence County, beneath alluvial deposits which are estimated to be 100 to 150 feet thick.

The "Cretaceous" formations are estimated to be 100 feet in maximum thickness in the southeastern corner of the County. One of the sandstones found near Batesville and known as "Batesville" sandstone (while found in other areas) attains its maximum thickness in this County, about 225 feet. Some of the limestones exposed here are not found exposed in any other area in the State.

Some very valuable mineral deposits have been found in Independence County, the most important of which are manganese, iron pyrite, sand, gravel, and marble. In the past few years, there have been over two million dollars worth of these minerals mined commercially in this County. There are two known fields of manganese in Arkansas, but practically all the mining has been done in the Independence County area which is about twenty miles in length, and from eight to ten miles in width.

Probably the best known mineral mined or quarried in this County is marble. The Arkansas State Capitol, the Pulaski County Court House at Little Rock, and numerous other buildings were constructed partially of Independence County marble from the Pfeifer Quarry near Batesville. There is an almost unlimited supply of light colored marble, besides red, pink, gray, yellow, brown and black. While this marble takes as high and lasting a polish as any, they have been used to a much greater extent for building purposes than in the arts. Mantels have been manufactured of this marble for use in many public buildings of the United States. Prominent engineers and architects insist that the Arkansas marble is elastic, a quality which prevents it from crumbling under the continued expansion and contraction which occurs where climatic conditions are subject to sudden changes. One slab of this marble weighing 220 tons was removed from a quarry near Batesville. This marble is exceptionally free from fissures.

There are several gravel quarries in the vicinity of Batesville, and the gravel is being sold in commercial quantities. Sand is being taken from the beds of White and Black Rivers.

Other minerals known to exist in this County are brick and pottery clay, phosphates, silver, lead and zinc; but at this time they are not being mined in commercial quantities.

The transportation facilities of this County consist of the White River branch of the Missouri Pacific Railroad, five State Highways and the White and Black Rivers. This branch line road crosses the County diagonally. It enters the County in the southeastern part and passes through Newark, Magness, Moorefield, Paroquet, Ellers, Sulphur Rock, Batesville and O'Neal.

While the State Highways that traverse the County in practically all directions from Batesville may be ample, yet they are not of the best type. With the exception of a few miles of paving on State Highway No. 11, running south from Batesville, the highways in the County are mostly gravel or stone surfaced. There are no Federal Highways in this County.

Material is shipped in and out of the County via the White and Black Rivers.

Batesville U.S.G.S. quadrangle map covers the western and central portions of the County, while the eastern part is covered by M.R.C. Quadrangles Strawberry and Newport. A small portion of the north central part has not been mapped in detail. Highway and State topographical and Geological maps are also available.

IZARD COUNTY

Izard County, situated in the north central part of the State in the Ozark foothills, is bounded on the north by Fulton County, on the southwest by White River, on the southeast by Independence County, on the east by Sharp County, and on the west by White River and Baxter County.

This County lies in both the Salem and Springfield Plateaus of the Ozark uplift. Only a small portion in the southern part is in the Springfield Plateau.

About one-third of the County is mountainous. The balance, the bottom lands along the southern and western slopes of the County, the northeastern and eastern portions, ranges from rolling hills to level plains, some of which are very productive. In the bottoms there is a dark sandy loam soil and in the level uplands there is a sandy loam with a clay subsoil which produces well. The soils of the County vary between these extremes. There is a lighter dark sandy loam, or mulatto limestone in the level lands that is very fertile. The prevailing soil in the hills is a close ashy soil with a little sand and a clay subsoil.

The climate is delightful, the four seasons being about equally divided and having an average temperature of about 60 degrees. The rain fall is ample (about 50 inches) and well distributed. The prevailing winds are from the southwest. There are few mosquitoes, plenty of pure water, and health conditions are good. The lowest elevation in the County, 300 feet (estimated) is at East Sylamore. Highest elevation, 1,250 feet (estimated) is on Turkey Knob.

A few of the representative towns with their respective elevations are as follows:-

Guion	313 feet	Melbourne	610 feet
Calico Rock	368 feet	Oxford	811 feet
Sylamore	332 feet		

This County is drained by White River and its tributaries. The only portion of the County subject to overflow, are the lowlands along White River. There are no stream gaging stations in the County. Any information desired concerning the flow of White River, may be obtained from records of gaging station No. 3, located at Flippin, Arkansas, on White River.

The rocky surface of this County is very rough but the tops of the hills and ridges are fertile and generally level. Underlying the surface are found limestone formations and a clay subsoil. Most of the surface rocks are of the Ordovician

period and consist largely of limestone and dolomites, although there is considerable sandstone. Common white marble is a form of dolomite which is a combination of carbonate of two minerals, calcium and magnesium. St. Peter sandstone, one of the sandstones found here, is quarried for glass sand. Among the limestones found, are the St. Clair, Kimswick and Fernvale. The St. Clair is a coarse-grained, pinkish light gray limestone carrying casts of fossil remains.

The principal minerals found in commercial quantities in this County, are St. Peter sandstone, sand (building), sandstone (building and crushed stone or gravel) manganese, limestone and marble.

The only deposit of glass aand being worked in Arkansas at the present time, is located at Guion, Izard County. This sand is a part of the St, Peter sandstone formation which outcrops through northern Arkansas. It is almost entirely free from impurities and the finished glass product has no stain. Manufacturers consider it to be as good quality as the best glass sands in Missouri; it has, however, a finer texture. Glass sand is used in the manufacture of flintware, window glass, plate glass, cast and rolled glass, and as a steel moulding sand. The glass sand of Arkansas has been used principally for the manufacture of flint, window and bottle glass. It is also used as a steel moulding sand.

The manganese mined in this County is found in the southeastern part on the north fork of White River, and in or near Gid, Anderson, Mt. Pleasant and Croker Spur. There are about 30 mines in this vicinity. Braunite (manganese ore), Psilomelane (manganese ore, with Pyrolusite) and Wad (Bog manganese) are found and mined in this vicinity. The limestone used in the manufacture of lime, is quarried at Guion and East Sylamore. Marble is also quarried in the County but not in very large quantities.

The White River branch of the Missouri Pacific Railroad affords transportation for the southern and western portions of the County. It parallels White River in its diagonal course through the County, passing through Croker Spur, Guion, Twin Creek, East Sylamore, Mount Olive, Vest, Creswell and Calico Rock. State Highways No's 5, 9, 56, 58 and 69 traverse the County in practically all directions. There are no Federal Highways in this County. According to report of the United States Engineers, White River is a navigable stream.

U.S.G.S. quadrangle maps Mountain Home, Mountain View and Batesville cover the northwestern, western and southern portions of the County. Part of the northern and all of the eastern and northeastern parts have not been mapped in detail. Highway and State Topographic maps are available.

JACKSON COUNTY

Jackson County, situated in north central Arkansas, is bounded on the north by Lawrence County; on the south by Woodruff County; on the east by Poinsett and Craighead Counties, and on the west by White and Independence Counties.

This County lies within the Gulf Coastal Plain with the exception of a small area in the southwestern part, which is included in the Ozark Province of the Paleozoic region. Most of the soil in Jackson County is alluvial bottom with the exception of the extreme southwestern portion, which is hilly.

With the exception of a small area in the southwestern part, which lies in the Ozark Province of the Paleozoic area, Jackson County is in what is known as the Gulf Coastal Plain. The Grandglaise terrace is a narrow ridge, or dissected terrace, bordering the Ozark Province just west of the St. Louis, Iron Mountain & Southern Railroad (Missouri Pacific), the crest of which is about 300 feet above sea level. The Advance lowland is a plain 200 to 300 feet above sea level and sloping slightly to the south. In the interstream areas the surface is undulating and partly timbered. The broad flood plains of the streams, a few feet lower than the interstream areas, are, in part, swampy, and are traversed by numerous bayous. Between the swamps and bayous are heavily timbered ridges of sand or sandy loam, some rising a few feet higher than the general level of the lowlands.

The Midway formation is represented by pebbly fossiliferous limestone inter-bedded with gray to yellowish sands which crop out in the basal 20 to 25 feet of the east-facing escarpment of the Grandglaise terrace. The Midway is overlain by reddish, pebbly sand, probably of the same age as the similar sands (Lafayette formation) overlying the Eocene strata of Crowley's Ridge. The red sands are overlain by dark and light, more or less sandy, loams resembling certain facies of the loess of Crowley's Ridge.

The Midway is separated from the alluvial deposits of the Advance lowlands to the east by an abrupt erosion escarpment. The alluvial deposits, which underlie the Advance lowland to an estimated depth of 100 to 150 feet, consist of loams, clays, sands, and gravels of "Pleistocene" and "Recent" age. The few wells drilled in Jackson County have furnished only a meagre record of the thickness and the character of the sediments which underlie the surface of this area.

In the Ozark Province, in the southeastern part of the County, the surface is formed by "Paleozoic" rocks of Pennsylvanian age. At their eastern border the "Paleozoic" rocks are separated from the materials of the Gulf Coastal Plain by an abrupt erosion escarpment along which their eroded surface

passes beneath the Coastal Plain deposits. The basement rocks extend eastward to increasing depths estimated to be about 1,500 feet below sea level in the southeastern part of the County.

The Gulf, or "Cretaceous," series increases in thickness from a few feet in the northwestern part to an estimated thickness of 300 feet in the southeastern part of Jackson County. The age of the basal beds in the southeastern part of the County, is not definitely known, but it is probably the equivalent of the Marlbrook marl. To the west these beds are overlapped by the Saratoga chalk and the Nacatoch formation. The Arkadelphia has not been recognized in the western part of the County, where it is rather absent, or changes to sands, and therefore can not be separated from the underlying Nacatoch.

The Midway formation, or "Eocene" series, consists chiefly of gray, noncalcareous clays and sandy clay in the upper part, and of limestone, calcareous shale and sand in the lower 25 to 50 feet of beds. It is estimated to be about 275 feet thick in the southwestern part of the County. The Midway formation, except in the western part, is overlain by sands and clays which reach a maximum thickness of 650 to 700 feet in the southeastern part of the County. The age of these beds has not been determined, but they probably belong to the Wilcox formation, and may include some beds of Claiborne age.

The Advance lowland is underlain by alluvial deposits of "Pleistocene" and "Recent" age to an estimated depth of 100 to 150 feet.

The available data, or structure, indicates that the Cretaceous dip to the east and southeast. The top of the Nacatoch formation lies at sea level in the northwestern part at a depth of about 1,000 feet below sea level in the southeastern part of the County.

The lowest elevation in the County, 194 feet, is at Newport. Highest elevation, 500 feet, is at Denmark. A few of the representative towns with their respective elevations are as follows:-

Tuckerman	246 feet	Tupelo	216 feet
Weldon	228 feet	Grubbs	214 feet
Diaz	233 feet		

The County is well drained by the White River and its tributaries; Black and Cache Rivers and Village Creek. The latter flows through the central part of the County and empties into White River below Newport. White River flows through

the west central portion, while the Black River forms the northwestern boundary of the County. Cache River, in its southern course, follows closely the eastern boundary. The only portion of the County subject to overflow are the lowlands along the rivers at flood stage. There are no stream gaging stations in this County. A station is needed however, on White River at Newport.

The most important minerals produced in Jackson County are sand and gravel. In the past few years over $200,000.00 of these minerals have been marketed; the gravel being taken from two gravel pits located near the city limits of Newport. The sand has been dredged from White River.

Two railroads, one Federal Highway and seven State Highways give Jackson County good transportation facilities, particularly the central and southern parts. The northern portion of the County is somewhat lacking in transportation, in that there are no State Highways traversing this section. Federal Highway No. 67, however, runs through the northern portion of the County out of Newport. State Highways No's. 14, 17, 18, 33, 37, 42 and 145 cover the central and southern portions of the County in practically all directions.

The Chicago, Rock Island & Pacific Railroad enters the County in the southwestern part and passes through Tupelo, Weldon, Auvergne and Newport. The Missouri Pacific crosses the County from the northeast to the southwest, paralleling Federal Highway No. 67.

Fairly large boats ply up and down the White and Black Rivers, particularly White River, as far as Newport. The Black River, which flows along the western boundary of the County and empties into White River at Jacksonport, a few miles northwest of Newport, is used principally by dredge boats in searching for pearl-bearing shells.

M.R.C. quadrangle maps Strawberry, Alicia, Tuckerman, Newport, Tilton and Augusta cover the County with the exception of the extreme southwest corner, which has not been mapped in detail. Highway and State topographic maps are available.

JEFFERSON COUNTY

Jefferson County, situated in the south central part of the State, is bounded on the south by Lincoln and Cleveland Counties; on the west by Grant County; on the north by Pulaski and Lonoke Counties, and on the east by Arkansas County. It has a land area of 577,920 acres.

This County lies in the flood plains of the Arkansas River Valley, in the Gulf Coastal Plain. The soil of the County is exceptionally fertile, a large part of it being alluvial! In the higher lands there is a fairly light, dry sandy loam. The alluvial bottoms extend east and west the whole length of the County, and north and south about one-fourth of the distance. This soil, in many places, is several feet deep. The alluvial bottom land is the highest priced land in the County.

Twenty two soil types, representing ten series, are mapped in the County. The soils are classed in two general groups; the Upland, or Sedimentary soils, and the Lowland, or Alluvial soils. The Upland soils are the direct product of the weathering of unconsolidated sedimentary deposits of the Tertiary age; they comprise five soil series: The Ruston, Susquehanna, Caddo, Norfolk and Lufkin. The Lowland, or alluvial soils are derived from two main sources: (1) Material transported from the Permian red beds, giving rise to the "Miller" series, and (2) Reassorted material of the Upland soils, forming the Portland and Yahola soils of the Arkansas River flood plain, and the Ochlockonee and Bibb soils, along the small streams traversing the upland. The heavier types of the bottom soils, the silty clay loams and clays, are usually imperfectly drained, a condition which can be improved largely through the construction of lateral drainage ditches to the main canals which are completed in this County. The sandy and silt loam types of the Alluvial soils constitute the best agricultural land in the County.

The well defined topographic division of the Gulf Coastal Plain is represented in Jefferson County. In the west an area, varying in width from five miles in the north, to 16 miles in the south, forms part of an upland which is extensively developed in the inter-stream areas of southwestern Arkansas, which, in this County, lies 300 to 350 feet above sea level. The remainder of the County is included within the advance lowland; the general surface of which is a plain 190 to 235 feet above sea level, sloping slightly to the south. The Arkansas River traverses the lowland from northwest to southeast. Nearly all of the land northeast of the river is included within the gently undulating flood plain of the Arkansas River; it is, in part, swampy and is traversed by numerous bayous and abandoned stream channels.

The Jackson formation of the "Eocene" age crops out in the upland area west of the Arkansas River. "Eocene" deposits underlie the remainder of the County beneath 100 to 150 feet of Quaternary alluvium. The "Eocene", which includes the Jackson, Claiborne, Wilcox and Midway formations, ranges in thickness from about 2,000 feet in the northwestern, to about 3,800 feet in the southwestern part of the County. The "Cretaceous" strata, which unconformably underlie the "Eocene", increase from about 200 feet in the northern, to about 800 feet in thickness in the southeastern part of the County.

The basement rocks have not been penetrated in wells drilled in Jefferson County, but from the altitude of the Nacatoch sand and the regional thickness of the Cretaceous beds, it is estimated that these rocks lie at depths ranging from about 2,000 feet below sea level in the northwestern corner, to about 4,600 feet below sea level in the southeastern corner of the County.

The data concerning the Gulf, or Cretaceous series, is meager, as the deepest well drilled, located in the northwestern part of the County, penetrated the Nacatoch sand. From original studies, it is estimated that the Gulf series is about 200 feet thick in the northwestern part, and more than 800 feet thick in the southeastern part of the County. The northwestward thinning of the strata is the result of the thinning of individual members and of overlap.

The Arkadelphia marl, estimated to be from 65 to 100 feet thick, consists of gray, calcareous shale, characteristic of this formation over most of Arkansas.

The Nacatoch and Saratoga chalks are estimated to be from 175 to 300 feet thick, and probably consist chiefly of fine textured sand and sandstone, in part glauconitic, with subordinate beds of shale and chalk in the lower part.

The Marlbrook marland older strata are estimated to attain a maximum thickness of 350 feet in the southeastern corner of the County, where the beds of the Tokio-Woodbine age may be present.

The Jackson formation of Eocene age is exposed in a belt five miles wide in the north and 16 miles wide in the south, lying west of the Arkansas River. These beds are perhaps best exposed in White Bluff in Section 19, Township 3., Range 10 West. In the remainder of the County the surface materials are Quaternary alluvial deposits.

The Midway, 460 to 500 feet thick, consists of gray

and bluish-gray, generally non-calcareous clays, but is calcareous and fossiliferous in its lower part.

The Wilcox formation is made up principally of sands, sandy clays and clays, and is, in a large part, lignitic.

The Claiborne formation consists chiefly of sands and clays in the upper part, and of glauconitic sand and clays in the lower part.

The alluvial deposits in the Advance lowland northeast of the Arkansas River have an estimated thickness of 125 to 150 feet, consisting of alluvial loams, clays, sands and gravels. The surface materials are probably, for the most part, of Recent age, but some of the higher inter-stream areas may be of Pleistocene age.

The top of the Nacatoch sand lies at a depth of about 1,700 feet below sea level in the northwestern corner, and is estimated to be about 3,800 feet below sea level in the southeastern corner of the County. The dip is toward the southeast at the rate of 60 to 90 feet per mile. The available data are insufficient to indicate local structural features which may be present in this area.

The lowest elevation in the County, 167 feet, is at Burr Crossing, 350 feet east of the Bank of the Arkansas River. Highest elevation, 359 feet, is at Doylestown Station. A few of the representative towns with their respective elevations are as follows:-

Moten Station	228 feet	Pine Bluff	220 feet
Tucker	221 feet	Sherrill	215 feet
Red Field Station	300 feet		

The County is well drained by the Arkansas River and its tributaries; Salt Bayou, Wabbaseka Bayou, Rattlesnake Bayou, Cusotte Bayou, Plum Bayou and Bartholomew Bayou. The only portion of the County subject to overflow are the lowlands along the Arkansas River or the larger bayous.

There are no stream gaging stations in the County. Information concerning the flow of the Arkansas River may be obtained from Station No. 10 located on the Arkansas at Little Rock, Pulaski County.

The principal minerals in Jefferson County are clay, sand and gravel. There are two gravel pits in the County located about 1½ miles east of Pine Bluff. The sand is produced from the bars and bed of the Arkansas River. The alluvial and surface clays found in this County are used in

the manufacture of brick at Pine Bluff and Redfield. Among the other minerals known to exist in the County are shell marls (which have been mined) and glass sand, the latter now being produced in small quantities at Pine Bluff.

Two railroads, three Federal Highways and three State Highways give Jefferson County good transportation facilities. The St. Louis Southwestern Railroad enters the County in the southwestern part and runs in a northeasterly direction, passing through Faith, Sorrels, Pine Bluff, Rob Roy, Altheimer, Wabbaseca, Dianty and Humphrey. A branch of the St. Louis Southwestern traverses the northern part of the County, connecting with the main line at Altheimer. The Missouri Pacific Railroad has two branch lines operating in the County. One of these branches enters the County in the west central part and runs in a southeasterly direction, passing through Doylestown, Pine Bluff, Moscow and Tamo. The other branch enters the County in the northwestern part, also running in a southeasterly direction, with its terminus at Pine Bluff.

This County has been among the foremost in road construction with a view to making good all the roads in the County. Federal Highways No's. 65, 79 and 270, and State Highways No's. 13, 15 and 31 are, for the most part, all paved and traverse the County in practically all directions, using Pine Bluff, the County Seat, as a hub. It has also many hard surfaced and gravel roads traversing the rural sections. According to report of the United States Engineers, the Arkansas River is navigable in this County. The only boats operating, however, are snag and dredge boats in the vicinity of Pine Bluff by the Pine Bluff Sand & Gravel Company.

M.R.C. quadrangle maps Pastoria, Altheimer, Goldman, Varner and Noble Lake cover the County with the exception of the southwestern portion, which has not been mapped in detail. Highway and State topographic maps are also available.

JOHNSON COUNTY

Johnson County, situated in the northwestern part of the State, is bounded on the north by Newton and Madison Counties, on the east by Pope County, on the south by Logan County, and on the west by Franklin County.

The northern part of the County lies in the Boston Mountain area of the Ozark Plateau, while the southern portion is in the Arkansas valley. The central portion of the County is quite rolling and it becomes rough and mountainous toward the north line. The sandy loam soil found everywhere is fertile and productive.

The surface formations, and those immediately underlying the surface in the southern part of the County, in the Arkansas valley area, consist of alluvial sands, gravels and clays which are of the "Pleistocene" or "Recent" age. In the northern part the surface soil is immediately underlain with sandstones and sandy shales which outcrop in many places. Beneath these formations are found shales and sandstones of the "Pennsylvanian" period, an age marked by deposits of coal; and beds of coal are found beneath the surface here. These formations rest on strata of the Mississippian period, consisting of hard shales, sandstones and limestones.

The lowest elevation in the County, 340 feet, is about 1.5 miles south of Lamar, along the Missouri Pacific Railroad. Highest elevation, 2,279 feet, is 3.2 miles northwest of Salus, along State Highway No. 21.

A few of the representative towns with their respective elevations are as follows:-

Clarksville	370 feet	Knoxville	395 feet
Spadra	372 feet	Hartman	361 feet
Coal Hill	470 feet		

The Arkansas and Mulberry Rivers and numerous creeks furnish ample drainage for the County. The Arkansas River forms the southern boundary, and the Mulberry River flows through the extreme northwestern part of the County. Floods rarely occur in Johnson County. There are no stream gaging stations in this County; one is needed, however, at Knoxville on Piney Creek. Information concerning the flow of the Arkansas River may be obtained from Station No. 9 at Van Buren, Arkansas.

A study of the logs of test wells drilled in the central and southern parts of the County in a search for oil and gas, gives a general knowledge of the underground rock. These test wells showed only a small trace of oil, but gas-bearing sands were penetrated and considerable commercial gas production obtained. Recently large gas fields have been developed within

three miles of Clarksville, and this field is now supplying millions of feet of gas to a number of cities in the State.

The principal minerals produced in the County for a number of years, have been coal, natural gas, sand, gravel and stone. Heavy veins of the finest smokeless anthracite and low volatile bituminous coal underlie nearly the entire County. The great coal fields of Arkansas are located in this area, Johnson, Franklin, Logan and Sebastian Counties. There are numerous coal mines in Johnson County, but the principal production has been at or in the vicinity of Spadra, Hartman and Clarksville. Mineral production statistics of Arkansas will show that there have been millions of dollars worth of coal mined in the County.

There are two gravel pits in the County from which gravel is produced in commercial quantities; one of these pits is located in the eastern part of the County near Lamar; the other is in the southwestern part of the County north of the Arkansas River. Sand produced in the County is taken from the bars and also dredged from the bottom of the river. In the past three or four years some stone has been produced in the County, but not extensively. Other minerals known to exist are iron, moulding sand, limestone, fire and pottery clays, but not developed commercially.

The transportation facilities of Johnson County are not the best. The southern part of the County is served by the Missouri Pacific Railroad and Federal Highway No. 64. The northern part of the County is without railroad transportation. State Highways No's 21 and 123 cover a portion of the northern section, and are either gravel or stone surfaced, or unimproved earth roads. Federal Highway No. 64 traverses the entire southern part of the County, passing through Knoxville, Lamar, Clarksville and Hartman. The Missouri Pacific Railroad practically parallels Federal Highway No. 64. It has three branches, one of which leaves the main line at Knoxville and runs directly to Spadra. Another branch leaves the main line at Montana and runs only to the coal mines at North Spadra. The third branch leaves the main line at Hartman, and serves the extreme southwestern part of Johnson County, and also the manganese district in Franklin County.

The Arkansas River, which forms the southern boundary of the County, is reported by the United States Engineers as being navigable, but is limited to only small snag and dredge boats.

U.S.G.S. quadrangle maps Magazine Mountain, Dardanelle, Ozone and Treat cover the County with the exception of the northwest portion, which has not been mapped in detail. Highway and State topographic maps are also available.

LAFAYETTE COUNTY

Lafayette County, situated in the southwestern part of the State, is bounded on the north by Nevada and Ouachita Counties, on the east by Columbia County, on the south by the State of Louisiana, and on the west by Miller County. It has a land area of 336,000 acres.

This County lies in the Red River valley of the Gulf Coastal Plain. One third of the area of the County is rich bottom land and the rest is undulating and rolling plains. The soil ranges from black alluvial bottom soil to light loam in the uplands. The quality of the soil is best evidenced by the fact that Lafayette once was one of the best timber Counties in Arkansas.

The rocks at the surface in Lafayette County range in age from Recent to Tertiary, but deep wells have penetrated all of the Gulf series, and more than 1,500 feet of the Trinity.

The character and thickness of the Cretaceous, or Comanche, series underlying Lafayette County, are estimated from deep wells drilled in Miller, Nevada and Columbia Counties. The greatest thickness of these rocks is in the southwestern part, and the least thickness in the northeastern part of the County.

The Woodbine sand and the Tokio formation in Lafayette County, as in Miller County, are not separable in distinct formations. Their combined thickness is 550 feet in the southern part and 400 feet in the northern part of the County, consisting of generally thin-bedded sand, sandy shale and shale. The lower part is dominantly tuffaceous and, locally, contains lenses of conglomeratic tuffaceous sandstone. Locally, red clays are present at the base.

The Ozan formation is 125 to 160 feet thick, consisting of micaceous gray and greenish-gray marl and shale. The basal member (the "Buckrange" sand) is best developed in the southern half of the County, where it is 15 to 35 feet thick, made up of sand and sandy shale. In the northern half of the County the Buckrange sand is absent in local areas. The formations above the Ozan show only slight changes in character and thickness within this area.

The Nacatoch sand, the uppermost producing horizon of the Cretaceous system, is present, and finally developed as a reservoir sand throughout Lafayette County. The Buckrange sand, at the base of the Ozan formation, is generally thin and not a very satisfactory oil and gas reservoir. It is best developed in the southern part of the County, where it is the oil producing horizon in the Bradley district.

The Tokio-Woodbine section contains several excellent reservoir sands. The Upper Glen Rose (Trinity Group) has yielded a small amount of oil in T. 15 S., R. 26 W., just across the line in Miller County; and this horizon, with the beds immediately below the anhydrite zone of the Glen Rose formation, should be tested for oil and gas in deep wells drilled in Lafayette County.

The strike of the Nacatoch sand in the northern part of Lafayette County is nearly east-west and the dip to the south at the rate of 25 to 50 feet per mile. There are no determinable local structural features in this part of the County.

The lowest elevation in the County, 211 feet, is two miles southwest of Hartfield's store. Highest elevation, 279 feet, is at McKamie Station. A few of the representative towns with their respective elevations are as follows:-

Lewisville	236 feet	Stamps	257 feet
Kress City	267 feet	Gotham	224 feet
Baker	269 feet		

The County is drained by Red River and its tributaries, Little Bodcaw Creek, Bayou Dorcheat and Bodcaw Creek. Floods rarely occur in the County except in the lowlands along Red River and Bodcaw Creek. Stream gaging station No. 14 is located on Red River at Garland.

Lafayette is not a large mineral producing County. The principal production is sand, gravel and petroleum. The sand is taken from the Red River, and the gravel from two gravel pits, one of which is located two miles northeast of Lewisville, and the other six miles north of Lewisville. The petroleum is obtained from what is known as the "Bradley" district in T. 19 S., R. 24 W. There have been a number of wells drilled in this district in Section 18, yielding a production of 141,000 barrels. This production is from the "Buckrange" sand at an average depth of 2,780 feet.

Two railroads and Federal and State Highways provide Lafayette County with excellent transportation facilities. The main line of the St. Louis Southwestern crosses the County from east to west, passing through Stamps, Lewisville, Shreveport Junction and Jo Ella. A branch of this road crosses the southern part of the County and passes through Kress City, Patton, Canfield, Frostville and Bradley. The Louisiana & Arkansas Railroad enters the County in the northeastern part, serving the eastern part of the County, passing through Baker, Gamma, Stamps, Buckner, McKamie and Experiment. Federal Highway No. 82 crosses

the central part of the County from east to west. While this is one of the trunk line roads of the State, it is for the most part, graveled or stone surfaced.

According to report of the United States Engineers, the Red River is a navigable stream, but to only snag and dredge boats which ply up and down the river keeping the channel cleared and dredging sand from the bottom of the river.

Highway and State Topographic maps are available, but Lafayette County has not been mapped in detail.

LAWRENCE COUNTY

Lawrence County, situated in the northeastern part of the State, is bounded on the north by Sharp, Randolph and Greene Counties, on the south by Independence, Jackson and Craighead Counties, on the west by Sharp County, and on the east by Greene County. It has a land area of 378,880 acres.

The western part of the County is in the Salem Plateau, while the eastern portion lies in the Gulf Coastal Plain area. This County varies in surface from the mountains in the western part to great stretches of fine bottom land in the eastern portion. The soil varies with the surface from clay loam to rich, deep alluvial deposits. The subsoil is red and yellow clay, and in the western part is often hilly. The soil and the water supply is unexcelled in both quality and quantity. Farms are supplied with driven wells that are inexhaustible.

The Paleozoic rocks, which crop out in the Ozark Province, pass beneath the Coastal Plain sediments, slope to the southeast and lie at estimated depths of 700 feet below sea level in the southeastern corner of the County. The Grandglaise terrace, which extends from Independence County for a short distance into Lawrence County, is composed chiefly of stratified sands and clays, probably belonging to the Nacatoch formation of the Upper Cretaceous. These beds are capped by 3 to 10 feet of pebbly sands and loams, probably corresponding, in part, to the loess of Crowley's Ridge. The remainder of the Coastal Plain is mantled by 150 to 180 feet of alluvial deposits resting unconformably on strata of Cretaceous and Eocene age.

The Cretaceous strata, represented by the Arkadelphia marl, and a part of the Nacatoch formation, thickens to the southeast and is estimated to lie less than 200 feet thick in the southeastern corner of Lawrence County. The top of the Nacatoch lies approximately at sea level in the southeastern part of the County.

In the past few years the principal mineral production of this County has been sand and gravel. The gravel comes from two sources. Part of the production is taken from a gravel pit at Black Rock; the balance from the bottom of Spring River. The sand is also produced from the bottom of the river.

The lowest elevation in the County, 229 feet, is located 0.2 of a mile south of Black Rock at railroad bridge over Black River. Highest elevation, 500 feet (estimated) is at Denton and Annieville. A few of the representative towns with their respective elevations are as follows:-

Black Rock	249 feet	Hoxie	268 feet
Portia	263 feet	Ravenden	302 feet
Walnut Ridge	270 feet		

This County is well drained by the Black, Strawberry, Spring

and Cache Rivers, together with numerous creeks, the principal of which is Village Creek; it flows through practically the entire east central part of the County. Black River flows through the central part of the County, while Spring River, which forms a part of the northern boundary, flows in a southeasterly direction and empties into Black River in the southern part of the County. Cache River forms the eastern boundary and flows south the entire length of the County. The only area in the County subject to overflow are the low lands along the major streams in extreme high water. There are no stream gaging stations in the County. A station is needed, however, on Black River at Black Rock.

The principal production in Lawrence County will probably be zinc, as there are some large deposits of this mineral in the County; several are northwest of Black Rock, while other known deposits are in the vicinity of, and north of, Smithville. Other minerals in this County known to exist, but which have not been developed extensively, are limestone, marble, iron pyrites, phosphate and sulphur.

With two railroads, two Federal Highways and four State Highways, Lawrence County enjoys good transportation facilities. The main line of the Missouri Pacific enters the County in the southern part, passing through Alicia, Minturn, Linsey, Hoxie, Walnut Ridge and Murta. The St. Louis & San Francisco has two lines crossing the County. One of these enters the County in the northwestern part, passing through Ravenden, Sloan, Black Rock, Portia, Hoxie and Sedgwick. The other line enters the County in the northern part and runs only to Walnut Ridge, connecting with the Missouri Pacific at this point. This division does not extend to Hoxie, and therefore does not connect with the other line of the road anywhere in the County.

The highway system consists of Federal Highways No's 63, and 67, and State Highways No's 25, 91, 115 and 122. No. 63 is gravel or stone surfaced; it runs northwest across the County from the southeast. No. 67 is an all paved road, and covers the eastern portion of the County, running north and south. Black River, which flows through the central part of the County; Spring River, which forms a portion of the northern boundary; Strawberry River, which flows through the western part of the County, and Cache River, which forms the eastern boundary of the County, are all navigable to small boats, according to report of the United States Engineers.

M.R.C. quadrangle maps Powhatan, Walnut Ridge, Strawberry, Alicia and Sedgwick cover the County with the exception of the northwest portion, which has not been mapped in detail. Highway and State Topographic maps are also available.

LEE COUNTY

Lee County, situated in the eastern part of the State, is bounded on the north by St. Francis County, on the east by the Mississippi River, on the south by Phillips County, and on the west by Monroe County. It has a land area of 384,640 acres.

This County lies in the Mississippi River bottoms. The County is divided into two parts by what is known as Crowley's Ridge. This ridge is the principal topographic feature in Lee County, and trends north and south a little east of the center of the County. About 15 sections of the central part constitute the hilly portion of the County. The soil is exceptionally fertile in the entire eastern section, and ranges from black alluvial in the east to sandy loam in the western portion.

The lowest elevation in the County, 180 feet, is near Big Creek Bridge in Section 24, T. 2 N., R. 1 W. Highest elevation, 301 feet, is at Kokomo. A few of the representative towns with their respective elevations are as follows:-

Marianna	200 feet	Moro	200 feet
Rondo	216 feet	Winona	205 feet
Felton	217 feet		

The St. Francis and the L'Anguille Rivers and their tributaries, Blackfish Bayou, Fifteen Mile Bayou and Big Creek, all tributaries of the Mississippi River, drain the County. The St. Francis River flows through the northeastern part and the L'Anguille River crosses the central portion of the County. The eastern part of the County is entirely bottom land and in places subject to occasional overflows. A great amount of drainage has been done in past years. Property owners have become interested, and practically all the land in the County needing drainage has been drained. There are no stream gaging stations in this County. Any information or data concerning the flow of the St. Francis River or the St. Francis River Floodway, may be obtained from gaging stations at Marked Tree, Poinsett County.

The principal feature in this County is Crowley's Ridge, which trends north and south slightly east of the center of the County. The ridge is interrupted by a gap six to eight miles wide, through which L'Anguille River flows. Only the extreme southern part of the main Crowley's Ridge which extends northward beyond the State Line, appears in Lee County. The part of the ridge south of the gap is a hilly wooded area, three to five miles wide, extending from Marianna to the southern boundary of the County a distance of six miles. The maximum elevation of the ridge in Lee County is 300 feet above sea level, or 70

to 100 feet above the lowlands to the east and west. The advance lowland, which includes that part of the County west of Crowley's Ridge, is, in general, a plain 200 to 230 feet above sea level. The Mississippi lowlands include that part of the County east of Crowley's Ridge, and is a heavily timbered plain 200 to 220 feet above sea level.

Crowley's Ridge, to a height of 50 to 80 feet above its base, is composed of irregularly bedded sands and clays, in part lignitic, belonging to the Jackson formation of Eocene age. The surface materials to the west and east of Crowley's Ridge consist of loams, clays, sands and gravels of Pleistocene and Recent age. The Tertiary sediments are estimated to range in thickness from 2,100 feet in the northwestern part to 3,500 feet in the southeastern portion of the County, and the Cretaceous from 600 feet to about 1,000 feet.

The Coastal sediments, or basement rocks (Cretaceous and younger in age) were deposited upon a nearly level floor of folded and truncated Paleozoic rocks. This floor was subsequently downwarped toward the southeast, and now lies at a depth of about 2,700 feet below sea level in the northwestern corner, and about 4,500 feet below sea level in the southeastern corner of the County. The character of the basement rocks is not known, but probably consists of sandstones, shales and limestones of Pennsylvanian and Mississippian age.

The Cretaceous rocks have not been penetrated in deep wells drilled in Lee County, but from regional studies there are reasons for assuming that they are similar in essential details to the equivalent rocks in St. Francis County to the north. The Cretaceous is estimated to be about 600 feet thick in the northwestern part and about 1,000 feet thick in the southeastern part of the County.

The following formations should be represented in this area: Arkadelphia marl, Nacatoch sand, Saratoga chalk, Marlbrook marl and the Tokio formation. The Tokio formation, or its equivalent (the Tuscaloosa formation of Mississippian age) is believed to be present in the southeastern part, but may be absent in the northeastern part of the County.

The Arkadelphia marl consists of gray to dark-gray shales. The Nacatoch sand consists principally of fine and medium textural sand, sandstone and sandy limestone, in part glauconitic, and subordinate beds of shale. The Saratoga chalk and Marlbrook marl are believed to be made up chiefly of chalks and marls with, perhaps, sand and sandy marls in the northwestern part. The Tokio formation probably consists principally of sands and clays.

The Eocene series, which comprises the Jackson, Claiborne, Wilcox and Midway formations, has an estimated thickness of about 2,000 feet in the northeastern part and about 3,500 feet in the eastern part.

The Midway clays, estimated to be 500 to 600 feet thick, rest unconformably upon the Arkadelphia marl of Cretaceous age. They consist of gray and blueish-gray, generally noncalcareous clays, characterized by an abundance of siderite concretions.

The Jackson, Claiborne and Wilcox formations cannot be differentiated in this area; they have a combined thickness in the southeastern part of the County. These formations are made up chiefly of sands, clays and sandy clays, especially in the basal part of the Claiborne formation and in the Jackson formation. The Jackson formation on Crowley's Ridge is overlain by from 10 to 15 feet of coarse sands and gravels of the Lafayette formation, provisionally assigned "Pliocene" age.

The advance lowland, west of Crowley's Ridge, is underlain to a depth of 125 to 200 feet by loams, clays, sands, and gravels of Pleistocene age. Although irregularly bedded, in general they grade downward from silty clays, loams and fine sands to coarse sands and gravels at the base. The Mississippi lowland, east of Crowley's Ridge, is underlain to an estimated depth of 150 to 200 feet by Quaternary alluvial loams, clays, sands and gravels.

The top of the Nacatoch sand lies at a depth of about 2,100 feet below sea level in the northwest corner, and probably at a depth of not less than 3,500 feet in the southeast part of the County. The dip is to the southeast at the rate of 35 to 50 feet per mile. The presence or absence of local anticlinal structure is not determinable from the available data.

Our records do not disclose any material mineral production in this County. There is, however, some brick clay taken from the loess of Crowley's Ridge, and used for the manufacture of brick. There are other clay deposits in the County, but there are no statistics available as to the extent of its development, if any.

With the Mississippi River on the east, two railroads, one Federal Highway and four State Highways traversing different sections, Lee County has excellent transportation facilities and puts everyone within easy reach of a market and a shipping point.

Many of the larger boats which ply up and down the Mississippi River via St. Louis and Memphis to New Orleans touch the eastern boundary of the County. The rivers of the County do not afford navigation for these boats, but all materials and

commodities can be placed on barges and then transported up the rivers, giving most of the County water facilities.

The Missouri & Arkansas Railroad crosses the County from the northeast to the southeast, passing through Moro, Aubrey and Rondo. The Missouri Pacific Railroad has two lines running through the County, one of which enters the County in the northern part and runs almost due south through the central portion, passing through Haynes, Wrightland, Felton, Marianna (the County Seat), Allen and La Grange. The other line crosses the northeastern part of the County from Marianna, passing through Soudan, Park Place, Brickeys and Hoodland. Federal Highway No. 79 traverses the western, central and northeastern portions of the County, and State Highways No's 1, 78, 121 and 131 cross and cris-cross the County in practically every direction.

M.R.C. quadrangle maps Brinkley, Marianna, Park Place, Horseshoe Lake, Latour, Marvell and Holly Grove completely cover the County. Highway and State Topographic maps are also available.

LINCOLN COUNTY

Lincoln County, situated in the south central part of the State, is bounded on the north by Jefferson and Arkansas Counties; on the south by Drew County; on the east by Desha County, and on the west by Cleveland County. It has a land area of 365,440 acres.

This County lies in the Arkansas River Valley of the Gulf Coastal Plain. Generally, the County is level, but there are, some rolling lands and hills. The prevailing soil in the bottoms is the strong alluvial loam, and in the hills a reddish sandy soil with a clay sub-soil. The most important soil is alluvial, covering about one-half of the surface of the County, and extending from Pine to Napoleon, along the banks of the Arkansas River, a distance of about 90 miles. About 240 square miles of this area is alluvial and 300 square miles yellow loam. There is plenty of good well water, numerous springs, and a delightful climate, such as make Arkansas the land of double crops.

Bartholomew Bayou, which traverses Lincoln County from the northwest to the southeast corners, divides the County into two distinct topographic provinces. To the east is the wide, alluvial flood plain of Bartholomew Bayou, and the Arkansas River which slopes gently from an elevation of 185 feet in the north to 155 feet above sea level in the south. To the west a narrow terrace, a northwestward continuation of the Hamburg terrace, separates the flood plain from Monticello Ridge. In the vicinity of Star City the ridge is more than 300 feet above sea level. Rocks of Jackson age crop out along Monticello Ridge, but elsewhere alluvial deposits of Pleistocene and Recent age form the surface in Lincoln County.

The basement rocks have not been penetrated in deep wells drilled in Lincoln County, but, based on a regional study, the floor upon which the Cretaceous sediments accumulated, slopes toward the east and is estimated to lie about 4,100 feet below sea level in the western part, and about 5,000 feet below sea level in the eastern part of the County. Rocks of Comanche age are not believed to be present in this area, but are absent either by non-deposition or by truncation. The Gulf series is estimated to range in thickness from about 400 feet in the western part to about 900 feet in the eastern part of the County.

The available well records do not permit accurate differentiation of the Eocene sediments. Like the Cretaceous, the Eocene sediments increase in thickness from west to east. Alluvial deposits, consisting of sands, gravels, silts and loams of Pleistocene and Recent age underlie the surface, except over Monticello Ridge in the southwestern part of the County,

to a depth of 200 feet. A generalized picture of the structure indicates that the top of the Cretaceous lies about 3,300 feet below sea level in the western part, and more than 4,000 feet below sea level in the eastern part of the County.

The lowest elevation in the County, 160 feet (estimated) is at Lyko. Highest elevation, 395 feet, is about 4 miles south of Star City. A few of the representative towns with their respective elevations are as follows:-

Gould	166 feet	Glendale	250 feet
Grady	185 feet	Star City	250 feet
Varner	180 feet		

Lincoln County is well drained by the Arkansas River and Bartholomew Bayou, together with numerous creeks. The Arkansas River flows along the northwestern boundary, and Bartholomew Bayou flows through the central part of the County from the northwest. That part of the County subject to overflow is in the lowlands along the major streams. There are no stream gaging stations in this County. However, a request has been made for a gaging station on Bartholomew Bayou at Warrenton.

In the past few years the principal mineral production in Lincoln County has been sand, gravel and brick clay. The sand and some of the gravel is taken from the bars and dredged from the bottom of the Arkansas River by specially designed boats. The most of the gravel produced in the County, however, is taken from a gravel pit located in the vicinity of Star City. The yellow surface clay found in the County is used for common brick at Palmyra.

Two railroads, a Federal Highway and four State Highways give Lincoln County good transportation facilities. The Missouri Pacific crosses the northeastern part of the County, passing through Grady, Varner, Lyko and Gould. The Arkansas Railroad is only a local short line and traverses the east central and northeastern portions of the County, connecting with the Missouri Pacific at Gould, with its terminus at Star City. Federal Highway No. 65 crosses the northeastern part of the County, paralleling the Missouri Pacific Railroad. State Highways No's 11, 13, 114 and 140 give the County good overland service.

M.R.C. quadrangle maps Noble Lake, Varner, Rotan, Feenyville and Gillett completely cover the County. Highway and State topographic maps are also available.

LITTLE RIVER COUNTY

Little River County, situated in the southwestern part of the State, is bounded on the north by Sevier County; on the east by Hempstead County; on the west by Oklahoma, and on the south by the State of Texas. It has a land area of 349,440 acres.

This County lies between Little River and Red River, and is the first County south of the foothills of the Ouachita Mountains, and wholly within the Gulf Coastal Plain. The valley lands on the Red River are of a deep, sandy loam soil. The valley lands of Little River are of a dark, deep sandy loam, but not quite so productive as those of Red River. The remainder of the County is composed mostly of rich, sandy loam upland, with a red clay subsoil. The County is well adapted by soil and climate to any southern crop.

Little River County, except for a small area in the southwestern part, is mantled by terrace and river deposits of Pleistocene and Recent age which lie unconformably upon the truncated edges of Upper Cretaceous strata ranging in age from Arkadelphia to Brownstown. The Marlbrook marl, Nacatoch formation, Annona chalk, Ozan formation, and Brownstown marl appear at the surface in a small area in the southwestern part of the County. The Upper Cretaceous sediments of this area have been described by Dane. The Upper Cretaceous strata dip to the southeast.

Strata of Comanche age underlie the Gulf series throughout Little River County. Limestone and shale of Washita-Fredericksburg age are in contact with the base of the Gulf series in the western and southwestern parts; but elsewhere in the County the upper part of the Trinity group occupies the same stratigraphic position. The Comanche sediments increase in thickness from north to south. The Grote et al Arden No. 1 well, Sec. 2., T. 13 S., R. 31 W., in the southern part of the County, recorded 130 feet of limestone and shale of Fredericksburg and Washita age, and 1,380 feet of the Glen Rose, including the Paluxy sand at the top. The Glen Rose consists chiefly of red clays and sands in the upper part, and of Marine shale, impure limestone, and sand with interbedded red clays in the lower part. The anhydrite zone ranges from a few feet to about 50 feet in thickness. The thickness of the Travis Peak formation is not known; but it is estimated to be not less than 1,000 feet in the southern part of the County.

A very generalized interpretation of the structure of this area is drawn on the base of the anhydrite zone of the Glen Rose. According to this interpretation, the Glen Rose strata slope to the south from a depth of about 500 feet below sea level in the northwestern part to a depth of about 3,000 feet below sea level in the southern part of the County.

The lowest elevation in the County, 249 feet, is at Walnut Bayou. Highest elevation, 451 feet, is at Arkinda. A few of the representative towns with their respective elevations are as follows:-

Ashdown	328 feet	Ogden	300 feet
Wilton	320 feet	Winthrop	327 feet
Foreman	408 feet		

Little River County is well drained by the Red River and its tributaries; Little River and Saline River. Little River flows along the northern boundary of the County and empties into Saline River between White Cliffs and Millwood. The Saline River forms the eastern boundary of the County and empties into the Red River in the southeastern part. The only portion of the County subject to overflow are the lowlands along the three major streams. There are no stream gaging stations in the County. Information concerning the flow of Little River may be obtained from Station No. 15 at Horatio, Sevier County, and that of Red River, from Station No. 14 at Garland City, Miller County.

In the past few years the principal minerals produced in the County are chalk, green sands, limestone, sand and gravel. The chalk can be used in the manufacture of burnt and unburnt lime products, such as Portland cement, plaster, fire brick, chemicals, soap, bone ash, artificial gas, paper, pottery, pottery material, egg preservations, tanning materials, and in the dehydration of alcohol. It is also used in the treatment of acid soils. No Federal or State figures are available concerning the output of chalk from the chalk area of the County. However, since 1926 the Lime Products Corporation has been using this chalk, and turns out ground and dried chalk for the rubber trade and for agricultural purposes. The capacity of the plant is about 250 tons per day. The product for the rubber trade is worth $18.00 to $27.00 per ton, and other grades from $5.00 to $25.00 per ton.

The green sand, or Glauconitic sand, contains potash in the form of the potash mineral Glauconite. This Green sand marl is found along the Little River in this County near Morris Ferry, in considerable quantities, and is widely used in the manufacture of fertilizer, not only in this County but other places. The limestone found in the County is used in the manufacture of cement. There are two cement plants located near large deposits of this mineral. The sand and gravel produced in the County is taken from the bars and also dredged from the bottom of Little River. Other minerals known to exist in the County are lignite, brick and tile clays, and several kinds of marls; but there are no statistics available as to their production.

This County enjoys excellent transportation facilities; unique in one respect, being surrounded on three sides by water; on the north by Little River; on the south by Red River, and on the east by Saline River. According to report of the U. S. Engineers these are all navigable streams, but possibly only to small snag and dredge boats. The other transportation facilities are three railroads, a Federal Highway and two State Highways, thus placing everyone within easy reach of a market and a shipping point.

The Kansas City Southern Railroad enters the northwestern part of the County and traverses diagonally the central and southeastern parts.. The St. Louis & San Francisco enters the County in the western part and runs almost due east through the central portion. The Graysonia, Nashville & Ashdown Railroad crosses the northeastern part from Ashdown, the County Seat. Federal Highway No. 59-71 crosses the County from north to south through the central part. North of Ashdown, this Highway is gravel or stone surfaced, and south of Ashdown, it is all paved with concrete, asphalt, etc. State Highway No. 41 runs north and south through the western part, and State Highway No. 32 crosses the County from east to west through the central part, and is paralleled in places by the St.Louis & San Francisco Railroad.

Little River County is not covered by quadrangle maps. Highway and State topographic maps are available.

LOGAN COUNTY

Logan County, situated in the northwest central part of the State, is bounded on the north and east by the Arkansas River, on the south by Yell and Scott Counties, and on the west by Sebastian County. It has a land area of 464,640 acres.

This County lies in the Arkansas valley area of the Ouachita Province, both of which are in the Paleozoic region, and mostly on the north slope of Magazine Mountain range, a local name given to that part of the Ozark Mountain system. About one-fourth of its surface is on the south side of the summit of the main range.

While Logan County is a mountainous country, there is a large acreage of very good land, as the plateaus are large, the slopes general and the valleys wide. Rich alluvial soils cover the valleys, while the dark sandy loam, so common all over the State, is found on the hills and plateaus.

The southern part of Logan County is in the Magazine Mountain section of the Arkansas valley area, while the northern part is in the Arkansas River bottoms of the Ouachita Province. The surface formations, and those immediately underlying the surface in the northern part of the County, in the Arkansas River bottoms of the Arkansas valley area, consist of alluvial sands, gravels and clays which are of the Atoka formation. In the southern part the surface soil is immediately underlain with sandstone and sandy shales which outcrop in many places. Beneath these formations are found shales and sandstones of the Pennsylvanian period marked by deposits of coal; and beds of coal are found beneath the surface here. These formations rest on strata of the Mississippian period and consist of hard shales. A study of the logs of test wells drilled in the County in a search for oil and gas gives a general knowledge of the underground rock. These test wells showed only a small trace of oil, but gas-bearing sands were penetrated and commercial gas production obtained.

The lowest elevation in the County, 375 feet (estimated) is at Kalamazoo. Highest elevation, 2,800 feet (estimated) is on Magazine Mountain. A few of the representative towns with their respective elevations are as follows:-

Paris	410 feet	Booneville	511 feet
Magazine	456 feet	Blue Mountain	507 feet
Echo	672 feet		

The drainage system of the County consists of the Petit Jean River, which crosses the southern portion of the County, and the Arkansas River which forms the north county line for more than 50 miles. The tributaries of these two rivers are Hurricane Creek, Shoal Creek, Cane Creek and Six Mile Creek,

all fine mountain streams that give excellent drainage to the County. Being thus adequately drained, floods are at a minimum in the County except in the lowlands along the rivers, which overflow in extreme high water. There are no stream gaging stations in the County. Information concerning the flow of the Arkansas River may be obtained from either Station No. 9 at Van Buren or Station No. 10 at Little Rock.

The principal mineral production of Logan County since 1923 has been coal. This is a splendid coal region and heavy veins of the finest smokeless semi-anthracite and low volatile bituminous coal underlie this area. The coal-bearing area of the State is 1584 square miles in extent; the field reaches from Russellville on the east through Pope, Johnson, Yell, Franklin, Crawford, Sebastian, Scott and Logan Counties, to and beyond the Oklahoma border. The coal production in Logan County comes from a formation known locally as the Paris formation.

There has been some sand and gravel produced in the County in commercial quantities. Iron has been found in all parts of the County; deposits are very light however, and probably none of them will be worked, yet they are of great value to the land on which fruit is raised in giving the fruit its beautiful coloring.

The transportation facilities of Logan County are fairly good, with three railroads and five State Highways. There are portions of the County that have no overland service owing to the mountainous condition. The main line of the Chicago, Rock Island & Pacific Railroad traverses the southwestern part of the County and passes through Waveland, Blue Mountain, Magazine, Booneville (the County Seat), Barber and Echo. The Fort Smith, Subiaco & Rock Island runs through the north and north central parts, passing through Delaware, New Blaine, Scranton, Subiaco and Paris. This is a local short line railroad that runs from the coal fields at Paris to Ola, Yell County, Arkansas, via Dardanelle in Pope County. On April 20, 1937, however, the Interstate Commerce Commission recommended that the Chicago, Rock Island & Pacific Railroad be authorized to abandon operation of 13.9 miles of the line of the Rock Island & Dardanelle Railway from Ola, Yell County, to Dardanelle in Pope County, Arkansas. A branch of the Missouri Pacific Railroad traverses the northwestern part of the County and runs as far as Paris, connecting with the Fort Smith, Subiaco & Rock Island at this point.

State Highways No's 23, 109 and 116 cross the western and southwestern parts of the County and connect with the two trunk line highways at Booneville and Magazine. State Highway No. 10 which crosses the southern part of the County, and is shown on highway maps as a trunk line route, is, for the most part, only gravel or stone surfaced. State Highway No. 22, which crosses

the central part, is an all paved route and one of the most picturesque drives in the State.

U.S.G.S. quadrangle maps Dardanelle, Magazine Mountain and Fort Smith completely cover the County. A preliminary edition of the new Booneville quadrangle, covering an area of approximately 250 square miles in the western part of Logan County, has been issued and is the first map of this area made since 1888. Contours are shown at intervals of 20 feet. Highway and State Topographic maps are also available.

LONOKE COUNTY

Lonoke County, situated in the central part of the State, is bounded on the north by White County; on the east by Prairie County; on the south by Jefferson County, and on the west by Pulaski County. It has a land area of 508,160 acres.

This County lies in what is known as the Gulf Coastal Plain, except the extreme northwest corner, which is in the Fourche Mountain area of the Ouachita Province. The County is in three divisions: Northern, central and southern. In the northern division rises the foothills of the Ozark Mountains, with an abundance of good water. The soil is a sandy loam with a red clay subsoil. The central division is covered by Prairie Longue and Grand Prairie, with skirts of timber. The soil is of a chocolate color, with a clay subsoil. The southern division of "Rich Woods" is a part of the great cotton belt of the Arkansas River Valley, in which is located some of the largest plantations in the State. A part of the soil is dark sandy loam, while a portion of it is gumbo and "buckshot" land, all of which is very productive.

The Ozark Province is represented by a few square miles in the northwestern part. The remainder of the County is included in the Gulf Coastal Plain, which is here separable into Chinquapin Ridge and the Advance lowland. The area included in the Ozark Province coincides with the outcrop of Paleozoic rocks forming hill lands, in which the tops of the hills and ridges rise to a height of 400 to 600 feet above sea level.

Chinquapin Ridge, or the "sandhills," lying just east of the Ozark Province and east of Austin and Cabot, is a sandy ridge several miles wide and extending north and south for a distance of about 12 miles. The ridge is 375 to 400 feet above sea level. The Advance lowland is a nearly level or gently rolling plain 200 to 250 feet above sea level, and slopes slightly to the south. The interstream areas present numerous tracts of open, grass-covered prairies, separated by slightly lower timbered lands. Grand Prairie, an irregular, but, in general, continuous tract of prairie, lies northeast of Bayou Two Prairie and extends from a point six miles northwest of Lonoke southeastward through Lonoke, Prairie and Arkansas Counties. Prairie Longue, a similar prairie, extends southeastward through Lonoke County south of Bayou Two Prairie, and parallel to Grand Prairie. The broad flood plains of the streams formed, for the most part, of swampy and heavily timbered land, are characterized by numerous ponds, abandoned stream channels and bayous. The southwestern part of the County falls within the flood plain of the Arkansas River and supports a vigorous growth of timber.

Paleozoic rocks, belonging to the Atoka formation of

Pennsylvanian age, crop out in the Ozark Province in the northwestern part of the County. They are separated from the Coastal Plain sediments by a relatively steep southeastward facing erosion escarpment, along the line of which the Paleozoic rock passes under the deposits of the Coastal Plain. A small out crop of the Midway formation overlies the Paleozoic between Cabot and Austin, which, in turn, is overlain by sands of the Wilcox formation forming Chinquapin Ridge. Throughout the remainder of the County the Eocene is overlain by Quaternary alluvial loams, clays, sands and gravel of the Pleistocene and Recent age.

The Coastal Plain sediments were deposited on a nearly level floor of folded and truncated Paleozoic rocks; and, in part of the area, is similar in character to the sandstones and shales of the Atoka formation of Pennsylvanian age, which crop out in the northwestern part of the County. Subsequent warping has lowered the floor which now slopes toward the southeast and lies at an estimated depth of about 3,000 feet in the southeastern corner of the County.

Strata of Cretaceous age are not known to crop out, but are present beneath the Tertiary sediments throughout the County. A well at Cabot obtained Calcareous sandstone containing upper Cretaceous fossils at a depth of 15 to 20 feet below the surface, and deep wells drilled elsewhere in the County have penetrated more than 300 feet of the Cretaceous strata, represented by the Arkadelphia marl, Nacatoch sand and Saratoga chalk.

The Cretaceous strata decreases in thickness from southeast to northwest, in part the result of actual thinning of individual members of the strata, and in part the result of overlap. The Cretaceous is estimated to be about 400 feet thick in the southeastern part of the County where the Marlbrook marl is believed to be represented in the basal part of the section.

The Arkadelphia marl, ranging from less than a foot to 75 feet thick, consists chiefly of gray and dark-gray Calcareous shale, but is probably represented, in part, by sand and sandstone in the northwestern part of the County.

The Nacatoch sand and Saratoga chalk are made up principally of fine textured sand and sandstone, in part Calcareous and Glauconitic, and sandy shales and some chalk in the lower part in the southwestern part of the County.

The Marlbrook marl, when present, probably consists of marl, shale and chalky marl and sand at the base.

The out crop of the Tertiary strata is confined to a small area in the northwestern part of the County. The Midway crops out in a small area less than half a mile wide and 3 miles long at Cabot, where it lies directly on the Paleozoic rocks, and is overlain by sands and sandy clays, probably belonging to the Wilcox formation which composes Chinquapin Ridge. In the remainder of the County the Eocene deposits are overlain by Quaternary alluvial deposits.

The Tertiary strata increase in thickness from northwest to southwest, where they attain their maximum thickness, estimated to be 2,500 feet. Here the Jackson, Claiborne, Wilcox and Midway formations are represented.

Throughout the Advance lowland the Eocene deposits are overlain by 100 to 175 feet of alluvial loams, clays, sands and gravels of Pleistocene and Recent age. The Pleistocene series, which crops out in the interstream areas, though irregularly bedded, grades downward from gray compact, silty water-bearing sands and gravels at the base. The Recent alluvian immediately underlies the flood plains of the present streams.

The generalized structure of Lonoke County, drawn on top of the Nacatoch sand, shows the strata slopes toward the southeast, carrying the top of the Nacatoch sand from above sea level in the northwestern to about 2,500 feet below sea level in the southeastern corner of the County. The rate of dip is from 50 to 75 feet per mile.

The lowest elevation in the County, 194 feet, is at Bayou Two Prairie. Highest elevation, 289 feet, is at top of west rail opposite Mo. Pac. Railroad Station. The following are a few of the representative towns with their respective elevations.

England	228 feet	Carlisle	233 feet
Lonoke	238 feet	Cabot	289 feet
Keo	230 feet		

The County is well drained by numerous bayous and creeks, principal of which are Press Bayou, Wattensaw Bayou, Bayou Meto, Two Prairie Bayou and Plum Bayou. There are no rivers flowing within the borders of the County, and floods rarely occur except in the lowlands along the bayous. There are no stream gaging stations in the County.

Lonoke County is not one of the mineral producing Counties of the State; its production lies in agricultural products. However, several minerals are known to exist in the County, such as brick clay at Lonoke and Cabot that could be used in the manufacture of common brick, and calcareous and shell marls;

but the only production in the past few years on a commercial scale has been a few tons of stone.

Lonoke County has excellent transportation facilities with three railroads--The Missouri Pacific, Chicago, Rock Island & Pacific, and the St. Louis Southwestern; two Federal Highways No's 67 and 70 and four State Highways No's 15, 30, 31 and 89. The Missouri Pacific Railroad traverses the northwestern part of the County and passes through Holland, Cabot, Austin and Ward. The Chicago, Rock Island & Pacific crosses the County through the central part and passes through Kerr, Meto, Lonoke, Sissnors, Moore Anor and Carlisle. The St. Louis & Southwestern Railroad has two branches traversing the County; one of these branches enters the County in the western part and runs in a southeasterly direction through the southwest part of the County and passes through Scott, Toltec, Keo and England; the other branch crosses the County from east to west in the extreme southern part. It leaves the main line in Arkansas County and connects with the above mentioned branch at England. Federal Highway No. 67 crosses the northwestern part of the County, while Federal Highway No. 70 traverses the central portion from west to east. State Highways No's 15, 30, 31 and 89 give good overland service in practically all parts of the County.

The southern part of the County is covered by M.R.C. quadrangles Pastoria, Altheimer and Goldman; the northern portion is covered by Hazen M.R.C. quadrangle; U.S.G.S. quadrangle Stuttgart covers the southeastern part. All the western portion is covered by U.S.G.S. quadrangle Little Rock. The center of the County is now being mapped. Highway and State topographic maps are available.

MADISON COUNTY

Madison County, situated in the northwestern part of the State, is bounded on the north by Carroll County, on the east by Newton County, on the south by Johnson County and on the west by Washington County. It has a land area of 535,040 acres.

This County lies in the Paleozoic region. The northern part is in the Springfield Plateau, while the southern portion is in the Boston Mountain area of the Ozark region. Madison is one of the mountainous counties of the State, and only about two-fifths of the land area is level alluvial land and suitable for the growth of field crops.

The surface of the Springfield Plateau is rather rough, particularly near the northern border, where streams are cutting back into the Eureka Springs escarpment, and also near its southern border where monadnocks are most numerous. In many areas, however, the surface of the Plateau is only gently undulating. Such areas, which are locally called "prairies," are most abundant in the extreme northwestern part of the State. These prairies range in size from about five to fifty square miles, and their greatest difference, in relief, rarely is more than 100 feet. Their combined area is not great, but they comprise the better farm land of the Plateau. They have determined the location of many towns and villages.

Most of the surface rocks of the Plateau belong to the Boone formation, but upper Mississippian formations are exposed near the southern border of the area, and Pennsylvanian beds cap a few of the higher monadnocks. The weathering of the Boone formation produces a mantle of insoluble chert, which is left after the limestone has been dissolved; and this characteristic surface veneer is widely distributed over the Springfield Plateau. Over large areas also, where the Boone is the surface formation, the Plateau is marked by solution valleys. These valleys are strikingly uniform in width, and most of them are nearly straight. Their slopes are steep but not precipitous. Their heads are somewhat cirquelike and simulate the appearance of sink holes cut in half along a vertical plane. These valleys commonly join each other at an angle of less than 90 degrees; and, as they are extremely numerous, they dissect the surface of the Plateau in labyrinthine fashion. These valleys are so characteristic of the Springfield Plateau that they may be used as a criterion of that physiographic Province.

The fragments of the Boone chert that are carried by streams form an effective abrasive agent. Where they are washed over the King's River or the St. Peter sandstone, they commonly form straight-sided, symmetrical potholes. These are minor through locally spectacular physiographic features, which are generally found in the northern part of the Springfield

Plateau. Caves also are abundant in the Boone formation throughout the Springfield Plateau, and many of the larger ones are near the southern boundary in Arkansas. Most of the beds of the Springfield Plateau lie nearly flat, but they show a slight regional dip toward the south, which is most pronounced near the southern edge of the Province. At some places, however, they have been flexed into shallow basins and low domes, and are displaced by normal faults.

The so-called Boston Mountains rise above the Springfield Plateau in a second, and more prominent northward-facing escarpment which attains a height of 800 feet. Viewed from the Springfield Plateau this escarpment appears to be a uniform, even-topped wall. In reality it is very irregular, for many outliers of the Boston Mountains stand on the Plateau, and streams have deeply serrated the scarp. Steep cliffs and deep narrow valleys are numerous throughout the Province. The southern slope of the mountains to the Arkansas valley, generally, is less precipitous, but at some places, as north of Clarksville, it descends abruptly and is broken by many ravines.

The Boston Mountain escarpment is capped by the resistant basal sandstone of the Atoka (Winslow) formation, which is the surface rock over most of the mountain area. The narrow group and the chester beds, however, crop out below the Atoka in the escarpment, and the morrow is exposed in a few of the deeper valleys south of the crest of the mountains. Most of the mountain tops stand at about the same level and form a greatly eroded table-land that rises 1,900 to 2,200 feet above sea level; but a few monadnocks rise several hundred feet above the deeply dissected Plateau. Gorges 500 to 1,250 feet deep, which lie between steep ridges and jagged spurs, are common enough to warrant the application of the term "mountainous" to this highland region. The beds that form the Boston Mountains, however, are little folded, though a series of southward-dipping monoclinal folds on the southern slopes bring the younger beds there into view.

The pre-carboniferous rocks of northern Madison County include strata belonging to the Ordovician, Silurian and Devonian systems. Of these, however, only the Ordovician formations are of considerable thickness, or of large areal extent. Practically all these formations have been encountered in wells drilled in areas south of their outcrop, but these wells have found in them neither oil or gas. Therefore, although these formations will probably be tested further, they are not considered in detail in this report, for the chances of obtaining from them either oil or gas in commercial quantities are poor.

The lowest elevation in the County, 1,214 feet (estimated) is at Rockhouse. Highest elevation, 2,200 feet (estimated) is

at Heath and Red Star. A few of the representative towns with their respective elevations are as follows:-

Huntsville	1,452 feet	Combs	1,401 feet
Dutton	1,690 feet	Patrick	1,357 feet
Pettigrew	1,821 feet		

The river and drainage system of the County consists of White and Kings Rivers and their tributaries. Other streams are War Eagle Creek, Piney Creek, Richland Creek and South Fork. White River flows through the southern and southwestern parts of the County, while Kings River flows through the eastern portion. The area is not subject to floods except possibly along the rivers in times of high water. There are no stream gaging stations in this County.

Madison County is in the mineral belt of the State, and has deposits of marble, iron, zinc and lead; but these deposits have never been worked to the extent of commercial production. The distribution of crystalline limestone, or marbles, has been traced for over 2,000 miles and through eleven Counties in the northern part of the State, which includes Madison County. The beds nearly always have a workable thickness which usually varies from 25 to 50 feet, and at some places is 155 feet thick. There is an unlimited supply of marble located near Huntsville, but it has been little developed. This is probably the most valuable of the minerals to be found and may sometime in the future be of much wealth to the County. Iron ore is of common occurrence throughout many parts of the County, but the deposits are of too small quantities to be profitably worked.

Madison County has fairly good transportation facilities. A branch of the St. Louis & San Francisco Railroad runs from Fayette Junction, Washington County, to Pettigrew, Madison County. It has been ascertained, however, that after a long controversy this branch of road was allowed an order by the Interstate Commerce Commission abandoning this 30 mile stretch of railroad. When this order takes effect, Madison County will also be without a railroad, making two adjoining Counties in Arkansas, Madison and Newton, without railroad transportation.

State Highways No's 12, 16, 23, 45, 68 and 127 are the overland routes, and cover the County in practically all directions. According to report of the United States Engineers, the White and Kings Rivers are navigable to small boats.

Madison is one of the few counties in the State that does not have a Federal Highway; nor does it have an all paved State Highway. All the five State Highways traversing the County are gravel or stone surfaced.

The northern half of the County is covered by U.S.G.S. quadrangle map Eureka Springs. The southern portion of the County has not been mapped in detail.

MARION COUNTY

Marion County, situated in the northwest part of the State, is bounded on the north by the State of Missouri, on the east by Baxter County, on the south by Searcy County, and on the west by Boone County. It has a land area of 414,440 acres. This County lies in the Salem and Springfield Plateaus. The surface of the County generally is broken and hilly with fertile valleys and wide uplands. Crooked Creek divides the County from west to east, and along the valley of this stream there is rich fertile soil. The lowlands of both the White and Buffalo Fork Rivers are very fertile.

The division between the two plateaus is very irregular, but well marked by an escarpment or hard formation of limestones and resistant "chert", or flint. The Springfield Plateau, standing between 1,000 and 1,500 feet high, is considerably above the Salem, which ranges from 500 to 1,250 feet. The latter Plateau is of the "Ordovician" period. The principal rocks exposed, and those that underlie the surface, are limestones and dolomite (a combination of two silver white metals) and some sandstones.

The rocks exposed, and those underlying the surface of the Springfield Plateau, which is very rough, are of the Boone formation of the Mississippian period. This formation is composed of "cherts" and limestones. As "Chert" is a very hard, flinty formation and the limestone much softer, surface streams have washed away much of the limestone in places, leaving the "chert" exposed in various shapes and creating a great number of caves and underground streams. Below these upper formations, lie beds of gray and pink crystalline, known as "St. Joe" limestone; and this rests on a formation known as "Chattanooga" shale.

The lowest elevation in the County, 435 feet, is at McBee Landing. Highest elevation, 1,350 feet, is on Hall's Mountain. A few of the representative towns with their respective elevations are as follows:-

Yellville	859 feet	Flippin	642 feet
Pyatt	743 feet	Oakland	650 feet

This County is well drained by the White and Buffalo Rivers and their tributaries, the principal of which is Crooked Creek; this stream divides the County from east to west. White River traverses the northern and eastern portions of the County, and the Buffalo River (a fork of White River) crosses the southern part of the County. There is hidden in the White and Buffalo Rivers a wealth of water power. It has been estimated that there is enough horse power in these two streams to supply every industry in the State. Development of this water power is now under way. There are two stream gaging stations in the County.

Station No. 3 is on White River at Flippin, and Station No. 5 is on the Buffalo River at Rush. These stations are maintained for the purpose of obtaining data concerning the flow of these two streams.

The minerals of Marion County are her most valuable asset. The most important minerals are lead and zinc, both of which have been mined to a considerable extent. The zinc ore is of an exceptionally good quality. It is found in the form of sulphide or sphalerite; also in forms of zinc carbonate of many colors, known as "black jack." The zinc blend will run from 55 to 65 per cent metal. The ore averages 5 per cent better than in the Galena-Joplin district. The principal mine is the "Morning Star" near Yellville. The extent of these deposits is not known, though there seems to be an almost inexhaustible supply.

The synclinal accumulations and the brecciated deposits are unknown, save where they have been hit upon almost by accident. In these synclines vast bodies of free zinc carbonate are found. Many hundred thousands of dollars have already been invested in these mineral lands and properties. During and since the World War this district has produced around $6,000,000.00 in minerals.

There are other known minerals in the County, some of which have been produced in small quantities. Of these we mention a few as follows:-

GALENA:	Mined in limited quantities.
PEARLS:	In past years pearls were quite extensively produced from the fresh water mollusks of White River. They are still found, but not in as large quantities as in previous years.
CALAMINE (ZINC SILICATE)	This mineral is found in the zinc mines of the Sugar Orchard region, and has been produced in commercial quantities.
HYDROZINCITE (ZINC CARBONATE)	Found in the zinc and lead belt of Marion County.
SAND (GLASS)	St. Peter sandstone is found along the valley of White River, and probably will make excellent glass sand.
NITER (SALT PETER)	Occurs in nitre earth of limestone caves.

SPHALERITE (ZINC BLENDE)	This is the most important zinc ore in the northern Arkansas field, and is found abundantly at Wood's mine, this County.
TRIPOLI (POLISHING POWDER)	Reported abundant at Lees Mountain.
ONYX MARBLE	Found in numerous caves and in limestone. This and the gray marble is now being produced in commercial quantities; and, with the advent of better highways, it is believed this mineral will be a very valuable asset to the County.

A branch of the Missouri Pacific Railroad, one Federal Highway, and three State Highways give this County fairly good transportation facilities. Federal Highway No. 62 crosses the central part of the County from east to west, and is paralleled, for the most part, by the White River Branch of the Missouri Pacific Railroad, which enters the County in the eastern part, passing through the towns of Cotter, Flippin, Summit, Turkey and Pyatt. Other parts of the County are badly in need of railroad transportation. The southwestern, southeastern and northern portions of the County are without a Federal or State Highway.

U.S.G.S. quadrangle maps Yellville and Mountain Home completely cover the County. Highway and State Topographic maps are also available.

MILLER COUNTY

Miller County, situated in the extreme southwest corner of the State, is bounded on the west by the State of Texas, on the east by Lafayette County, on the north by Little River and Hempstead Counties, and on the south by the State of Louisiana. It has a land area of 398,720 acres.

This County lies in the Gulf Coastal Plain. The County is generally level, and the river bottoms are among the most fertile in the State. The soil ranges from a dark alluvial in the river bottoms to a light sandy loam, with a clay subsoil in the uplands. There are five important soils in this County, which are described in detail with their possibilities in a soil survey of Miller County, published by the U. S. Dept. of Agriculture. Droughts are seldom, the annual rainfall being about 46 inches. The Springs and Autumns are long and pleasant. Pure freestone water can be secured at depths of from 20 to 40 feet. Health conditions are excellent.

The rocks at the surface in Miller County range in age from Recent to Tertiary, but deep wells have penetrated all of the Gulf series and more than 1,500 feet of the Comanche series. The oldest Comanche sediments recognized in this region is a series of shale, limestone and sand of Trinity age. These beds have not been reached in any of the deep wells drilled in Miller County, but were penetrated in deep wells drilled in Louisiana, a few miles to the south, and no doubt are present in the southern part of this area. The Trinity group increases from north to south, and becomes more characteristically marine in that direction. The decrease in thickness is, in part, the result of erosion in the interval between Lower and Upper Cretaceous time.

The Washita and Fredericksburg groups have not been recognized in deep wells in the northern part, but are present in the southern part of Miller County.

The Woodbine sand and the Tokio formation are inseparable in the well records of this area. Their combined thickness ranges from 400 feet in the northern part to 600 feet in the southern part of Miller County. The upper part consists of light colored sands and gray to dark-gray shale and clay; and the lower part consists of tuffaceous sands interbedded with shale and glauconitic sands. Locally, thin beds of red clay are present in the basal part of the section. The lower part of the section, although it represents the basal beds of the Gulf series, is younger than the Woodbine sand of Texas.

The Ozan formation is from 125 to 150 feet thick, made up of Micaceous clay and marl, and with a persistant sand member (the "Buckrange" sand) at the base. This member is best developed in the southern half, but is either thin or represented by sandy shale in the northern part of the County. A glauconitic sand or sandy shale is generally present in the upper part of the Ozan formation in northern Miller County.

The Cretaceous formations above the Ozan formation show only slight changes in thickness and character within the boundaries of Miller County.

The Nacatoch sand, Buckrange sand, the several sands in the Tokio formation, and the basal beds of the Upper Cretaceous, and the Trinity group of the Lower Cretaceous, which produce oil and gas in other parts of southern Arkansas and northern Louisiana, are present over most of Miller County. The geological structure is generalized, owing to lack of adequate data. Structural details and local structural features, which may have an important bearing upon oil and gas accumulations, are not determinable, or at the best are only suggested.

The area adjacent to the east side of the Fouke area has been drilled; however, favorable structural conditions may exist. There is one oil and gas-producing area in Miller County in Sections 33 and 34, T. 16 S., Range 26 W., and Sections 3 and 4, T. 16 S., Range 14 W. The Lenz Johnson No. 1 well, Section 24, T. 15 S., Range 26 W., made oil from the upper part of the Trinity group at a depth of 2,850 feet below the surface.

The lowest elevation in the County, 211 feet, is at Ravanna Bridge A 516. Highest elevation, 408 feet, is opposite the St. Louis Southwestern Railway Mile Post No. 413. A few of the representative towns with their respective elevations are as follows:-

Texarkana	337 feet	Homan	265 feet
Doddridge	227 feet	Garland	227 feet
Mayton	225 feet		

The drainage of the County consists of Red River and its tributaries, among which are Sulphur River (a fork of Red River) Big Creek and McKinney Bayou. Red River flows along the northern and eastern boundary for the full length of the County, while Sulphur River crosses the County in a southeasterly direction and empties into Red River a few miles east of Doddridge. These streams adequately drain the County. Floods are rare except in the lowlands along the various streams in times of extreme high water. A stream gaging station is located in the extreme eastern part of the County on Red River at Garland, Arkansas, where data can be obtained concerning the flow of this stream.

The principal minerals in Miller County are clay and petroleum, both of which are produced in commercial quantities. The clay is used to make terra cotta, flower pots, fire brick, common brick, mosaic and floor tiling and innumerable other products. During 1931 and 1932 quite a bit of gravel was produced, as at that time there was considerable construction work going on in the County, and the gravel was used locally.

Miller County is served by three railroads, three Federal Highways, one State Highway and a navigable river. The Missouri Pacific enters the County in the northeastern part and runs in a southwesterly direction, passing through Homan, Clear Lake Junction, Handeville and Texarkana. The St. Louis Southwestern enters the County in the eastern part, and crosses the central portion to the west, passing through Garland, Pine Star, Iton, Genoa and Texarkana. The Texas & Pacific enters the County in the southern part, passing through Kibla, Doddridge, Fort Lynn, Boggy, Fouke, Roberts, Boyd and Texarkana.

Federal Highway No. 67 traverses the northeastern part, while Federal Highways No's 82 and 71 serve the central and southern portions of the County. State Highway No. 134 connects with Federal Highways No's 82 and 71 in the southeastern part of the County.

The Red River, which forms the northern and eastern boundaries of the County, is a navigable stream, and each year many tons of supplies and commodities are moved by this water route. It will no doubt prove to be more valuable to the County in the future, owing to the latest oil strike. In another County, in the southern part of the State, one of the major oil companies is transporting oil and gasoline via the Ouachita River.

U.S.G.S. quadrangle maps Atlanta and Texarkana cover the western edge of the County. The northern, central and southern portions are not mapped in detail. Highway and State Topographic maps are available.

MISSISSIPPI COUNTY

Mississippi County embraces that portion of Arkansas bounded on the north by the State of Missouri; on the east by the Mississippi River; on the south by Crittenden County, and on the west by Poinsett and Craighead Counties.

This County lies in the Gulf Coastal Plain. The highest land in the County, with the exception of Big Lake highlands, a tract of slightly elevated land two or three miles wide, lying west of Big Lake and extending northward into Missouri, is immediately west of the Mississippi River.

The soil in the County is the richest to be found anywhere, being a black loam of great depth. This soil will produce abundantly any crop that grows in the southland.

Mississippi County, lying within the Mississippi lowlands of the Gulf Coastal Plain, is covered at the surface, and down to an estimated depth of 150 to 225 feet, with Quaternary alluvial loams, clays, sands and gravels of the Pleistocene, or Recent, periods of the earth's history. Underlying these formations are lignitic sands and clays of the Eocene period. These sands and clays are estimated to range from 1,000 to 1,800 feet in thickness, and beneath them are the basal beds of the Eocene formations some 400 to 500 feet in thickness, and consisting chiefly of gray clays.

The above strata of Eocene age rest on what are known as the Gulf series of formations, consisting of sands, marls and chalks. These belong to the Cretaceous system, and were found at a period marked by deposits of chalk and coal.

The Arkadelphia marl, Nacatoch sand, Saratoga chalk and Marlbrook marl, have been identified here and are believed to be in the Cretaceous strata, which is estimated to range from 400 to 800 feet in total thickness. These formations of the different periods all rest on the basement floor, believed to consist of folded Paleozoic strata, and sloping toward the east from about 1,700 feet below sea level in the northwestern corner to about 3,200 feet below sea level in the southeastern corner of the County.

The lowest elevation in the County, 224 feet, is near Barfield. Highest elevation, 269 feet, is at Frenchman's Bayou. A few of the representative towns with their respective elevations are as follows:-

Blytheville	257 feet	Osceola	238 feet
Wilson	227 feet	Luxora	237 feet
Manila	244 feet		

The eastern part of Mississippi County, adjacent to the

Mississippi River, is drained by this stream. The western and central parts of the County are drained by the Little and Tyronza Rivers and their tributaries; Pemiscot Bayou and Buffalo Creek; the latter in the extreme western portion of the County.

In addition to the natural drainage of the County, an extensive system of drainage ditches has been placed in operation, draining more than 100,000 acres of land. The land in the eastern part of the County, along the Mississippi River, is protected from overflow by a system of levees along this stream. These levees extend from Helena, Phillips County, Arkansas, to Cape Girardeau, Missouri. Mississippi County, however, still suffers from overflow during extremely high flood stages on this river. Notable examples of this occurred during the floods of 1927, 1936 and 1937. The flood problem of this and other counties bordering the Mississippi River have not yet been solved. While there are a great many stream gaging stations along the Mississippi River, none are located in this County. However, data on the flow of the Mississippi is available from stations located on the river above and below the County.

The only minerals found in the County are clay deposits in the extreme eastern part on the Mississippi River. Among these are yellow alluvial clays suitable for the making of common brick and draintile. There are some plants for the manufacture of these products located at Blytheville.

The transportation facilities of Mississippi County are fairly good. The St. Louis & San Francisco Railroad crosses the County from west to east in the northern part, and also from the north to the south in the eastern part. It has three branches, two of which serve the east central part and the other the western part of the County. The St. Louis Southwestern Railway enters the County in the northwestern part, running to Blytheville and connecting at this point with the St. Louis & San Francisco. There is no section of the County that is not within easy reach of some means of transportation, whether water or rail, supplemented by asphalt, concrete and gravel highways. Federal Highway No. 61, and State Highways No's 18, 120, 137 and 150 give excellent overland service.

M.R.C. quadrangle maps Leachville, Evadale, Manila, Jerico, Blytheville, Deckerville, Marked Tree, Osceola and Hales Point completely cover the County. Highway and State topographic maps are also available.

MONROE COUNTY

Monroe County, situated in the eastern part of the State, is bounded on the north by Woodruff County; on the south by Arkansas County; on the east by Lee and Phillips Counties, and on the west by Prairie County. It has a land area of 385,920 acres.

This County lies in the White River valley of the Gulf Coastal Plain. In the southwestern portion there are 15 square miles of level prairie land. The whole County, while generally level, is sufficiently undulating to afford ample drainage. The general character of the soil in the bottom is a sandy loam, mixed with alluvial; and in the uplands the soil is sandy. The climate, free range, prairie lands, etc., adaptability of the soil to any of the southern crops, make farming an industry of considerable importance in the County.

Monroe County lies within the Advance lowland, one of the topographic sub-divisions of the Coastal Plain. The surface is, in general, a gently undulating plain 175 to 210 feet above sea level. In most of the County east of White River are numerous swamps, bayous and abandoned stream channels, separated by low, rolling ridges of sand or sandy loam. Much of the surface is poorly drained, and the greater part of the area is wooded. However, there are a few small tracts of prairie-like land in the northeastern part. A relatively small area in the west central part of the County lies west of White River, and about 15 square miles of this section is open grass-covered prairie, forming a part of Grand Prairie.

Throughout the County the materials underlying the surface to estimated depths of 125 to 175 feet, are Quaternary alluvial loams, sand and gravels of Pleistocene and Recent Age, which rest unconformably on strata of Eocene age. The Eocene strata have an estimated thickness of about 1,700 feet in the northwestern part, and about 4,000 feet in the southeastern part of the County.

The Cretaceous is estimated to range from 400 feet to nearly 1,000 feet in thickness, with the greater thickness in the southeastern portion of the County. The Cretaceous sediments in this area were deposited on a nearly level floor of folded and truncated rocks of Paleozoic age. Warping has modified the attitude of the floor, which now lies at a depth of about 2,100 feet below sea level in the northwestern corner, and about 5,000 feet in the southeastern corner of the County.

The Cretaceous strata have been penetrated in but two deep wells, both located in the northwestern part of the County. The Cretaceous is estimated to be about 400 feet

thick in the northwestern corner, and about 1,000 feet thick in the southeastern corner of the County. The following formations are believed to be represented in this section:- Arkadelphia marl, Nacatoch sand, Saratoga chalk, Marlbrook marl, and Tokio formation (present only in the southeastern part of the County).

The structure of Monroe County is shown by means of control lines drawn on top of the Nacatoch sand at intervals of 100 feet and 500 feet. In as much as only a few wells have penetrated the Nacatoch sand in this area, the structure is generalized and does not show any local structural features which may be present. The Nacatoch sand lies at a depth of about 1,700 feet below sea level in the extreme northwestern corner, and is estimated to be more than 4,000 feet below sea level in the southeastern corner of the County. The dip is to the southeast at the rate of 35 to 50 feet per mile.

The lowest elevation, 149 feet, is about 0.75 miles northwest of Indian Bay Mound. Highest elevation, 229 feet, is at Roe, Arkansas. A few of the representative towns with their respective elevations are as follows:-

Clarendon	175 feet	Brinkley	206 feet
Holly Grove	180 feet	Eden	176 feet
Duncan	165 feet		

The County is drained by the White and Cache Rivers and their tributaries. Numerous creeks and bayous contribute to the drainage. The White River flows through the western part of the County and forms the boundary in the southwestern and southern portions. The Cache River flows through the northwestern and a part of the western portion of the County. This is a fork of the White River and empties into it a few miles north of Clarendon.

The Cypress Drainage District, formed many years ago, drains about 150,000 acres of lowland in Monroe County that had been heretofore too wet for cultivation. This project drained almost every acre in that County that needed it, and threw vast tracts of fertile soil open to settlers. The value of drainage in the County is almost incalculable. The drainage districts embrace the territory including Brinkley, Keevil, Glenwood, Blackton, Pine City, Palmer, Raymond, Holly Grove, and considerable territory adjacent to Clarendon. The only land that is subject to overflow is that along the rivers in times of extreme high water. There are no stream gaging stations in this County. Any information concerning the flow of White River may be obtained from Station No. 4 at De Valls Bluff, Prairie County, Arkansas.

Monroe County is not one of the large mineral producing counties of Arkansas. There are, however, several minerals produced in the County and they are, for the most part, used locally.

There is a good supply of brick and tile clay near Brinkley, and at one time there were two brick manufacturing plants operating in the County--one at Clarendon and the other at Fargo. At the present, however, there is only one plant operating, and it is producing on a small scale, only enough to supply the local demand for both brick and tile. Gravel is also produced and used locally as road metal. These gravels consist almost entirely of chert, quartz and novaculite pebbles, and range in age from Lower Cretaceous to Quaternary. The sand produced in this County is also used locally; it is dredged from the White River.

Four railroads, two Federal Highways, three State Highways and two navigable rivers give Monroe County excellent transportation facilities. The St. Louis Southwestern Railroad enters the County in the northeastern part, traversing the County diagonally and passes through Zent, Fargo, Brinkley, Keevil, Jeffreys, Clarendon and Roe. The Missouri & Arkansas Railroad crosses the northeastern part of the County, passing through Fargo, the only town of any importance on this line of road in Monroe County. The Chicago, Rock Island & Pacific crosses the north central part of the County and passes through Degmar, Eden and Brinkley. The Missouri Pacific enters the County in the southeastern part, passing through Palmer, Pine City, Holly Grove and Clarendon.

Federal Highway No. 70 crosses the north central part of the County. This is an all paved route, while Federal Highway No. 79, which crosses the southern part of the County, is, for the most part, only gravel or stone surfaced. State Highways No's 1, 17, and 20 cross the County from north to south and from east to west.

The White River is navigable as far up as Batesville, Independence County, and large boats ply up and down this stream. The Cache River is navigable, probably only to snag and dredge boats.

M.R.C. quadrangle maps De Valls Bluff, Brinkley, Holly Grove, Indian Bay and Clarendon completely cover the County. Highway and State topographic maps are also available.

MONTGOMERY COUNTY

Montgomery County, situated in the west central part of the State, is bounded on the north by Yell County, on the east by Garland County, on the south by Pike County and on the west by Polk County. It has a land area of 570,240 acres.

This County lies in two distinct regions of the Paleozoic uplift; about one-third of the County in the northern-most part in what is called the Fourche Mountain area, while the southern part of the County, comprising about two-thirds of the total area, lies in a region known as the Novaculite uplift. This is a spindle-shaped area which extends in the State from the vicinity of Little Rock slightly south of west to southern Polk County, which bounds Montgomery County on the west. About two-thirds of the County is hilly, and one-third alluvial lowlands. This area is divided into several mountain ranges and basins.

With the exception of the northwest corner, Montgomery County lies within that part of the Paleozoic area of Arkansas known as the Novaculite uplift, and is divided into the following basins and mountain ranges: Ouachita Basin, Saline Basin and Mazarn Basin: Northern Mountains, Crystal Mountains, Trap Mountain and Zigzag Mountain. The chief formation exposed on the mountains, in this County, is Arkansas novaculite, of which whetstone is a form. In the basins the formations exposed consist of shales, sandstones, some limestone and chert. The Arkansas novaculite, which ranges up to 950 feet in thickness, is of the Devonian period. Immediately beneath the above formations are sandstones, cherts and shales of the Silurian, Ordovician and Cambrian periods. The quartz veins and crystals which are exposed in the Crystal Mountains in small areas, and which are known to be of the Cambrian age, the oldest period represented here, are quite interesting and have attracted much attention.

The Womble shale, named from the town of Womble, is exposed in valleys that extend eastward through Montgomery County. The shale ranges in thickness from about 250 to 1,000 feet. The rocks are dominantly black graphite shales, with thin beds of sandstone near the base of the formation and limestone near the top.

The Polk Creek shale was named from Polk Creek, is typically exposed along the headwaters, and is in close association with the Big Fork chert; it crops out in Montgomery County. The Polk Creek shale is black, fissile, graphitic, and either very soft or hard and slaty. The softer beds are clayey and are graphitic enough to soil the fingers. The lower part of the formation has been prospected for slate near Washita, in Montgomery County.

The Missouri Mountain formation was named from Missouri Mountains in Montgomery County, where it is typically exposed. The formation is familiarly known as a slate, but it is different from other shales; however, it has been extensively prospected for commercial slate in Montgomery County. It ranges from a feather edge to 300 feet thick. At Slatington it has been quarried for use in switchboards. The formation consists of shale, slate conglomerate and sandstone. The shale is soft and argillaceous, and on fresh surfaces is gray, green, black or red. The Stanley shale, Mississippian age, crops out in Montgomery County. The formation is composed of dark, fissile clay shale inter-bedded with fine-grained, greenish-gray or bluish-gray sandstone.

The Arkansas novaculite, Devonian system, consists mainly of an unusual type of rock. Its average thickness is about 900 feet; it crops out in Montgomery County, especially at Caddo Gap. It consists of three well defined divisions. The lower division is made up almost entirely of massive white novaculite. The middle division is composed of thin beds of black novaculite inter-bedded with shale; and the upper division is essentially massive, calcareous novaculite. The Arkansas novaculite is of no value as a source or a reservoir of oil or gas.

The lowest elevation in the County, 574 feet, is about eight miles northeast of Mount Ida on highway No. 27 at Ouachita River bridge. Highest elevation, 2,212 feet, is on Missouri Mountain. A few of the representative towns, with their respective elevations are as follows:-

Black Springs	277 feet	Adams	677 feet
Norman	707 feet	Caddo Gap	619 feet
Waters	640 feet		

The Ouachita River and its tributaries, the Caddo River, together with numerous creeks, afford adequate drainage for the County. Floods rarely occur except in the lowlands along the rivers at high flood stage. There are no stream gaging stations in this County.

The mineral products of Montgomery County are varied, many of which are not found in commercial quantities. Several localities in the County have been fitfully and unprofitably exploited for silver at various times in the past, but no deposits large enough to be of commercial importance have been discovered.

It has been reported that traces of gold have been found in this County, but nowhere has there been discovered a deposit containing a sufficiently high average per ton in gold to pay for the treatment.

MANGANESE is a metallic element which has about the same specific gravity as iron. It is used principally as an alloy with other metals. Manganese is found in several localities in the State, included in which is Montgomery County, a portion of the west central Arkansas District. The ores in this section of Arkansas are found in pockets scattered through the Arkansas novaculite formations which are probably of Devonian age. These deposits, however, although containing large amounts of ore, are not sufficiently concentrated to permit profitable mining during normal prices of manganese.

The slate region of Arkansas is confined to the central portion of the Ouachita uplift and covers portions of Polk, Montgomery, Garland and Saline Counties. All of the deposits which have been developed commercially lie in western Montgomery and eastern Polk Counties. Slate has been rather extensively prospected all the way from Board Camp Creek in Polk County eastward to the Ouachita River, in Garland County. The point at which it has been most extensively worked is Slatington, Montgomery County, though there are other prospects in it of considerable magnitude.

The wide extent to which it has been prospected is due, not only to the promise it has given as a source of commercial slate, but to the favorable location of its outcrops, which usually are in bluffs and well up on the mountain slopes. It varies in thickness from a maximum of about 300 feet to a minimum of 50 feet or less. The thickest portion is along the central line of the Ouachita range, from which it thins out southward and probably northward.

This formation produces both red and green slate. Though both kinds may, and often do, occur in the same quarry, the red is predominant. In color it varies from a scarlet to a dark red, but that of any particular quarry is likely to be uniform. In exposed surfaces it presents rich, usually pleasing appearance.

In most parts this slate is intersected by numerous joints that run in all directions; but if favorable places are selected these are not so common as to prevent the quarrying of large blocks. The slate cleaves with fairly even surfaces, and can readily be split into sheets a quarter of an inch thick or less. Because of its softness and homogeniety this is altogether a desirable slate to work. It splits, saws and planes easily, and soon takes a polish on the rubbing bed; but in the process of drying, after having been taken from the rubbing bed, it is likely to check, and the amount thus lost greatly reduces the profit of working it. If some method of working can be devised that will avoid this checking, the slate industry of the State will become an important and paying one.

NOVACULITE; Novaculites are usually of one of two classes, which are known as the Arkansas stone and the Ouachita stone. The Arkansas stone is a very fine-grained homogeneous stone, has a waxy luster and is usually white. This stone is preferred for making whetstones and is usually shipped rough in blocks weighing between five and fifteen pounds. The Ouachita stone is more porous than the Arkansas stone and has the appearance of unglazed porcelain. The demand for the Ouachita stone is much greater than that of the Arkansas stone, and it is used in blocks up to 1,500 pounds or more for making large whetstones. Novaculite is found in the area covered by Pulaski, Saline, Garland, Hot Spring, Pike, Polk and Montgomery Counties. Recently large quantities of novaculite have been used by the Chicago, Rock Island & Pacific Railroad for ballast. The novaculite does not disintegrate, is easily crushed and makes a durable roadbed. Lead has been found sparingly and mined occasionally in Montgomery County at Rubicon, near Virginia City.

Other minerals known to exist in the County are "chert" (mined at Hot Springs, Garland County) for road building; barite (heavy spar) found in seams or pockets; building stone, mineral waters, sandstone, pottery clay, paint material, zinc, iron, amethyst, agate, and sand and gravel.

The only railroad transportation in Montgomery County, is a branch of the Missouri Pacific which runs into the southern part of the County for a distance of about 12 miles. Federal Highway No. 270 crosses the County from east to west, and State Highways No's 8 and 27 cross the County from north to south. There is no water transportation in the County.

U.S.G.S. quadrangle maps Mt. Ida, Caddo Gap, Caddo Gap No. 1 and Caddo Gap No. 2 completely cover the County. Highway and State topographic maps are also available.

NEVADA COUNTY

Nevada County, situated in the southwestern part of the State, is bounded on the north by Clark County; on the east by Ouachita County; on the south by Columbia and Lafayette Counties and on the west by Hempstead County. It has a land area of 396,800 acres, and lies wholly within the Gulf Coastal Plain. The surface of the County is generally level and rolling, there being only a small portion that could be said to be hilly.

The general feature of Nevada County is a dissected upland area. The highest ridges in the interstream area stand at altitudes of 350 to 375 feet above sea level. Ouachita River, forming the northern boundary, and Terre Range Creek, emptying into the Ouachita River in the northeastern part, are the principal streams in the County. Both of these streams flow through wide flood plains with altitudes of 175 to 225 feet above sea level.

Rocks of Upper Cretaceous age are exposed in the northwestern part of Nevada County. In the central and southern parts of the County, the Midway, Wilcox and Claiborne strata of Tertiary age form the surface rocks. Alluvial sand, gravel, clay and loam of Pleistocene and Recent age underlie the flood plain of Ouachita River and Terre Range Creek to an estimated depth of 40 feet.

The Midway formation maintains its regular character throughout the Tertiary Eocene series area and a nearby constant thickness of 475 to 500 feet.

The Wilcox formation in southern Nevada County is between 600 to 650 feet thick.

The Claiborne, of which only the lower part is present, has a maximum thickness of 200 to 250 feet in the southeastern part of the County.

The Cretaceous system, Gulf series, increases in thickness to the southwestern part of the County. The sediments, down to and including the Ozan formation, are exposed at the surface in northwestern Nevada County.

The Tokio-Woodbine section ranges in thickness from 150 feet in the northeastern part to 375 feet in the southern part of the County. It consists of gray shale, sand and sandy shale in the upper part, which becomes increasingly sandy to the northeast. The lower part consists chiefly of tuffaceous sand with subordinate beds of clays and, locally, contains red beds at the base.

The Brownstone marl and the Ozan formation decrease in thickness and become increasingly sandy to the north and east.

The Annona chalk, as a lithographic unit, is recognizable only in the southwestern part of the County. The Saratoga chalk and the Nacatoch formation thin out to the north and east. The Arkadelphia marl maintains its regional character throughout Nevada County and a nearly constant thickness of 90 to 100 feet.

The Cretaceous system, Comanche sediments, as originally deposited in this area, decreased in thickness and changed laterally in character to the north and northeast until, in the northern part, they were comparable in thickness and character to the sediments now exposed in Pike County. The changes in thickness and in lithology appear to have been most pronounced in the vicinity of and to the north of the flexure in the basement rocks.

The Comanche strata were tilted and truncated before the beginning of Upper Cretaceous deposition, and the basal beds of the Gulf series lie unconformably on strata ranging in age from Upper Glen Rose to Travis Peak. The Upper Glen Rose and the anhydrite zone of the Glen Rose are present only in the extreme southern and western part, where they have a combined thickness of about 150 feet.

The Lower Glen Rose underlies all except the northeastern part of Nevada County. The maximum thickness is about 900 feet. In the northeastern part of the basal, Upper Cretaceous beds are in contact with red shale and sands of the Travis Peak formation. The Travis Peak formation is estimated to be about 2,000 feet thick in the southern part of the County. To the south of the flexure, the Travis Peak formation is probably underlain by marine beds of Neocomian age of unknown thickness.

The basement floor, on which the Cretaceous sediments accumulated, slopes from a depth of 500 feet below sea level in the extreme northern part to about 2,500 feet below sea level in the central part of Nevada County. South of the line, represented by the 2,500 foot contour line, the basement floor is sharply flexed, and lies at depths greater than the depths of the deep wells drilled in this area.

The lowest elevation in the County, 171 feet, is at Emmet. Highest elevation, 378 feet, is near Rosston. A few of the representative towns with their respective elevations are as follows:-

Boliver	283 feet	Boughton	234 feet
Prescott	319 feet	Falcon	320 feet (Est.)
Sutton	370 feet (Est.)		

The Little Missouri River which forms the northern boundary, together with its tributaries, furnishes adequate drainage for the County. According to map showing emergency flood control work in Arkansas in June, 1935, no floods have been recorded in Nevada County. There are no stream gaging stations in the County. A station is needed, however, at Reeder on the Little Missouri River.

From a geological standpoint, the State of Arkansas has two mineral producing areas: The northern and the southwestern part of the State; Nevada County being in the latter area. Its principal production comes at this time from sand, gravel, coal, clay, natural gas and oil.

The Irma or Waterloo fields of Nevada County were discovered in September, 1922, by the Lyke Watkins well, located in Section 11-14S-21W. The fields cover an area of about 1,080 acres, or slightly less than two square miles. These two fields were named after the towns of Irma and Waterloo. Production is derived from the Nacatoch sand, which is encountered at about 1,225 feet. The oil produced has an average gravity of from 13 to 17 degrees B. These fields had produced 1,099,400 barrels up to January 1, 1926, from fifty six wells. The peak production of the fields was in 1923, in the week ending March 15th, during which time 2,150 barrels were produced daily.

The excitement of the discovery of oil in this County died down until in 1924;it was thought the fields had been accurately defined-that they could not be extended-so the wells that were still producing were all placed on pumps.

During the early part of 1937, the Benedum & Trees Corporation began drilling their Graves No. 1 well, in Section 10-14-20. This well was brought in during the latter part of April, 1937, and excitement again ran high. This discovery well was drilled to a depth of 2,200 feet, and brought in as a Woodbine or Tokio sand producer. It was placed on the pump and has been one of the best producers in the new field.

The Waterloo field was extended half a mile June 2,1937, by the C.B. & F. Petrolium Company's William Haynie No. 2 well, which was completed as a 200 barrel producer. The well is flowing from the Nacatoch sand at a depth of about 1,200 feet. This well is located in Sec. 5-14-20. In addition to the oil, this well is also producing about 40,000,000 cubic feet of gas.

Other wells recently completed in this field, are the William Haynie No. 1, and the Shephard Bros. Purifoy No. 1. This latter well is located in the southeast corner of Sec. 17-11-20, and is eleven miles due east of Prescott, Arkansas.

This County also has considerable sand and gravel production. The principal operator at the present time is The Reader Gravel Company. The capacity of their plant is about six cars of sand and twenty-five cars of gravel per day. The plant is located just over the county line at Reader, Ouachita County. Most of the production is taken from the Little Missouri River which flows along the northern boundary of the County.

There are several clay deposits in the County, probably the most valuable being at Emmet and Prescott in the northwestern part of the County. These deposits are suitable for and are used in the manufacture of common brick and drainage tile. There is also a deposit of pottery clay in the County, and this is used in the manufacture of pottery in a small way.

There are also deposits of coal and lignite in Nevada County, but they have not been worked to any great extent. The size of the deposits, or beds, has never been determined. If a survey were made to obtain this information, these deposits might prove to be very valuable to the County.

The main line of the Missouri Pacific Railroad crosses the northwestern part of the County, passing through Boughton, Prescott, Bolivar and Emmet. A branch of the Missouri Pacific runs from Gurdon, Clark County, through the northeast corner of Nevada County.

The Prescott & Northwestern Railroad enters the County from the west and terminates at Prescott.

The highway transportation of Nevada County consists of Federal Highway No. 67, which passes through the extreme northwestern part of the County, and State Highways No's 4, 19, 24 and 53.

U.S.G.S. quadrangle maps Gurdon and Camden completely cover the County. Highway and State Topographic maps are available.

NEWTON COUNTY

Newton County, situated in the northern part of the State, is bounded on the north by Carroll and Boone Counties, on the South by Johnson and Pope Counties, on the west by Madison County, and on the east by Searcy County.

This County lies in the Paleozoic area. The northeastern part is situated in the Springfield Plateau, while the southern and northwestern portions are in the Boston Mountains. This is said to be one of the most mountainous Counties in the State. Some of the peaks belonging to the Boston Range attain an elevation of more than 1,000 feet above the general level of the Country.

There are some good prairies on the north and northeast with grayish loam soil and clay subsoils. There are yet several thousand acres of Government land in this County, subject to homestead entry, which is being rapidly taken up. The most flattering inducements for settlers are offered in this County.

The surface of the Springfield Plateau is rather rough, particularly near the northern border, where streams are cutting back into the escarpment, and also near its southern border, where monadnocks are most numerous. In many areas, however, the surface of the Plateau is only gently undulating. Such areas, which are locally called "prairies," are most abundant in the extreme northwestern part of the State. These prairies range in size from about five to fifty square miles, and their greatest difference, in relief, rarely is more than 100 feet. Their combined area is not great, but they comprise the better farm land of the Plateau. They have determined the location of many towns and villages. Most of the surface rocks of the Plateau belong to the Boone formation, but upper Mississippian formations are exposed near the southern border of the area, and Pennsylvanian beds cap a few of the higher monadnocks.

The weathering of the Boone formations produces a mantle of insoluble chert which is left after the limestone has been dissolved; and this characteristic surface veneer is widely distributed over the Springfield Plateau. Over large areas also, where the Boone is the surface formation, the Plateau is marked by solution valleys. These valleys are strikingly uniform in width, and most of them are nearly straight. Their slopes are steep, but not precipitous. Their beds are somewhat cirquelike and simulate the appearance of sink holes cut in half along a vertical plane. These valleys commonly join each other at an angle of less than 90 degrees; and, as they are extremely numerous, they dissect the surface of the Plateau in labyrinthine fashion. These valleys are so characteristic of the Springfield Plateau that they may be used as a criterion of that physiographic Province.

The fragments of the Boone chert that are carried by streams form an effective abrasive agent. Where they are washed over the Buffalo River or the St. Peter sandstone they commonly form straight-sided symmetrical potholes. These are minor through locally spectacular physiographic features, which are generally found in the northern part of the Springfield Plateau. Caves also are abundant in the Boone formation throughout the Springfield Plateau, and many of the larger ones are near the southern boundary of the State.

Most of the beds of the Springfield Plateau lie nearly flat, but they show a slight regional dip toward the south, which is most pronounced near the southern edge of the Province. At some places, however, they have been flexed into shallow basins and low domes, and are displaced by normal faults.

The so-called Boston Mountains rise above the Springfield Plateau in a second, and more prominent northward-facing escarpment, which attains a height of 800 feet. Viewed from the Springfield Plateau this escarpment appears to be a uniform, even-topped wall. In reality it is very irregular, for many outliers of the Boston Mountains stand on the Plateau, and streams have deeply serrated the scarp. Steep cliffs and deep, narrow valleys are numerous throughout the Province. The southern slope of the mountains to the Arkansas valley generally is less precipitous; but, at some places, it descends abruptly and is broken by many ravines.

The Boston Mountain escarpment is capped by the resistant basal sandstones of the Atoka (Winslow) formation, which is the surface rock over most of the mountain area. The Morrow group and the Chester beds, however, crop out below. The Atoka in the escarpment, and the Morrow is exposed in a few of the deeper valleys south of the crest of the mountains. Most of the mountain tops stand at about the same level and form a greatly eroded table-land that rises 1,900 to 2,200 feet above sea level; but a few monadnocks rise several hundred feet above the deeply dissected Plateau. Gorges 500 to 1,250 feet deep, which lie between steep ridges and jagged spurs, are common enough to warrant the application of the term "mountainous" to this highland region. The beds that form the Boston Mountains, however, are little folded, though a series of southward-dipping monoclinal folds on the southern slopes bring the younger beds there into view.

The pre-carboniferous rocks of northern Newton County, include strata belonging to the Ordovician, Silurian and Devonian systems. Of these, however, only the Ordovician formations are of considerable thickness or of large areal extent. Although these formations will probably be tested for oil or gas, they are not considered in detail in this report, for the chances of obtaining from them either oil or gas in commercial quantities are poor.

The lowest elevation in the County, 580 feet, is at Cave Creek. Highest elevation, 2,560 feet, is 3.5 miles N.W. of Old Village Fallsville. A few of the representative towns with their respective elevations are as follows:-

Jasper	833 feet	Bass	894 feet
Deer	2,351 feet	Limestone	910 feet
Lurton	2,007 feet		

The northern part of the County gets its drainage from the Buffalo River (a fork of White River) and its tributaries. The southern part is drained by tributaries of the Arkansas River. Floods are not prevalent in the County except in the lowlands along the Buffalo River during high water stage. There are no stream gaging stations in the County. Any information desired concerning the flow of Buffalo River may be obtained from Station No. 5 located at Rush, Marion County, Arkansas.

About four miles south of Jasper in this County, is found the justly renowned cave called "Diamond Cave." It is well known, and is one of the principal attractions of the State for wonder hunters, as it contains a number of chambers of various forms and richest colors. There are numerous springs of medicinal properties in the County worthy of mention.

Newton County is included in the great mineral belt of north Arkansas; and, though it contains vast resources of minerals, especially zinc and lead, it has been slow of development because of lack of transportation facilities. This industry has been practically idle since the World War. Recently however, hundreds of men have resumed work in the zinc and lead fields.

The principal production in this County will probably be zinc and lead as there are several large deposits here. There is a deposit of zinc in the northeastern part of the County, in the vicinity of Carver. A deposit of lead is found in the northwestern part of the County near Ponca City and in the north central part of the County north of Jasper. There are also deposits of both lead and zinc ore between Low Gap and Plumlee.

A large deposit of marble is found in the northeastern part of the County. In years gone by it was produced in commercial quantities, but the cost of transportation was so great that it did not pay and the production at this time is very small. The first marble shipped out of the State was from Newton County for the Washington monument.

Newton County has very poor transportation facilities. There is no railroad in the County, and the only paved highway

within its borders is Federal Highway No. 65 which runs through the extreme northeastern part. State Highways No's 7, 16, 21, 43 and 103 cover various parts of the County, but all of them are only gravel or stone surfaced. There is no water transportation in the County.

U.S.G.S. quadrangle maps Harrison, Ozone, Treat, Mount Judea and Marshall cover the County with the exception of the west central part which has not been mapped in detail. Highway and State topographic maps are available.

OUACHITA COUNTY

Ouachita County, situated in the southwestern part of the State, is bounded on the north by Dallas and Clark Counties, on the east by Calhoun County, on the south by Union and Columbia Counties, and on the west by Nevada and Columbia Counties. It has a land area of 469,120 acres.

This County lies wholly within the Gulf Coastal Plain area of Arkansas. The surface of the County is generally broken. The Ouachita River flows through the County in a southeasterly direction and affords much rich bottom land, which is very productive. The uplands embrace several varieties of soil; gray, red, sandy and gravelly, and will produce well any southern crop with proper cultivation.

The general features of Ouachita County is a dissected upland. The higher ridges in the interstream areas stand 200 to more than 300 feet above sea level in the western part, but slope eastward to about 200 feet in the bluff along the Ouachita River.

Rocks of Wilcox age are exposed in the northern part, and rocks of Claiborne age form the surface in the central and southern parts of Ouachita County. Deep wells have penetrated all of the Cretaceous strata in this area. Alluvial deposits of sand, gravel, clay and loam of Pleistocene and Recent age of the Quaternary system underlie the flood plain of the Ouachita River to an estimated depth of 50 feet.

The Midway formation, Tertiary system, Eocene series, underlying Ouachita County, maintains its regional characteristics and is 450 to 500 feet thick.

In the northwestern part of the County a part of the Wilcox formation has been removed by erosion, but, where the complete section is present, it is from 600 to 650 feet thick. The maximum thickness of the Claiborne is about 700 feet in the southeastern part of Ouachita County.

The Cretaceous system of the Gulf series increases in thickness to the southwest from about 700 feet in the northeast corner to slightly more than 1,200 feet in the southwest corner of the County.

The Tokio-Woodbine sediments range in thickness from 175 to 400 feet, with the greater thickness in the southwestern part. The sediments consist of clays, sands, and sandstone and certain volcanic materials which are especially abundant in the lower half of the section. The sediments vary from light-gray to green, but contain red beds in the basal part in the southeastern part of the County.

The Ozan formation ranges in thickness from 100 to 180 feet, with the greater thickness in the western part. In the eastern part it consists chiefly of sands with the Meakin sand at the top and the Buckrange, or Graves sand, at the base, with the intervening sediments made up of sandy marls and thin beds of marls.

The Annona chalk, as a lithologic unit, is recognizable only in the western part of the County. Elsewhere the Annona and Marlbrook are grouped together. The sediments increase in thickness from 85 feet in the northeastern part to 240 feet in the southwestern part of the County. The Saratoga chalk and Nacatoch formation have a combined thickness ranging from 270 to 340 feet. The Arkadelphia marl is from 70 to 100 feet thick in Ouachita County.

In the Cretaceous system of the Comanche series, the Comanche sediments increase in thickness to the southwest. The youngest known Comanche sediments are represented by the Lower Glen Rose formation which underlies the surface in the southwestern part of the County. It is 800 feet thick in the southwestern corner of the County.

The Travis Peak formation underlies most of Ouachita County. It is about 2,000 feet thick where overlain by the Glen Rose formation, but decreases in thickness to the northeast as the result of truncation and is probably absent in the extreme northeast part of the County. The Travis Peak formation is probably underlain by marine beds of Neocomian age in the southern half of the County.

The basement rocks have been reached in a number of deep wells in the northern half of Ouachita County where these rocks lie at depths of 2,000 to 2,500 feet below sea level. The northern part is separated from the southern part of the County by faulting or sharp flexing of the basement floor which carries these rocks to undetermined depths in that area.

The lowest elevation in the County, 90 feet, is about 18.5 miles downstream along the Ouachita River from Camden. Highest elevation, 288 feet, is about 120 yards south of the southeast corner of the St. Louis Southwestern Railway Station. A few of the representative towns with their respective elevations are as follows:-

Camden	199 feet	Lake Station	115 feet
Barham Sta.	189 feet	Stephens Sta.	231 feet
Bests Sta.	248 feet		

The County is well drained by the Ouachita River and its

tributaries, the largest of which are the Missouri River, the Little Missouri River and Smackover Creek. The Missouri River forms the northern boundary and the Ouachita River the eastern boundary of the County. According to maps showing emergency flood control work under the Works Program in Arkansas, 1935, this County is subject to overflow during extreme high water on the Ouachita River. There are no stream gaging stations in this County.

Ouachita County is situated in the proven oil area of the State and is the second largest oil and gas producing County. Oil was first discovered in Arkansas in the S. S. Hunter well on April 10th. 1920, located in the S. W. N. E. Section 13, 15 S, 19 W. This is about two and one half miles east of Stephens, in the southwestern part of the County. This was the first well ever drilled in what later was called the Stephens field. There are two other oil fields in the County: The Mt. Holly field in the extreme southern part of the County, and the Smackover field; the latter being the largest oil field yet discovered in the State.

The Stephens field was discovered in November, 1921, upon the completion of the Hall No. 1, located in the northwest quarter of the southwest quarter of Section 11, Township 15 South, Range 20 West, known as the "Poverty" well, This field is located about four miles northwest of the town of Stephens and has an area of about 3,400 acres, or a little more than five square miles. The production is derived from the Nacatoch sand, which is encountered at a depth of about 1,542 feet, and produces oil of 14 degrees B. gravity; and also from the Blossom sand, which is encountered at a depth of about 2,150 feet, and produces oil from 26 to 31 degrees B. This field produced 2,408,000 barrels up to January 1st. 1926, from approximately 252 wells. Peak production was reached in 1923, during the week ending September 8th. with a production of 3,900 barrels daily.

There are a number of other minerals in the County, among which are lignite, Kaolin clays (both fire and pottery) sand and gravel. The most valuable field of lignite now known is the Ouachita County field, which lies northwest of Camden. This field probably covers an area of sixty square miles and usually varies in thickness from two to three and one-half feet, with extreme thicknesses of six feet. The deposit is estimated to contain 75,000,000 tons. Lignite from the Ouachita County field is high in bituminous matter, distillation tests showing that it contains an average of about twenty-five gallons of oil to the ton. The gas-producing qualities, as determined by the Pittsburgh Testing Laboratory, indicate that this lignite ranks with the best cannel coal as a gas producer, and also in the candlepower of the gas.

On account of the high water content (from 30 to 40 per cent) the lignite (coal) can not be used directly for burning unless provided with suitable grates. When air-dried, it offers possibilities as a commercial fuel and may be used directly and in powdered form, and also for briquette manufacture. Some local use has been made of the lignite, and the distillation of the oils has been carried on only in a small way.

There are a number of beds and local deposits of Kaolin found in the County, where igneous rocks have been much weathered. These are frequently impure from siliceous or ferruginous admixtures. These deposits have been used locally.

At and near Lester, there are deposits of high grade fire clay which burns gray to reddish brown. This clay is used instead of imported German pottery for crucibles, tank blocks and the like; also for refactory vessels and glass works.

Ouachita County is one of the largest producers of sand and gravel in the State. In the past few years, millions of dollars worth of these two minerals have been shipped out of the County by both rail and water. This County has the unique distinction of having three rivers flowing either along or within her borders. The beds and bars of these rivers are the source of this vast supply of sand and gravel. There are two large sand and gravel operators in the County; the Bearden Gravel Company, located one and one-half miles west of Millville, and the Reader Gravel Company, located one-half mile northwest of Reader. The combined capacity of these two plants is about 75 cars of sand and gravel per day.

The transportation of Ouachita County consists of one main line railroad, two branch lines, one Federal Highway and three State Highways. The main line of the St. Louis Southwestern Railway traverses the County from the northeast to the southwest, passing through Kent, Camden, Finns, Buena Vista and Stephens. A branch of the Missouri Pacific runs through the County from the northwest to the southeast, and a branch of the Chicago, Rock Island & Pacific operates between Malvern, Hot Spring County, and Camden, in Ouachita County.

The overland routes are Federal Highway No. 79 and State Highways No's. 4, 7 and 24. The Ouachita River affords water transportation between Camden and New Orleans.

U.S.G.S. quadrangle maps Gurdon and Camden cover the northern and central portions of the County. The southern part of the County has not been mapped in detail.

PERRY COUNTY

Perry County, situated in the west central part of the State, is bounded on the north by Conway and Pope Counties; on the east by Faulkner and Pulaski Counties; on the south by Saline and Garland Counties, and on the west by Yell County. It has a land area of 253,280 acres.

This County lies in the Paleozoic region. The surface of the County is mostly hilly or mountainous, the mountains standing in narrow ranges, east and west, with broad fertile valleys intervening. The bottom lands of both the Fourche and Arkansas Rivers in the County are alluvial and very productive.

The Fourche Mountains consist of the sandstone ridges lying north of the novaculite area, including Poteau and Petit Jean Mountains. The northern limit of the Fourche range, as here defined, coincides with the southern boundary of the Arkansas valley Province, so that Poteau and Petit Jean Mountains are excluded from the Fourche range.

The Fourche Mountains make up an extensive system of ridges which are the topographic expressions of rather closely folded anticlines and synclines.. The ridges are at least as high as those in the novaculite area, but are perhaps somewhat less rugged. The only formations exposed are the Stanley shale, the Jackfork sandstone, and the Atoka formation. The first two of these do not crop out north of Fourche La Fave River.

There are several overturned folds in the area, but open folding is more common there than in the novaculite area. Many of the anticlines that are not overturned are steeper on their northern than on their southern flanks; but some, such as the Dutch Creek anticline, are essentially symmetrical. The structural features north of Township 2 N have been described with those in the Arkansas valley, and may be regarded as rather typical of the entire Fourche range, though the structure becomes increasingly more complex toward the south.

A few test wells have been drilled in Perry County for oil and gas, but all have been unsuccessful. Furthermore, there is no reason to believe that commercial deposits of oil or gas will ever be discovered in the County.

The Perryville syncline mentioned above is bounded on the north by the Redemption anticline, and on the south by the Wye and Palarm anticlines. The surface rocks belong to the Atoka formation, and the syncline is rather poorly expressed topographically by the valley of the Fourche La Fave River. At its west end the syncline is apparently somewhat offset from the Fourche La Fave syncline, but more detailed examination may show that the two are continuous. The Perryville syncline, which is rather closely folded, is asymmetrical, its south limb being steeper than its north limb. The dips on the north limb

range from 5 to 65 degrees, but show little dimunition toward the synclinal axis; those on the south limb range from 8 to 80 degrees, and in places the beds may be overturned. The dips diminish regularly toward the east on both sides of the axis. The Perryville syncline is also structurally unfavorable for the accumulation of oil and gas, and its exploration is inadvisable.

The lowest elevation, 103 feet, is at Gulf Park Station. Highest elevation, 1,400 feet, is on Forked Mountain. A few of the representative towns with their respective elevations are as follows:-

Perryville	325 feet	Perry	295 feet
Casa	364 feet	Bigelow	293 feet
Adona	368 feet		

The County is well drained by the Arkansas River and its tributaries, the Fourche La Fave River, Maumelle River and South Fourche La Fave River. The Arkansas River forms the northeastern and a part of the eastern boundary, while the Fourche La Fave River flows through the central part of the County from west to east and empties into the Arkansas River a few miles below Fourche, Arkansas. The South Fourche La Fave River and the Maumelle River drain the southwestern and southeastern portions of the County. The only lands in the County subject to overflow are those along the Arkansas River at high flood stage. There are no stream gaging stations in the County. Two stations are needed, however, at Nimrod and Perryville. Until these stations are established any information desired concerning the flow of the Arkansas River may be obtained from Station No. 10 at Little Rock.

Little can be said of mineral production in Perry County. Some of the minerals known to exist are limestones, shales, sandstone, clays and gravel. The latter has been produced in small quantities in past years.

The northern and eastern parts of the County are crossed by the Chicago, Rock Island & Pacific Railway. State Highways No's 7, 9, 10, 60, 76 and 113 give good overland transportation. Water transportation are the Arkansas and Fourche La Fave Rivers, the former being navigable to sand and dredge boats, and the latter to small tug and dredge boats, according to report of the United States Engineers.

U.S.G.S. quadrangle maps Hot Springs, Dardanelle and Morrilton completely cover the County. Highway and State Topographic maps are also available.

PHILLIPS COUNTY

Phillips County, situated in the eastern part of the State, is bounded on the north by Lee County, on the east by the Mississippi River, on the south by Desha County, and on the west by Arkansas and Monroe Counties. It has a land area of 442,880 acres.

This County lies in the Gulf Coastal Plain. The south end of Crowley's Ridge is in this County. The soil in all parts of the County is very productive. In the southern portion of the County are the broad Mississippi bottoms which have a deep alluvial soil that is unusually productive. The soil on Crowley's Ridge is a sandy soil with a clay subsoil. The ridge flattens out westward, forming large bodies of level land, watered by Big Creek. The three topographic sub-divisions of the upper Mississippi embayment (Crowley's Ridge, the Advance lowland and the Mississippi lowland) are represented in Phillips County.

Crowley's Ridge includes a small tract of hilly, partly wooded, partly cultivated land, in the northeastern part of the County. Its maximum elevation is about 400 feet, or about 200 feet above the surrounding lowland.

The Advance lowland includes the area between Crowley's Ridge and the western boundary, and extends southward to a maximum of 14 miles from the northern boundary. The surface is a rolling plain 170 to 240 feet above sea level, with a gentle slope to the south. The creeks and bayous flow through poorly drained, shallow valleys and are separated by low ridges of light to dark loam. One of the more prominent ridges, known as Hickory Ridge, is 20 to 30 feet higher than the surface to the west, which extends from a short distance of Marvel to the northern boundary of the County.

Along the western side of Crowley's Ridge is a well defined terrace, one to three miles wide, lying 30 to 40 feet above the lowland immediately to the west, from which it is separated by an abrupt escarpment; it is also separated from Crowley's Ridge on the east by a plainly defined escarpment.

The Mississippi lowland is an area one to twelve miles wide, bordering the Mississippi River along the entire southeastern side of the County. A few square miles of the area lie east of the southern part of Crowley's Ridge and north of Helena. The lowland slopes from about 200 feet above sea level in the western part to about 170 feet above sea level in the southern part of the County. Swamps, lakes, abandoned stream channels and bayous are numerous, and much of the surface is heavily timbered.

The Jackson formation of the Eocene age forms the core of Crowley's Ridge. It is unconformably overlain by sands

and gravels with a maximum thickness of 80 feet, belonging to the Lafayette formation of Pleistocene age, which, in turn, is overlain by Pleistocene loess, having a maximum measurable thickness of about 140 feet.

The Advance lowlands west of Crowley's Ridge is underlain to estimated depths of 125 to 200 feet by Quaternary alluvial loams, clays, sands and gravels of Pleistocene and Recent age, and the Mississippi lowland is underlain by similar materials to estimated depths of 150 to 200 feet.

The Eocene series, represented by the Jackson, Claiborne, Wilcox and Midway formations, is estimated to range in thickness from about 3,000 feet in the north to about 4,600 feet or more in the south.

The Cretaceous, underlying the Eocene, is estimated to be about 700 feet thick in the northern part and about 1,100 feet thick in the southern part of the County. These rocks have not been penetrated in deep wells.

The lowest elevation in the County, 155 feet (estimated) is at Lundell. Highest elevation, 298 feet, is at west edge of Helena, on Route No. 20. A few of the representative towns with their respective elevations are as follows:-

Kendall	192 feet	Poplar Grove	188 feet
Elaine	172 feet	Edgewood	218 feet
Lake View	179 feet		

Phillips County is drained by the Mississippi River on the east, the St. Francis River on the northeast, and the White River on the southwest. These water courses and their tributaries are ample drainage for the County, Crowley's Ridge serving as a check to all occasional overflows. Little of the area is affected by high water, and on a small area only has high water prevented a good crop at any time. There are no stream gaging stations in this County.

The non-metallic minerals found in the County are gravel, brick and tile clays. Common brick is made from a mixture of surface clay and loess at Helena. Statistics do not disclose any metallic minerals in the County.

There are four branches of the Missouri Pacific Railroad in this County. One branch crosses the County from west to east; another branch crosses from north to south, and the other two branches cover the north central part of the County. The Missouri & Arkansas Railroad passes through the northeastern part of the County. State Highways No's 1, 20, 44 and 85 give good overland transportation. There are no Federal Highways in this County.

M.R.C. quadrangle maps Holly Grove, Modoc, Marvell, La Tour and Indian Bay completely cover the County. Highway and State topographic maps are also available.

PIKE COUNTY

Pike County, situated in the mineral belt of the southwestern part of the State, is bounded on the north by Montgomery County, on the south by Hempstead and Nevada Counties, on the east by Clark County, and on the west by Howard County. It has a land area of 380,640 acres.

The northern and central parts of the County lie in the Paleozoic area and the southern part in the Gulf Coastal Plain. The County extends from the high ranges of the Ouachita Mountains on the north to the broad bottoms of the Little Missouri River on the south. It possesses a great range of altitude, and a correspondingly great variation in the composition of the soil. Many beautiful streams traverse the surface and give the County a fine water supply. The soil, where free from stone, is easily tilled and very fertile. The surface of the County is generally rolling, with some hills and a great deal of level, general farming land.

The rocks at the surface in the Ozark Province consist of sandstone and shales belonging to the Atoka formation, Jackfork sandstone and Stanley shale of Paleozoic age. The surface of the Paleozoic rocks dips under the Coastal Plain sediments and is estimated to lie at depths of about 500 feet below sea level in the southern part of Pike County.

The Comanche series is represented in Pike County by the Trinity group. These strata are exposed in a generally east-west trending belt in the southern part of the County, extending with decreasing width from the western boundary into the eastern part, where they are overlapped by the Gulf series. The upper-most sand member and the De Queen limestone member diminish in thickness and lense out in the southwestern part of the County. The shale member intervening between the De Queen and Dierks limestone member decreases in thickness and is represented by only a few feet of beds in the eastern part. The Dierks limestone and the underlying sands, including the Pike gravel member, likewise decrease in thickness to the east. The total thickness of the Trinity group in the eastern part of Pike County is about 70 feet.

Deposits of asphalt impregnated sand occur in the basal part of the Dierks limestone lentil and in the sand beneath; and at least in one locality the Pike gravel member contains asphalt. The asphalt impregnated beds range in thickness from an inch to 12 feet.

The lower part of the Gulf series is exposed at the surface in the southern part of Pike County. The Woodbine sand appears only in the southwestern part; elsewhere in the County it is overlapped by the Tokio formation. The Brownstown marl and the Ozan formation are at the surface in the extreme southeastern part of Pike County.

Igneous rocks occur in four localities in Pike County. These rocks are Peridotite, and in three of the localities have yielded diamonds.

The lowest elevation in the County, 250 feet, is at Bills and Bowen, Arkansas. Highest elevation, 1,772 feet, is on Hogpen Mountain. A few of the representative towns with their respective elevations are as follows:-

Murfreesboro	366 feet	Kirby	665 feet
Pike City	689 feet	Glenwood	547 feet

The river and drainage system of Pike County consists of the Little Missouri and Caddo Rivers and numerous creeks, among which are Fallen Creek, Muddy Fork, Saline Creek, Wolf Creek, Woodall Creek, and Antoine Creek.

The Little Missouri River flows diagonally across the southern part and forms the boundary line in the southeastern portion of the County, while the Caddo River flows across the northeastern part. Antoine Creek flows along the eastern boundary and empties into the Little Missouri River in the southeastern part of the County. These streams adequately drain the County. The only area subject to overflow are the lowlands along the rivers at extreme flood stage. There are no stream gaging stations in the County. A station is needed, however, on the Little Missouri River near Murfreesboro.

In the past four or five years the principal mineral production in this County has been mercury (cinnabar ores), gravel, sand and stone. However, there are numerous mineral deposits in the County, among which are asphalt and diamonds; and the production in past years has been large, with the value running into the thousands of dollars.

Mercury was discovered near Cowhide Creek, in 1931. For half a century prospectors had been searching the State for cinnabar, the rock ore from which mercury is obtained. While they hunted for it, Pike County farmers were building fences of cinnabar. Doubtless a good many of them had examined the ruby-red crystals in the rocks they piled up and wondered what they were.

A boy in the hills of Pike County decided to find out. He took a piece of the rock to a prospector, who sent it to a Chemist. The red streaks in the rock proved to be mercury. Now, on the Little Missouri River, north of Murfreesboro, and on Antoine Creek, south of Amity, operators are extracting the mercury, and of late have been getting handsome prices for it.

There has been considerable sand and gravel production reported from this County, with most of it being taken from Wolf Creek between Delight and Antoine, and from pits located in this vicinity; this being in the southeastern part of the County. There is also a large gravel pit at Glenwood in the northern part of the County, and large amounts of gravel has been shipped from this locality. Most of the sand and gravel produced in the County is used in road construction being carried on in this and other Counties in this section of the State.

There are seven deposits of asphalt in southwestern Arkansas, three of which are in Pike County and four in Sevier County. The asphalt deposits in Pike County are near Pike, Delight and Murfreesboro.

The only locality in North America where diamonds are found in the rocks in which they were formed, is in Pike County, Arkansas. The diamonds occur there in dikes of volcanic rock known as Peridotite, which closely resembles the material in which diamonds are found in South Africa.

There are four separate areas of this Peridotite (diamond-bearing rock) near Murfreesboro, which aggregate about eighty acres, that have been found, and all but one of which have produced diamonds. One of these--that near the mouth of Prairie Creek--has been known to geologists since 1842. The rock was not known to be Peridotite, however, until 1889, when Dr. J.C. Branner studied and described the nature of the rock and its geologic relations. It is said that Dr. Branner spent half a day searching the surface of the area for diamond specimens.

Pike County has excellent transportation facilities, with two railroads, one Federal Highway, five State Highways and two rivers. The main line of the Missouri Pacific traverses the eastern part of the County. It has two branch lines operating in the County, one in the southwestern part and the other in the southeastern part.

The Murfreesboro & Nashville Southwestern is a local short line railroad and only runs from Murfreesboro to Wright. This line connects with the Missouri Pacific and the Prescott & Northwestern Railroads at Tokio, in Hempstead County, just south of the Pike County line.

Federal Highway No. 70 traverses the County from the southwest to the northeast. This Highway is only gravel or stone surfaced from Kirby southwest; from Kirby northeast it is an all paved route.

State Highways No's 8, 26, 27, 84 and 128 cross and criscross the County in practically all directions.

The Little Missouri River, which flows diagonally across the County and forms the boundary in the southwestern part, and the Caddo River, which flows through the northeastern part of the County, are both listed in a report of the United States Engineers as being navigable; but only to very small boats, such as dredge and snag boats.

U.S.G.S. quadrangle maps Caddo Gap and Gurdon cover the southern and extreme southeastern parts of the County. The northern part has not been mapped in detail. Highway and State topographic maps are also available.

POINSETT COUNTY

Poinsett County, situated in the northeastern part of the State, is bounded on the north by Craighead County, on the east by Mississippi County, on the south by Cross County, and on the west by Jackson County. It has a land area of 461,440 acres. This County lies in the Gulf Coastal Plain. It is divided into three distinct types. The eastern portion is the finest bottom land that covers the area between Crowley's Ridge and the eastern boundary of the County, and produces abundant crops. The central portion includes Crowley's Ridge, which runs through the County north and south, with an average width of three miles. It is a hilly country and somewhat broken. The western part of the County is Prairie land.

The three principal topographic divisions of northeastern Arkansas are represented in Poinsett County: Crowley's Ridge, the Advance lowland and the Mississippi lowland.

Crowley's Ridge is a belt of hilly land one to three miles wide, extending north-south, slightly west of the center of the County, and separated from the adjacent plains by sharply defined escarpments. The top of the ridge is 350 to 400 feet above sea level, or 100 to 150 feet above the lowlands on either side. West of Crowley's Ridge is a nearly level or gently rolling plain 230 to 290 feet above sea level, which forms a part of the Advance lowland. East of Crowley's Ridge is the gently undulating plain of the Mississippi lowland, lying 225 to 240 feet above sea level. Much of the surface is swampy, and bayous and ponds are common.

The surface rocks in Poinsett County, for the most part, are alluvial sand, gravels and clays of Pleistocene and Recent age; and the Lafayette formation of Pliocene age crops out in narrow bands on the flanks of Crowley's Ridge. Deep wells drilled in the County have penetrated all of the Tertiary and the Cretaceous strata and entered the Paleozoic rocks which form the basement floor upon which the Coastal Plain sediments were deposited.

The Coastal Plain sediments lie upon a floor of folded and truncated rocks of Paleozoic age, and probably similar to the rocks which are at the surface in the adjacent part of the Arkansas valley and the Ozark Province to the west. The basement floor slopes southeastward in Poinsett County, and lies at a depth of about 250 feet below sea level in the western part, and at a depth of 3,100 to 3,200 feet below sea level in the southeastern part of the County.

In the Advance lowland the Eocene strata are overlain by an estimated thickness of 125 to 175 feet of Quaternary alluvian of the Pleistocene and Recent age, and the Mississippi lowland is underlain by 150 to 225 feet of alluvial loams,

clays and water-bearing sands and gravels of Pleistocene and Recent age. The dip of the strata is to the east and southeast at the rate of 60 to 75 feet per mile. The top of the Nacatoch lies at a depth of 400 feet below sea level in the southeast corner of the County. The available data are inadequate to determine the presence or absence of local anticlinal folding.

The lowest elevation in the County, 200 feet, is at Como Post Office. Highest elevation, 430 feet, is about one mile east of Harrisburg. A few of the representative towns with their respective elevations are as follows:-

Truman	231 feet	Weiner	248 feet
Fisher	234 feet	Marked Tree	196 feet

There are some lowlands in this County which have heretofore been too wet for cultivation. However, drainage districts have been formed and all the land that needed it has been drained.

The St. Francis River flows through the eastern part of the County from north to south. Little River and the Tyronza River flow through the southeastern part, and the L'Anguille River through the western portion of the County. Long Creek and Bayou De View afford some drainage also in the western part of the County. With the drainage system above mentioned, and the rivers and their tributaries, there is little likelihood of floods in the County except in the lowlands along the rivers in extreme high water. There are two stream gaging stations in the County: No.1 station is located on the St. Francis River at Marked Tree, and No. 2 station is on the St. Francis River Floodway at Marked Tree.

The minerals of Poinsett County consist of lignites, clays and gravel. There has been no extensive development, however, of any of these minerals. The lignites of the Crowley's Ridge region are all of Tertiary age. They occur in the form of outcrops along the streams and in gullies, with an occasional bed appearing in wells. The thickness of these lignite beds is exceedingly variable. Usually they are less than five feet thick, though Bolivar Creek beds in Poinsett County are seven feet or more in thickness. Their chemical analyses show that the Bolivar Creek lignites are the best.

Clay deposits are found on both sides of Crowley's Ridge in this County. These clays are abundant and of excellent quality. Loess from Crowley's Ridge is used at Harrisburg for the manufacture of common brick and draintile. Fire clays occur under nearly all the beds of lignite wherever they have been found in Crowley's Ridge. At the base of the great beds on Bolivar Creek in Poinsett County are found clays rich in

alumina and which might be available for the manufacture of press bricks, sewer pipes and similar uses. The clay is light gray in color and contains but little grit.

With three trunk line railroads, one Federal Highway and five State Highways, this County has excellent transportation facilities. The St. Louis Southwestern Railway traverses the County in the western part, passing through Weiner, Waldenburg and Fisher. The St. Louis & San Francisco crosses the eastern part of the County through Truman, Marked Tree, Tyronza and Deckerville. The Missouri Pacific runs through the central portion of the County and passes through Greenfield, Harrisburg, White Hall and Hydrick. Federal Highway No. 63 crosses the County through the central part. State Highways No's 1, 14, 39, 136 and 143 cross and cris-cross the County in practically every direction. There is no water navigation in the County except possibly to small tug and dredge boats.

M.R.C. quadrangle maps Tuckerman, Weiner, Dee, Marked Tree, Deckerville, Princedale, Vanndale and Tilton completely cover the County. Highway and State topographic maps are also available.

POLK COUNTY

Polk County, situated in the extreme western portion of the State, is bounded on the north by Scott County, on the east by Montgomery County, on the south by Howard and Sevier Counties, and on the west by the State of Oklahoma. It has a land area of 541,440 acres.

The northern and southern portions of the County are mountainous, and the central belt of the County is valley and plateau land. Its northern boundary is the Rich Mountain range of the Ouachita Mountains, and on the south is another chain of the Ouachitas. The most thickly settled part of the County is in the broad lowlands of the Cossatot, Ouachita and Mountain Fork Rivers. The soil ranges from alluvial and rich sandy loam, with red clay subsoil, to thin sandstone and shale. The valley land is generally a red loam and is very productive.

This County lies in two distinct physiographic provinces of the Paleozoic area, with the northern, western and southwestern parts in the Fourche Mountains, and the central and southeastern parts in the Novaculite uplift or Ouachita Mountains.

The Fourche Mountains occupy a belt about 25 miles wide, and extend slightly north of east from the Oklahoma boundary to the Coastal Plain near Little Rock. Parallel ridges are most characteristic of this Province, but synclinal eminences and horseshoe ridges are common.

The rocks of the Fourche Mountains are all of Carboniferous age and belong to the Stanley, Jackfork and Atoka formations. They have been complexly folded, and, to a certain extent, thrust faulted. Many of the folds have been overturned toward the north, so that southern dips are common, but some of the folds are overturned toward the south. Many of the mountains are anticlinal, and some of the larger valleys, such as that of the Fourche La Fave River, are topographic expressions of the underlying synclinal structure. In the Fourche Mountains, there are a number of readily recognizable topographic basins, such as the one in which Mena stands.

The rocks of the Novaculite uplift range in age from Cambrian to Carboniferous. The oldest formation exposed is the Collier shale; the youngest is the Stanley shale. The rocks are completely folded into compound anticlines and synclines, and in some places they are thrust faulted. Recumbent folds are the rule, rather than the exception, and in places the beds are fan-folded. The Arkansas novaculite is the principal ridge-making formation; but near the center of the uplift, beds of Ordovician sandstone determine the topographic expression.

The rocks exposed in the Ouachita Mountains range in age from Cambrian to Carboniferous, and consist mostly of shale and sandstone, although novaculite is common in Polk County.

The lowest elevation in the County, 800 feet, is on Fork Mountain. Highest elevation, 2,800 feet (estimated) is on Rush Mountain. A few of the representative towns with their respective elevations are as follows:-

Cove Station	1046 feet	Engleton Station	1483 feet
Hatton Station	1185 feet	Potter Station	931 feet
Mena	1142 feet		

The river system of Polk County consists of the Cossatot, Ouachita and Mountain Fork Rivers and their tributaries, among which are Rock Creek, Long Creek, Blaylock Creek, Irene's Fork and South Fork. The Cossatot River flows through the southern part, and the Ouachita River through the eastern part of the County. These water courses should very adequately drain the County, although the lowlands are subject to overflow during times of extreme high water. There are no stream gaging stations in the County.

There are some very promising mineral deposits in Polk County, consisting of manganese, copper, novaculite and zinc. Some unusually good slate deposits have been worked and are producing paying material.

MANGANESE: This ore occurs in Polk County, and frequently attempts have been made to work the deposits, the last efforts of development being made during the World War; but mining of this mineral has not proven permanently profitable.

COPPER: Scattering deposits of copper has been discovered in several places in the County and mined on a small scale.

ASPHALT: Veins of asphalt west of Fourche Mountain, north of Mena, in Polk County.

BARITE-
(HEAVY SPAR) In seams or pockets in Polk County.

CHERT: Large deposits (Big Fork Chert) in Polk County, mined for road building in Hot Springs, Garland County.

COMMON BRICK: Made from residual clay at Mena, Polk County.

SLATE: The slate region of Arkansas is confined to the central portion of the Ouachita uplift, and covers portions of Polk, Montgomery, Garland and Saline Counties. All

of the deposits which have been developed commercially lie in western Montgomery and eastern Polk Counties. This slate has been rather extensively prospected all the way from Board Camp Creek in Polk County eastward, to the Ouachita River, in Garland County. The wide extent to which it has been prospected is due, not only to the promise it has given as a source of commercial slate, but to the favorable location and nature of its outcrops, which usually are in bluffs and well upon the mountain slopes. It varies in thickness from a maximum of about 300 feet to a minimum of fifty feet or less. The thickest portion is along the central line of the Ouachita Range, from which it thins out southward and probably northward.

NOVACULITE: Novaculites are usually one of two classes, which are known as the Arkansas stone and the Ouachita stone. The Arkansas stone is a very fine-grained homogeneous stone and has a waxy luster and is usually white. This stone is preferred for making whetstones and is usually shipped rough in blocks weighing between five and fifteen pounds. The Ouachita stone is more porous than the Arkansas stone and has the appearance of unglazed porcelain. The demand for the Ouachita stone is much greater than that of the Arkansas stone and it is used in blocks up to 1,500 pounds or more for making large whetstones. Novaculite is found in the area covered by Pulaski, Saline, Garland, Hot Spring, Pike, Polk and Montgomery Counties. Recently large quantities of novaculite has been used by the Chicago, Rock Island & Pacific Railroad for ballast. The novaculite does not disintegrate, is easily crushed and makes a durable road bed.

One railroad, three Federal Highways and three State Highways give Polk County fairly good transportation facilities. The Kansas City Southern Railroad crosses the southern, western and central parts of the County as far east as Mena, and also traverses the northwestern part, passing through Grannis, Wicks, Vandervoort, Cove, Hatfield, Potter, Mena, Eagleton and Rich Mountain. Federal Highways No's 59 and 71 parallel the Kansas City Southern Railroad in the southern and western parts, and Federal Highway No. 59-270 parallels the Kansas City Southern in the central and northwestern parts of the County. State Highways No's 4, 8, and 88 traverse the western, central and a portion of the southeastern parts of the County. Three rivers flow within its borders, the Cossatot, Mountain Fork and the Ouachita. None of these water courses are navigable in Polk County. The Ouachita River, however, is a stream of considerable importance and is navigable in some other counties in the State.

U.S.G.S. quadrangle maps De Queen, Poteau Mountain, Mount Ida and Caddo Gap No. 2 completely cover the County. The latter has not yet been published, but will be available soon. Highway and State topographic maps can be had at this time.

POPE COUNTY

Pope County, situated in the west central part of the State, is bounded on the north by Newton and Searcy Counties, on the east by Van Buren and Conway Counties, on the south by Yell and Perry Counties and on the west by Logan and Johnson Counties. It has a land area of 528,920 acres.

This County lies in two divisions of the Paleozoic uplift. The northern part of the County is in the Boston Mountain section, while the southern part lies in the Arkansas valley area of the Ouachita Province. The surface ranges from low bottom land in the south to rugged mountainous country in the north.

The general features of the County's soil are black sandy loam and "buckshot" in the bottoms, and sandy loam of a lighter color, in the uplands. The County is well watered by numerous creeks. On Illinois Creek, near the City of Russellville, is located one of the water power plants in the State. It furnishes light and water for the town of Russellville, and the town of Dardanelle, six miles distant. The soils of both plateau and bottom are extremely fertile.

The surface formations, and those immediately underlying the surface, in the southern part of the County, in the Arkansas valley area, consist of alluvial sands, gravels and clays, of "Pleistocene" or "Recent" age. In the northern part the surface soil is immediately underlain with sandstones and sandy shales which outcrop in many places. Beneath these formations are found shales and sandstones of the "Pennsylvanian" period, an age marked by deposits of coal; and beds of coal are found beneath the surface here. These formations rest on strata of the "Mississippian" age, and consist of hard shales, sandstones and limestones.

A study of the logs of test wells drilled in the west central part of the County in a search for oil and gas, gives a general knowledge of the underground rock. These test wells showed only a small trace of oil, but gas-bearing sands were penetrated and considerable commercial production obtained.

The lowest elevation in the County, 296 feet, is 3.5 miles east and 3.2 miles south of Atkins. Highest elevation, 2,175 feet, is about one mile north of Sand Gap. A few of the representative towns with their respective elevations are as follows:-

Russellville	351 feet	Pottsville	369 feet
Atkins	356 feet	Dardanelle	530 feet
Dover	410 feet		

Pope County is drained by the Arkansas River and its

tributaries. All of the streams, of which Illinois Bayou, Piney and Point Remove Creeks are principal, flow into the Arkansas River which forms the southern boundary of the County. The only area that is subject to overflow, are the lowlands along the Arkansas River at high flood stage. There are no stream gaging stations in the County. One is needed, however, on the Arkansas River at Dardanelle.

Pope County lies in two separate mineral areas, the "northern" and the "central and southern." The northern area is in the Ozark Plateau, which has produced 3 per cent, while the "Central and southern" portion is in the Arkansas valley area, and it has produced 24 per cent of the State's mineral returns between 1885 and 1936, or in the last 51 years. In the"northern"part of the County,the stone found and produced, is the County's contribution to the 3 per cent of that area's production. In the "central and southern" part, gravel, sand, water power, coal and gas production are included in the 24 per cent that this area produced. In the past few years, however, the most profitable production has been in water power, coal and gas.

One railroad, one Federal Highway, four State Highways and a navigable river constitute the transportation of Pope County. The Missouri Pacific Railroad traverses the south central part of the County from east to west, passing through Atkins, Pottsville, Russellville, Ouita, Mill Creek, Landon and Scotia. Federal Highway No. 64 crosses diagonally the south central portion of the County, and State Highways No's. 7, 27, 105 and 124 cover the County in practically every direction. According to a report of the United States Engineers, the Arkansas River, which forms all of the southern and a part of the western boundaries of the County, is a navigable stream.

U.S.G.S. quadrangle maps Dardanelle, Morrilton, Marshall and Treat completely cover the County. Highway and State topographic maps are also available.

PRAIRIE COUNTY

Prairie County, situated in the east central part of the State, is bounded on the north by White County; on the east by Woodruff and Monroe Counties; on the south by Arkansas County, and on the west by Lonoke County. It has a land area of 432,000 acres.

This County is wholly within the Gulf Coastal Plain, two-thirds of which consists of uplands which lie in the eastern part and are very productive; the creek bottom lands, and the lands along the White and Cache Rivers. One-third of the County is composed of prairie lands. These lands have become very valuable because of their adaptability to rice growing.

Prairie County is included within the Advance lowland, the surface of which is, in general, a gently undulating or rolling plain 200 to 240 feet above sea level, and sloping slightly to the south.

Quaternary alluvial deposits of Pleistocene and Recent age cover the surface of Prairie County and extend to depths of 120 to 180 feet and rest unconformably on strata of Eocene age. The Eocene series is represented by the Jackson (probably present only in the southeastern part), the Claiborne, Wilcox, and Midway formations, having an aggregate thickness ranging from about 650 feet in the northwestern part to about 2,800 feet in the southeastern part of the County.

The Cretaceous strata, which unconformably underlie the Eocene, increase in thickness from about 100 feet in the northwestern part to about 500 feet in the southeastern part of the County.

The Cretaceous strata were deposited on a nearly level floor of folded and truncated Paleozoic rocks which were subsequently lowered and tilted to the southeast, and now lie at depths ranging from about 500 feet below sea level in the northwestern corner to about 2,100 feet below sea level in the southeastern corner of the County. The basement rocks probably are composed of sandstones and shales of Pennsylvanian and Mississippian age.

The Cretaceous strata underlying Prairie County range in thickness from about 100 feet in the northwestern part to about 500 feet in the southeastern part of the County. On the basis of the driller's records of deep wells, the Cretaceous is divided into the following formations: Arkadelphia marl, Nacatoch sand, Saratoga chalk, and Marlbrook marl.

The Marlbrook marl, 50 to 75 feet thick, is composed of

gray to dark-gray calcareous shales.

The Nacatoch sand and the Saratoga chalk, not readily separable in the available records, range from 50 to 300 feet in thickness. In the northwestern part they are composed principally of fine-textured sand and sandstone, in part glauconitic and calcareous, and subordinate thin beds of shales and sandy shales. In the southeastern part of the County the upper part is composed chiefly of sand and sandstone, with shales, chalk, and chalky shales in the lower part of the section.

The Marlbrook marl is present only in the southeastern part of the County, where it is estimated to attain a maximum thickness of 150 feet. It is made up principally of shales and marls, with sand at the base.

The Eocene strata of the area, unconformably overlain by Quaternary alluvial deposits, have been penetrated in a number of deep wells which have furnished an incomplete record of their character and thickness. The Eocene series, represented by the Jackson, Claiborne, Wilcox and Midway formations, is estimated to be about 650 feet thick in the northwestern part and about 2,800 feet thick in the southeastern part of the County. The difference in the thickness is in part the result of lateral thinning of the formations, and in part the result of erosion and truncation.

The Midway, made up of gray and bluish-gray, generally noncalcareous clay and shale, containing an abundance of siderite concretions, is estimated to be from 200 to 500 feet thick.

The strata above the Midway consist principally of sands, clays and sandy clays, in part lignitic, with some glauconitic sand and clays in the basal Claiborne and Jackson formations. The Wilcox formation underlies all of the County, but the Claiborne formation probably does not extend west of the central part, and the Jackson formation is present only in the southeastern part of the County. The aggregate thickness of the formations is estimated to be about 2,250 feet in the southeastern corner of Prairie County.

Quaternary alluvial deposits of Pleistocene and Recent age immediately underlie the surface to depths of 100 to 175 feet, and rest unconformably on strata of Eocene age. The Pleistocene strata crop out in the interstream areas; they are irregularly bedded, but in general grade downward from fine silty loams and clays at the surface into coarse sand and gravels at the base. Loams, clays, sands and gravels of Recent age constitute the flood plain materials of the present streams.

The top of the Nacatoch sand lies at a depth of about 600 feet below sea level in the northwestern corner and at a depth of about 2,800 feet below sea level in the southeastern corner of the County. The dip is to the southeast at the rate of 70 to 90 feet per mile. The available data is not sufficient to determine local structural features.

The lowest elevation in the County, 180 feet, is about five miles from Des Arc, northeast of east end of toll bridge on State Route No. 38. Highest elevation, 259 feet, is 2.1 miles northwest of Cross Roads on road to Hickory Plains. A few of the representative towns with their respective elevations are as follows:-

Hazen Station	246 feet	Fairmount Station	247 feet
De Valls Bluff	191 feet	Hunterton	198 feet
Brassfield	183 feet	Mayhay Station	218 feet

The County is well drained by the White and Cache Rivers and Wattensaw Bayou. White River flows from north to south through the east central part; Cache River through the southeastern portion, and Wattensaw Bayou flows through the County from west to east and empties into White River a few miles above De Valls Bluff. Bayou Des Arc forms the north and northwest boundary of the County and empties into White River at De Valls Bluff. Floods rarely occur in the County except in the lowlands along the rivers during extreme high water. Stream gaging station No. 4 is located on White River at De Valls Bluff.

Prairie County is not one of the mineral producing counties in the State. The small quantities of minerals produced in the County consist of sand and gravel, and brick clays used in the manufacture of brick at De Valls Bluff.

Prairie County has excellent transportation facilities. The main line of the Chicago, Rock Island & Pacific Railroad runs through the southern part of the County, passing through Biscoe, De Valls Bluff, Hazen, Tollville and Brassfield. A branch of the Rock Island runs from Searcy to De Valls Bluff, passing through Griffithville and Des Arc. The Hazen branch of the St. Louis Southwestern Railway (Cotton Belt) passes through the extreme southeastern part of the County, with Hazen as its terminus.

The overland system consists of one Federal and three State Highways. Federal Highway No. 70 traverses the southern part of the County, and State Highways No's 11, 33 and 38 serve the County from north to south.

White River flows through the eastern part of the County

and is a navigable stream.

M.R.C. quadrangle maps Kensett, Gregory, De Valls Bluff, Clarendon, and U.S.G.S. quadrangle map Stuttgart cover the County except in the extreme northwest corner, which has not been mapped in detail. Highway and State topographic maps are available.

PULASKI COUNTY

Pulaski County is generally spoken of and regarded as the central County of the State, being by rail equal distance from the Missouri and Texas lines, 150 miles; 135 miles from the Mississippi River on the east and 150 miles from the Oklahoma line on the west. It is bounded on the north by Faulkner County, on the east by Lonoke County, on the south by Grant and Jefferson Counties, and on the West by Saline and Perry Counties. It has a land area of 478,000 acres.

This County lies in two major physiographic Provinces; the northern and western portions in the Paleozoic region, and the southern and eastern portions in the Gulf Coastal Plain.

The western half of the County is mountainous, and, except in the river and creek bottoms, the soil is very rocky. Just below the stone levels lies a strip of hill lands which are generally free from stone, with dark sandy soil and red and yellow clay subsoil. The balance of the County is alluvial and very fertile.

Paleozoic rocks of Ordovician and Carboniferous age crop out in the Ozark Province. These rocks pass under the Coastal Plain sediments and are estimated to lie at depths of about 2,000 feet in the southeastern corner of the County. Strata of Tertiary age, including the Midway and Wilcox formations, crop out in the Gulf Coastal Plain area in southeastern Pulaski County.

The Midway formation, which consists of 25 feet or more of limestone, Calcareous sandstones, sands and clays, crops out in a narrow area along the northwestern margin of the Coastal Plain from Little Rock southwestward to the County line.

The Wilcox sands and clays crop out in a small area southeast of the Midway area, and also in a small area in the vicinity of Jacksonville, in the northwestern part of the County. The materials immediately underlying the Arkansas River bottom, to estimated depths of 100 to 200 feet, consist of Quaternary alluvial loams, clays, sands and gravels.

The Tertiary deposits are underlain by strata of Upper Cretaceous age belonging to the Arkadelphia marl and the Nacatoch formation. These sediments increase in thickness from a few feet along the margin of the Coastal Plain area to about 200 feet in the southeastern corner of the County.

Syenite outcrops in a small area a few miles south of Little Rock. The decomposition of this Syenite by heated alkalin waters formed bauxite, which is extensively mined in Pulaski and Saline Counties.

The lowest elevation in the County, 200 feet (estimated)

is at Fourche dam. Highest elevation, 1050 feet (estimated) is on Shinall Mountain. A few of the representative towns with their respective elevations are as follows:-

Little Rock (north entrance to Court House) - -	291 feet
Jacksonville - - - - - - - - - - - - - - - - - - -	278 feet
Roland -	280 feet
Hensley -	256 feet

Pulaski County is drained by the Arkansas River and its tributaries, Maumelle River and Little Maumelle River, both of which contribute to the drainage of the western part of the County and empty into the Arkansas River at Pinnacle. The southern part of the County is drained by Fourche Creek which empties into the Arkansas River a few miles below Little Rock. The only area of the County that was flooded during the high water in 1935 were the lowlands northwest of Little Rock. Stream gaging station No. 10 is located on the Arkansas River at Little Rock.

Pulaski County enjoys excellent transportation facilities, with two main line railroads and their branches. The main line of the Missouri Pacific crosses the County from northeast to southwest, passing through Jacksonville, McAlmont, North Little Rock, Little Rock and Mabelvale.

The main line of the Chicago, Rock Island & Pacific runs from Little Rock west, passing through Pulaski Heights Station, Little Maumelle, Pinnacle, Natural Steps and Roland.

The St. Louis Southwestern Railway maintains a branch line running from the central part of the County southeast.

Federal Highways No's 65, 67 and 167, and State Highways No's 5, 10, 30 and 161 traverse the County in all directions, with Little Rock as their hub, except State Highway No. 161, which runs through the eastern portion of the County, connecting with Federal Highway No. 70 and State Highway No. 30. The Arkansas River flows diagonally through the County from west to east and is navigable to dredge, gravel and sand boats.

U.S.G.S. quadrangle maps Alexander, Little Rock and Benton completely cover the County with the exception of the extreme southeastern corner, which is covered by M.R.C. quadrangle map Pastoria. New 7½ minute quadrangle maps of the U.S.G.S. cover an area centered about Little Rock. County base maps and State topographic and geologic maps, as well as highway maps, are available.

RANDOLPH COUNTY

Randolph County, situated in the northeastern part of the State, west of Crowley's Ridge, is bounded on the north by Missouri, on the east by Clay and Greene Counties, on the south by Lawrence County, and on the west by Sharp County. It has a land area of 518,560 acres.

About three quarters of the total area of the County is included in the Ozark Province. A triangular area in the southeast, embracing about one-fourth of the County included, is in the Gulf Coastal Plain. The Paleozoic rocks of the Ozark Province pass beneath the Coastal Plain sediments and lie at estimated depths of 500 to 750 feet below sea level in the southeastern corner of the County. The Coastal Plain area is underlain by an estimated thickness of 150 to 180 feet of Quaternary alluvial deposits of Pleistocene and Recent age which rest unconformably on strata of Eocene age and perhaps on Cretaceous, or strata of Cretaceous, age in the western part. The maximum thickness of Cretaceous strata underlying the area is estimated to be 100 feet or less, and all of it is assigned to the Arkadelphia marl and the Nacatoch sand. The strata dip to the east and the top of the Nacatoch formation is estimated to lie at depths of 450 to 500 feet below sea level in the southeastern corner of Randolph County.

This County has as fine a type of lands as are to be found in any County in the United States. The soils are black loam and sandy loam, with a clay subsoil, and what may be called the gray loam, a light soil, with a clay subsoil.

The surface of the County is generally rolling, with some hills and considerable valley land; and is underlain with a limestone formation and a clay subsoil. The formations underlying the surface, and those partially exposed, are of the Ordovician period or age. These formations of Ordovician age consist of limestones, sandstones, some shale and dolomite. Dolomite is a combination of two silver white metals, calcium and magnesium. Common white marble is a form of dolomite. The limestones of this formation range from white, pink, gray, dark-gray, dark-gray to blue, blue-gray and drab in color, and from fine to coarse-grained in texture. These formations are estimated to range up to 2,000 feet in total thickness.

The lowest elevation in the County, 261 feet, is about one mile north of Lesterville. Highest elevation, 500 feet (estimated) is at Maynard. A few of the representative towns with their respective elevations are as follows:-

Pocahontas	310 feet	Keller	271 feet
Reyno	283 feet	Okean	273 feet
Ravenden Spgs.	500 feet (est)		

Randolph County is drained by the Black River and its tributaries; Current River, Eleven Point River and Spring River. Black River flows from the east through the southern part of the County. Current River flows through the northeastern portion and empties into Black River in the vicinity of Pocahontas. Eleven Point and Spring Rivers form a part of the southwestern boundary and empty into Black River near Black Rock. There is no record of overflow in the County. No stream gaging stations have been established in this County, but one is needed on Eleven Point River near Eleven Point, White River Basin.

There are a number of mineral deposits in the County, among which are iron, gravel, clay, dolomite and sandstone. However, none of them have been produced extensively, and what production there has been is consumed locally.

Iron ore is of common occurrence throughout many parts of Arkansas; but in only a few places is it found in important quantities. The largest and most accessible deposits yet discovered are in the northeastern part of the State, which includes Randolph County. During the World War this County produced quite a bit of iron ore; but since that time, due to low prices and the high cost of transportation, the production has been limited. In the past few months, however, due to higher prices and demands for iron and steel, no doubt there will be a revival in the production of iron ore in this County.

Eastern Arkansas contains immense quantities of gravel, which is frequently exposed in road cuts and in a few of the railway cuts. In this County, however, the production of sand and gravel has been from one of the four rivers which flow either along or within the borders of the County.

Randolph County has fairly good rail and highway transportation. The St. Louis & San Francisco Railroad enters the County from the northeast, running south through Pocahontas, Reyno, Biggers, Manson and Elnora. The Missouri Pacific Railroad crosses the extreme southeastern corner of the County.

Federal Highways No's. 67 and 62 traverse the eastern and central portions of the County. State Highway No. 90 crosses the County from the northwest to the southeast. State Highway No. 93 covers the northwestern part, and State Highway No. 115 runs from Pocahontas north. There is no water transportation in Randolph County.

M.R.C. quadrangle maps Walnut Ridge, Powhatan and Reyno cover the eastern portion of the County. The western part has not been mapped in detail.

SALINE COUNTY

Saline County, situated in about the central part of the State, is bounded on the north by Perry and Pulaski Counties, on the east by Pulaski County, on the south by Grant and Hot Spring Counties, and on the west by Garland County. It has a land area of 496,000 acres.

This County is in both the Paleozoic and Gulf Coastal Plain areas. The extreme northern part of the County is in the Fourche Mountains and a part of the central portion is in the Saline Basin. These two areas are in the Paleozoic region of the State. All of the southeastern part of the County lies in the Gulf Coastal Plain.

The rocks at the surface in the western part of the County consist of Paleozoic sandstones, shales and novaculites ranging in age from Pennsylvanian to Ordovician. The Paleozoic rocks dip under the Coastal Plain sediments and are estimated to lie at depths of 1,400 to 1,500 feet below sea level in the southeastern corner of the County.

The Comanche series is absent, but strata of Upper Cretaceous age underlie most of the Coastal Plain area of Saline County. These strata increase in thickness from a few feet to between 100 and 200 feet in the southeast corner of the County. The strata dip to the southeast and the top of the Nacatoch is estimated to lie at depths of 1,400 to 1,500 feet below sea level in the southeastern corner of Saline County.

The Midway formation of Tertiary age crops out in a southwesterly trending belt 1 to 4 miles wide, extending from the northeast corner of T. 1 S., R. 14 W., to the boundary of Hot Spring County in T. 3 S., R. 16 W. In the area to the east, the Midway sands and clays of Wilcox age are exposed at the surface.

The lowest elevation in the County, 249 feet, is at Rottaken Station. Highest elevation, 1,900 feet, is on the summit of Smith's Pinnacle. A few of the representative towns with their respective elevations are as follows:-

Bauxite	358 feet	Haskell	282 feet
Benton	291 feet	Owensville	400 feet
Collegeville	440 feet	Vimy Ridge	328 feet

The County is drained by the Saline River and its tributaries, principal of which are North Fork, Alum Fork, Middle Fork and South Fork. The only area in the County subject to overflow are the lowlands along the Saline River at high flood stage. There are no stream gaging stations in this County.

Two stations are needed, however, one on Alum Fork near Benton and one on the Saline River near Benton.

Saline County is probably best known in a mineral way by its extensive deposits of bauxite. About 21 per cent of the World's supply of bauxite is mined in this County.

Saline County is also known for her extensive brick and potters clay deposits located near Benton. There is no indication of the supply ever becoming exhausted. It has been said that the Saline County clay is equal in quality to any found in the United States. The Niloak pottery produced in Saline County is the only pottery of this kind produced in the Country. Among the items manufactured at these potteries are jugs, crocks, jars, art pottery and other clay ware. These Tertiary clays are also used in the manufacture of fire brick at Benton.

There are a number of other minerals produced in the County, among which are gravel, Fuller's earth, bentonite, novaculite, syenite (granite) and sand. The largest gravel pit in southern Arkansas is that of the Benton Gravel Company located at the edge of the City of Benton. The gravels there are, for the most part, well rounded, quartzite and terrace gravels of Quaternary age. They occur in beds which are in some places fifty feet in thickness. The capacity of this plant is 50 cars of gravel per day.

There is a deposit of bentonite in the eastern part of the County in Sec. 13., T. 2 S., R. 13 W. In the past three years the value of the production of bentonite has been about $10,000.00.

Novaculite, from which whetstones are made, occurs in Saline County and is quarried in a small way and used locally. Granite (syenite) also occurs in the County in large masses near Bauxite. This granite, or syenite, is light gray, pinkish, or buff in color, and is quarried in small amounts. There are also known deposits of limestone, pyrolusite (manganese ore), slate, sphalerite (zinc blende) and talc, (soapstone.)

Two trunk line railroads, three Federal Highways and two State Highways give Saline County good transportation facilities. The Missouri Pacific Railroad enters the County in the northeastern part, running southwest through Alexander, Bryant, Bauxite, Benton and Slocomb. The Chicago, Rock Island & Pacific also enters the County in the northeastern part, running southwest through Vimy Ridge, Bauxite and Benton. Federal Highways No's 67, 70 and 167, and State Highways No's 9 and 35 cover practically all parts of the County. There is no water transportation in the County.

U.S.G.S. quadrangle maps Hot Springs, Hot Springs and vicinity, Little Rock, Benton and Alexander completely cover the County. Highway and State Topographic maps are also available.

SCOTT COUNTY

Scott County, located about the center, and on the western border of the State, is bounded on the north by Sebastian and Franklin Counties; on the east by Yell County; on the south by Polk and Montgomery Counties, and on the west by the State of Oklahoma. It has a land area of 620,800 acres.

This County lies in two divisions of the Paleozoic uplift. The extreme northern part of the County lies in the Arkansas valley section, and the remainder in the Fourche Mountain area.

The County is made up of several wide valleys running east and west, with an intervening broken hilly country. The greater part of the soil is sandy loam with a clay subsoil. The lands in the valleys of the Fourche La Fave, Poteau and Petit Jean Rivers and Dutch Creek are very fertile.

The surface rocks of Scott County, consisting of sandstone and shale, are of Carboniferous age, and nearly all of them belong to the Pennsylvanian series. The topographic forms already mentioned owe their origin to the structure, which is that of a compound syncline. The beds have been closely folded and thrust faulted near the southern part of the valley, but they are open-folded and normal faulted near the Boston Mountains.

The rocks of the Fourche Mountains in Scott County are all of Carboniferous age, and belong to the Stanley, Jackfork and Atoka formations. They have been complexly folded, and, to a certain extent, thrust faulted. Many of the folds have been overturned toward the north, so that southern dips are common; but some of the folds are overturned toward the south. Many of the mountains are anticlinal, and some of the larger valleys, such as that of the Fourche La Fave River, are topographic expressions of the underlying synclinal structure. In the Fourche Mountains there are a number of readily recognizable topographic basins.

The lowest elevation in the County, 419 feet, is at Cedar, Kansas City Southern Railway crossing. Highest elevation, 2750 feet (estimated) is on Blue Mountain. A few of the representative towns with their respective elevations are as follows:-

Abbott	628 feet	Bates	607 feet
Waldron	654 feet	Newman	750 feet

The County is well drained by the Fourche La Fave, Petit Jean and Poteau Rivers and their tributaries, Cedar Creek,

Clear Fork, Sugar Creek, Jones and Dutch Creeks. Floods are not prevalent in this County. It withstood the extreme high water during the fore part of 1937 without serious impairment.

The most profitably produced minerals in Scott County are natural gas and coal.

There are two natural gas producing areas in Arkansas; (1) the area in the southwestern part of the State, which includes Union, Ouachita and Columbia Counties, and (2) the area in the western end of the Arkansas valley, east and south of Fort Smith, including Sebastian, Crawford, Johnson and Scott Counties. The gas produced in these two areas originates in two entirely different series of rocks. The western Arkansas fields obtain gas from the Atoka shales of Pennsylvanian age, while the south Arkansas fields are supplied from the Upper Cretaceous beds of the Coastal Plain.

The producing gas fields of the Arkansas valley area are known as the Massard Prairie, Kibler-Williams, Alma, Clarksville and Mansfield fields. All of these fields derive their production from the Atoka formation which underlies the productive coal measure beds and makes up the surface of the eastern portion of the Arkansas River valley of the State. The daily average production of this area is about 11,000,000 cubic feet per day.

The Mansfield field lies partly in Scott and partly in Sebastian County. The field was discovered in 1902, and covers an area of approximately 2,500 acres. Drilling in this area starts approximately 3,000 feet below which was once the top of the Atoka shale; and as the wells penetrate to over 2,000 feet, the indications are that at least the first 5,000 feet of Atoka shale is good for commercial gas production. Four producing sands have been encountered. The thickness of each of these sands are, respectively, 22 to 60 feet; 75 to 142 feet; 10 to 30 feet, and 10 to 101 feet. The initial rock pressure of the 1,200 foot sand, when the field was originally discovered, was 315 pounds; and the present day rock pressure is about 265 pounds. The open flow in the largest well in this field was about 4,500,000 cubic feet per day. There are eight wells reported as now producing in this field. The gas is used domestically in nearby towns, but the major portion is used for brick burning by the Choctaw Brick & Gas Company of Mansfield, Sebastian County. The cost of drilling in this field is about $8,000.00 for a 2,000 foot well.

There are other known mineral deposits in Scott County, among which are asphalt, dolomite, sandstone, iron and clays.

The production of these minerals, if any, has been small. A deposit of asphaltic dolomite has been found in the southwestern part of the County at the northern base of Fourche Mountain. This deposit occurs in the Jackfork sandstone of the Mississippian age. There has been no development, however, of this mineral.

The iron ores are too poor in quality and occur in too small quantities to be of any value at prices that have prevailed in the past. However, with the price of iron increasing from month to month, attempts will no doubt be made to produce this mineral, at least in a small way.

There are clays found in the County consisting principally of shales, and also alluvial clays of Recent age, located in the river bottoms and other lowlands. The clays in the County are widely distributed and are suitable for the manufacture of brick, tile, drains, and, to some extent, fire brick. There is no production at the present time, but these clay deposits will no doubt be a valuable asset to the County in the future.

The transportation facilities of Scott County consists of two railroads, three Federal and two State Highways. The Chicago, Rock Island & Pacific Railroad traverses the northwestern part of the County, and the Kansas City Southern extends from the western border of the County eastward to Waldron, the County Seat. Federal and State Highways cross and cris-cross the County in most all directions, affording good highway service.

U.S.G.S. quadrangle maps Poteau Mountain, Fort Smith, Mount Ida and Magazine Mountain completely cover the County. Highway and State topographic maps are also available.

SEARCY COUNTY

Searcy County is situated in the northern part of the State, in the Ozark Mountains, and in the zinc and lead belt of Arkansas. It is bounded on the north by Marion County; on the east by Stone County; on the south by Pope and Van Buren Counties, and on the west by Newton County. It has a land area of 430,720 acres.

This County lies in two distinct topographic divisions of the Paleozoic area. The northern part is in the Springfield Plateau and the southern portion in the Boston Mountains. Generally, the County is hilly and broken. There is a great amount of good farming land on the level plateaus, in the creek bottoms and in the valley of the Buffalo Fork of White River.

In the north and northeastern parts of Searcy County is the Boone formation, St. Joe limestone member. Below the chert and cherty limestone of the Boone formation, over a large area in the northern part of Arkansas (Searcy County), lies the St. Joe member, a well marked bed of gray to pink crystalline limestone, easily recognized by its freedom from chert, its color, its texture, and its general contrast with the underlying and overlying beds. The St. Joe ranges in thickness from a feather edge to about 100 feet.

The St. Joe limestone is described in the reports of the Old Arkansas Survey as a marble, and it will take a good polish. It is available for quarrying at many places, but the beds are too thin to permit its extensive use as an ornamental stone. The Arkansas stone in the Washington Monument was taken from a ledge of St. Joe limestone, about 4 feet thick.

The chert and the limestone, which vary in amount both horizontally and vertically, is a feature that makes the subdivision of the beds very difficult. Over large areas, however, the basal member of the formation, the St. Joe limestone, which is free from chert, is well exposed; and, at most places, the middle part of the formation also carries less chert than the higher and lower beds. A large part of the area of the Boone formation of Searcy County is cut by many narrow canyon-like valleys; but back from the larger streams, the surface is much less dissected, and is gently rolling.

In the southern part of the County is the Hale formation, Bloyd shale. This formation consists mainly of sandstone and shale, but includes some beds of limestone and conglomerate; all of which are extremely variable in lithology distribution and thickness. Also in the southern part of Searcy County is found Pitkin limestone, Fayetteville shale and Batesville sandstone.

The Pitkin limestone is the upper formation of the Mississippian system in Arkansas (Searcy County). Its thickness is generally between 10 and 40 feet; but in Pilot Mountain, northeast of St. Joe, it is 90 feet thick. In its typical phase the Pitkin formation consists of massive layers of compact, bluish-gray limestone, which is, at many places, ferruginous and porous.

The Fayetteville shale, 10 to 400 feet thick, consists principally of black or dark-gray carboneous shale. Also in the southern and northwestern parts of the County is found Batesville sandstone which is 0 to 200 feet thick, and the City of Batesville is built on it. In the southern part of the County is found traces of Moorefield shale, and it does not extend further west of Searcy County.

In the western part of the County is the Atoka formation, which consists of alternating beds of sandstone and shale and a few beds of calcareous sandstone of small areal extent. The sandstone beds range from less than 1 foot to more than 125 feet.

The Atoka formation consists of a rather unvarying series of alternating beds of sandstone and shale; and, although some of the beds are, or have been, somewhat calcareous, no limestone has been found among them in the Boston Mountains. The Atoka, which rests unconformably upon the rocks of the Morrow group, is the youngest formation that crops out in the Boston Mountains.

The lowest elevation in the County, 616 feet, is about 2.5 miles north of Zack Station, along the M.& A.Railroad. Highest elevation, 2200 feet, is on the summit of Lost Mountain. A few of the representative towns with their respective elevations are as follows:-

Marshall	1,050 feet	Leslie	979 feet
Blanco	675 feet	St. Joe	793 feet

The drainage of Searcy County consists of Buffalo River (a tributary of White River) and a few small creeks, the principal of which are Middle Fork and Bear Creek. Floods are not prevalent in the County except possibly in the lowlands of Buffalo River in extreme high water.

There are no stream gaging stations in the County. The nearest station is at Rush, Arkansas, in Marion County, on the Buffalo River.

There are numerous mineral deposits in Searcy County. Those that are now being mined most profitably are zinc, lead, iron sulphide ore, manganese, black marble, phosphate, sand,

gravel, and aluminum silicate.

Lead ore is not as widely distributed in this County as is zinc. This ore is found in both free and disseminated forms. The free ore is ready for the market as it comes from the ground. The disseminated ore has to be milled.

Most of the lead produced in this section has been free ore. At the price to-day (March 20th. 1937) a full wheelbarrow load of free ore is worth a little more than $20.00. Lead seems to have become unusually scarce generally in the last few months, and authorities on this metal are inclined to believe that the price will remain high for some time. At the price to-day, lead ore is profitable to mine if one has a deposit of any consequence.

One of the oldest zinc mines in the north Arkansas field is again being operated with the prospect of a new vein of ore being opened, restoring activity which characterized the World War days.

Zinc and lead mining in this and surrounding Counties, continues to show an increase every month, and shipments are running from three to five cars each week. The heavy shipping points in the County are Pindall and St. Joe, on the Missouri & North Arkansas Railroad.

The new market is for iron sulphide ore, familiarly known as pyrites of iron. There are large deposits of this ore northwest of Leslie, this County. For many years this ore was regarded as of little value, although an analyses shows 40 per cent sulphur. Now it is used extensively in the manufacture of certain acids and has a definite commercial value.

One of the largest steel mills in the south is investigating the manganese field north of Marshall, and it is expected that it may acquire properties there and begin operations soon.

There is promise now that the working of the black marble deposits near Leslie may be greatly extended. The manager of the largest marble company in the south has expressed interest, especially in the spotted black marble of that section. This company has plants at Atlanta, Birmingham, New Orleans, Memphis, and Columbus, Mississippi, and would have the Leslie marble handled at all these points. The largest former source of supply of black marble was Belgium. Marble workers say the Leslie marble takes as fine a polish as the Belgium marble; and of course it can be obtained much cheaper.

For many years people in Searcy County have been aware of a gray looking soft rock, but thought it of no consequence and never had it analyzed. Recently this deposit was investigated, and it was found to be aluminum silicate which is used as a filler for cement, and for abrasive purposes. Several people are interested in this deposit, and in a few months it probably will be giving the Missouri & North Arkansas Railroad additional tonnage.

Near St, Joe, in Searcy County, a large deposit of phosphate is located, which is used in the manufacture of fertilizer; and in the same locality there has been found a material running high in magnesium sulphate, more commonly termed "epsom salts".

Sand and gravel has also proven to be a very valuable asset to the County. In the last few years over $150,000.00 worth has been produced. The gravel is taken from a large pit near Marshall, and the sand is dredged from the bottom of Buffalo River.

Searcy County has fairly good transportation facilities, with one railroad, one Federal Highway and three State Highways. The Missouri & North Arkansas Railroad crosses the County from the northwest to the southeast, and is paralleled, for the most part, by Federal Highway No. 65. State Highways No's. 5, 14, 27 and 66 traverse the northeastern, southwestern and southeastern parts of the County. The western part of the County has no railroad, Federal or State Highways. There is no water transportation in this County.

U.S.G.S. quadrangle maps Mountain View, Mountain Home, Yellville and Marshall completely cover the County. Highway and State topographic maps are also available.

SEBASTIAN COUNTY

Bordering on the eastern boundary of the State of Oklahoma, about the middle of the western part of the State, of Arkansas, is Sebastian County. The Ozark Mountains on the north form a great atmospheric wall which has a tempering effect on the climate extremes in summer and winter.

This County lies in the Arkansas valley area of the Paleozoic region and has a multitude of natural resources, a basis of an industrial development of mammoth proportions probably not exceeded by any other section of the State. Nature has endowed this County with raw materials which, with reference to industrial possibilities, are extraordinary. It lies in the heart of the coal fields which extend from middle west Arkansas into the State of Oklahoma. The coal beds in this County range in thickness from 18 inches to 6 feet, and generally are of the smokeless bituminous variety.

The higher lands yield bountifully varied crops, and the bottom lands produce abundantly all the crops of the south.

Alluvium deposits of silt and clay of "Recent" age are found at the surface, along the banks of the Arkansas River, which forms the northern boundary of Sebastian County.

The Paris formation of Pennsylvanian age, composed of clay shale, arenaceous shale and minor amounts of sandstone, is exposed to a certain extent in the County and is about 650 feet thick. This formation contains several coal beds, of which the Paris is the thickest.

The Paris formation is, in many respects, similar to the Spadra formation but is generally lighter in color and more arenaceous. This formation is gray, brown, yellow or black, and is somewhat more resistant than the Spadra shale. The sandstone is ordinarily shaley and has no pronounced topographic expression.

The Paris shale has produced neither oil nor gas in this County, and as it is, essentially, a surface formation, it is of no importance in the search for these products.

The northwestern, northeastern, and southwestern parts of Sebastian County are of the Fort Smith formation of Pennsylvanian period, which comprises the middle or sandy division of the McAlester formation.

In this County these beds are easily distinguished from the overlying and underlying beds of shale, and were

assigned to a separate formation. The rocks are well exposed in the vicinity of Fort Smith, which is the type area of this formation. The Fort Smith formation is widely exposed in the County and ranges in thickness from about 375 to 525 feet.

The beds of sandstone are ordinarily ripple-marked and thin-bedded, but the irregular cross bedding that is so common in other sandstone is relatively rare in the Fort Smith formation.

The sandy shale is arenaceous at practically all its outcrops, and the soil it forms is sandy and is yellow to red in color. This soil is so different from that formed by the disintegration of the enclosing formations that it indicates, in a general way, the areal extent of the formation at Fort Smith. Flaggy sandstone has been quarried for use as flagstones and building material.

Coal is found at several horizons in the formation, but it is ordinarily of small extent and it is too thin to be mined. Near the top of the formation, however, there is an 18 inch coal bed that was formerly stripped near Fort Smith. This formation is well exposed near Greenwood, and the lower bed of sandstone, which is the same that is exposed at Fort Smith, makes the ridge forming the rim of the synclinal basin in which the town of Bloomer is situated.

The Fort Smith formation has yielded neither oil or gas, and although some gas may be obtained from it in a few areas where the structure is favorable, neither will probably be obtained in commercial quantities.

In the southern and southwestern parts of the County is what is known as Spadra formation of the Pennsylvanian age, which contains valuable Hartshorne coal at the base; and it comprises shales lying between the Hartshorne sandstone below and the Fort Smith sandstone above. This formation is widely exposed over the coal field in the County, where its outcrops form either broad open valleys or occur as bands around synclinal basins.

The Spadra formation ranges in thickness from 350 to 500 feet in its exposures, where it has been measured in drill holes as well as at the surface. The formation is well exposed in Sebastian County, and consists mainly of fine-grained, blue-black or gray-clay shale; but in places it contains thick lenses of sandstone; on such, beds of sandstone occur near Burma, in Sebastian County, and forms the parting between the upper and lower Hartshorne coals.

The residual soil produced by the weathering of the Spadra shale is poor and thin and supports only a scant vegetation. The Spadra formation has yielded neither oil nor gas from many of the test borings that have penetrated it in prospecting for coal. Furthermore, there is no reason to suspect that it will produce either in this County.

The Atoka formation of the Pennsylvanian period comprises a considerable part of the thick series of sandstones and shales that underlie the coal-bearing rocks in the Arkansas coal field in Sebastian County. This series of rocks was referred to in the publications of the Arkansas Geological Survey as the "Lower or Barren Coal Measures", although it does contain, here and there, a few thin coal seams.

The uppermost formation in this series is known as the Atoka formation and contains beds which are equivalent to part of the Winslow formation of the Boston Mountains. The Atoka is estimated to be about 7,000 feet thick, and is composed of sandstone separated by thick beds of black clay shale. It has not yielded any fossils in Sebastian County.

The sandstones form ridges and the shales underlie valleys and lowlands. Sandstone beds in the formation supply the gas from the Massard Prairie gas field near Fort Smith, and the Mansfield gas field near Mansfield.

The shales of the Atoka are ordinarily poorly exposed. They usually crop out in valleys and on the lower slopes of ridges and hills, where they weather to a product that ranges in color from yellow to blue. In new road cuts, and in similarly protected places, the unweathered shale is blue to black where clayey, and yellow to brown where sandy. Near Huntington, Arkansas, the formation consists essentially of shale.

The Atoka formation includes beds that lie at all the known gas-producing horizons in the Arkansas valley (Sebastian County). It is, therefore, an interesting formation to the Geologist; and it is of equal interest to the operator; for, as it is the surface rock over large areas, most of the drilling is confined to it.

Sebastian County is the largest producer of fuel minerals in the State, natural gas and coal. It is also one of the largest producers of clay in the State.

The western Arkansas coal (bituminous) was formed during the early Pennsylvanian portion of the Carboniferous era from vegetable matter which grew in the dense swamps of that time. This vegetable matter fell into water and was preserved from decay and eventually changed to

"peat". This was covered by some impervious material, probably mud or clay, and the land slowly submerged until the original bed was deeply buried. While covered this way the peat probably changed to lignite and eventually into harder coal, while the sands and clays which covered it slowly changed into sandstones and shales.

The coal lands of western Arkansas are concentrated in a rather narrow belt along the western end of the regional syncline, between the Ozark and Ouachita Mountain regions. The Arkansas field is an eastern extension of the Oklahoma field, and is usually designated as a portion of the western interior coal field of the United States.

The productive coal measure beds are distributed principally along the major synclinal trough which extends eastward from Fort Smith to the vicinity of Russellville, Pope County, a distance of about seventy-five miles. This area is about twenty miles wide and decreases in width toward the eastern end. The remainder of the developed coal field extends south of Fort Smith into southern Sebastian and northern Scott Counties.

There is also a deposit of light yellowish surface clay used at Comby's pottery in the manufacture of stone ware and art pottery.

Sand and gravel has also proved to be a very valuable asset to Sebastian County. In the past few years, about $30,000.00 worth of these two minerals have been produced, most of it being taken from the Arkansas River, through dredging with power boats.

An industry that is working both day and night at this time is the plant of the American Zinc, Lead & Smelting Company of Fort Smith. Due to the recent rise in the price of zinc and lead ores, more properties or mines are being operated at this time than at any time since the World War. This Company is receiving over 100 tons of high grade free zinc ore per week from the Yellville mining district.

The lowest elevation in the County, 410 feet, is at Lavaca Station. Highest elevation, 2500 feet (estimated) is on Poteau Mountain. A few of the representative towns with their respective elevations are as follows:-

Fort Smith	450 feet	Mansfield	605 feet
Bonanza	496 feet	Dayton	650 feet
Hackett City	536 feet		

The river and drainage system of Sebastian County

consists of the Arkansas River and numerous water courses, among which are Vache Grasse Creek, a tributary of the Arkansas River, and James Fork Creek, a tributary of Petit Jean River.

In normal times the above water courses furnish good drainage for the County. In 1927 and 1936, however, unusual conditions prevailed, and the Arkansas River went out of its banks and flooded a large area of land in this section of the State.

There are no stream gaging stations in this County. Information desired concerning the flow of the Arkansas River may be obtained from Station No. 9 at Van Buren, Arkansas.

The transportation of Sebastian County consists of three main line railroads; The Missouri Pacific; the St. Louis & San Francisco and the Chicago, Rock Island & Pacific and branch lines; and Federal Highway No. 71 and State Highways No's. 10, 22, 28, 45 and 96 cover the County in all directions, thus giving excellent rail and overland service.

The Arkansas River forms the northern boundary of the County, and is navigable only to small boats.

U.S.G.S. Quadrangle maps Fort Smith and Poteau Mountain completely cover the County. Highway and State Topographic maps are also available.

SEVIER COUNTY

Sevier County, situated in the southwestern part of the State, is bounded on the north by Howard County; on the east by Hempstead County; on the south by Little River County, and on the west by the State of Oklahoma. It has a land area of 366,080 acres.

This County is composed of the Athens-Piedmont Plateau of the Paleozoic area on the north, and the west Gulf Coastal Plain on the south. The central and southern parts of the County are comparatively level and the northern portions generally hilly. Nearly all of the County is admirably adapted to general farming. The southern portion is interspersed with large tracts of sandy soil, underlain by limestone and marl of Cretaceous formation. The soil of the central portion of the County varies from a light sandy soil, to a red clay loam.

The Athens-Piedmont Plateau is bounded on the north by the Novaculite uplift, and on the south and southeast by the Gulf Coastal Plain. It extends in a belt 8 to 18 miles wide from near the Ouachita River in Hot Spring County westward into Oklahoma. Practically all the rocks of this Plateau are of Carboniferous age, and most of them are "Jackfork" sandstones and "Stanley" shales of Paleozoic age. All of the beds have been completely folded and faulted, and at many places are inclined at high angles. The folds that produced the sandstone ridges are super-imposed on the south flank of the Ouachita anticlinorium. The surface of the Plateau was reduced to a peneplain in pre-Cretaceous time, and its present roughness is due to relatively recent elevation.

There is little possibility of obtaining commercial quantities of oil or gas in the Athens Plateau. The Carboniferous and older rocks are so intensely folded, fractured and metamorphosed, that any gas and much of the oil that they may once have contained, escaped long ago, though a part of the oil may remain as an asphaltic residue after the natural distillation.

The Athens-Piedmont Plateau is only slightly more favorable as potential oil and gas territory than the Novaculite uplift. Near its southern border, where the Atoka formation crops out, the chances of obtaining oil and gas are somewhat more favorable than elsewhere in the Plateau, but drilling is not recommended.

The Comanche series, represented by the Trinity group, is at the surface in the central part, and the Gulf series, up to and including the Annona chalk, is at the surface in the southern part of Sevier County.

The wide flood plains of Little River, Cossatot River and Saline River are underlain by sands, gravels and loams of "Pleistocene" and "Recent" age.

The basement rocks, on which the Cretaceous sediments accumulated, slope southward to a depth of about 2,500 feet below sea level in the southern part of the County.

The Trinity group of the Comanche series in Sevier County, in which these sediments are included, is in the Trinity formation. Several members are recognized, beginning with a sand member at the top. The De Queen limestone member, made up of limestone and green clay, with gypsum and celesite near the base; variegated clays containing the Ultina Thule gravel lentil; the Dierks limestone lentil, consisting of fossiliferous limestone and small amounts of green clay, and a lower sand member with the Pike gravel member at the base.

The total thickness of the Trinity formation, where exposed at the surface, is from 600 to 900 feet. The Trinity group increases in thickness to the south, and is estimated to total about 2,000 feet in the southeastern corner of Sevier County, where these sediments may be differentiated into the Paluxy sand, Upper Glen Rose, Anhydrite, Lower Glen Rose, and Travis Peak formations.

The Trinity rocks contain deposits of asphalt in Sevier County, where the asphalt impregnates nearly horizontal beds of loose sand in the basal part of the Dierks limestone lentil, or still lower beds in the Trinity. The deposits consist of asphaltic sand layers ranging from an inch to several feet in thickness. The Trinity strata dip to the south at the rate of 75 to 100 feet per mile.

The lowest elevation in the County, 300 feet (estimated) is at Walnut Springs. Highest elevation, 812 feet, is at Mineral, 20 feet south of Kansas City Southern Railway Mile Post No. 419. A few of the representative towns with their respective elevations are as follows:-

Brownstown(Est)	450 feet	Horatio	337 feet
De Queen (Court House)	426 feet	Lockesburg	437 feet
Gillham	748 feet		

This County is well drained by the Saline River, Little River and the Cossatot River and their tributaries. The Cossatot River flows through the east central part of the County from north to south and empties into Little River in the southern part. Little River forms the greater part of the southern boundary of the County and empties into the Saline River in the northeastern part of Little River County. The

Saline River flows through the eastern part of the County, and has for its tributaries the streams of Blue Bayou and Mine Creek. There is no record in the Division of Research and Statistics of any overflow in this County. Stream gaging station No. 15 is located at Horatio on Little River in the western part of the County. Two additional stations are needed in the County, No. 34 on the Cossatot River near Lockesburg, and No. 35 on the Saline River near Lockesburg.

Sevier County is in the mineral belt of the southwest part of the State. It has numerous mineral deposits, among which are antimony, asphalt, chalk, zinc, lead, gypsum, clay, chalcopyrite, barite, galena, sand and gravel. There are also salt wells in the County. At present no salt is being produced in Arkansas, and it is unlikely that the salines in different parts of the State, from which supplies of salt were obtained before and during the Civil War, will ever be active competitors of the salt-bearing sections of Kansas, where there exists a plentiful deposit of pure rock salt.

Of the above mentioned minerals, the ones that have been most profitably produced in the past, and some of which are being produced at this time, are antimony, clay, galena, chalk, sand and gravel. Antimony is a metallic element. It is usually found in its natural state as sulphide of antimony, or stibnite. It is also found as an impurity in other minerals, such as lead sulphide, silver and bismuth. Metallic antimony is used principally in the manufacture of lead alloys, such as babbit and hard lead, solder, type metal, bullets, battery plates, britannia metal, etc. It is also used in the manufacture of vulcanized rubber and rubber goods, enamel on metal ware, chemicals, paints and pigments.

The antimony deposits of Arkansas occur in a rather narrow belt of steeply folded Mississippian shales and sandstones (Stanley shale) in the northern part of the County. The antimony (stibnite) deposits are associated with veins of quartz which penetrate the shales and sandstones and have somewhat northeast-southwest trends. The ore is associated with small amounts of copper, iron, zinc, and bismuth sulphides. These were probably deposited by the circulation of underground waters which dissolved the metals from deep-seated volcanic rocks and deposited them along veins a considerable distance above.

The quantity of antimony ore in Sevier County has not been definitely estimated. A considerable amount of drilling would have to take place before an accurate estimate of the quantity of available ore could be made. The ore lies in lenses or pockets associated with quartzitic veins which are not continuous for any great distance. Some of the lenticular masses

exceed 100 feet in vertical dimension and vary in width from three to forty feet, and in thickness from a feather-edge to two and one-half feet. Mining is carried on by sinking shafts into the ore beds and drifting out from the main shaft. The shafts vary in depth from 20 feet to 220 feet.

The production of antimony ore in Sevier County has gone on since about 1873, when this mineral was discovered on the Otto property. Work was commenced that year in the Otto mine, and continued intermittently since that time up to about 1920, when production stopped altogether. However, on July 13, 1937, the Gillham Mining area, once the source of the largest production of antimony on the North American Continent, has been reopened.

The Arkansas Development Company has finished installing machinery to work the old Wolfton antimony shaft. The ore-bearing stratum, which extends across the north end of Sevier County for six miles, is again proving to be a very valuable asset to the County.

There is a deposit of surface clay near Delmar, that is suitable for common brick.

Galena has been found sparingly, and mined occasionally, in Sevier County, at Belloh mine, near Conboy.

The Sevier County chalk is of Upper Cretaceous age, and is connected with the Austin chalk beds of Texas, which extend from Texas eastward into Arkansas. These chalk lands include chalks, marls, and chalky marls of various composition, and they cover a portion of Sevier County. They are suitable for, and can be used in the manufacture of burnt and unburnt lime products, such as Portland cement, plaster, fire brick, chemicals, soap, bone ash, artificial gas, paper, pottery, pottery material, egg preservations, tanning materials, and in the dehydration of alcohol. They can also be used in the treatment of acid soils.

Sand and gravel has also proved to be a very valuable asset to the County. The most persistent gravel beds in this section of the State is known as the Pike gravel member of the Trinity formation (Lower Cretaceous). This extends irregularly across Sevier County near the northern edge of the Coastal Plain. The bed is from 20 to 50 feet thick. Another valuable bed is the Ultima Thule gravel lentil of the Trinity formation, which is exposed northeast, north and northwest of De Queen. This bed lies immediately south of the Pike gravel bed. In the past few years thousands of dollars worth of gravel has been removed from these deposits, and at this time they show no signs of ever becoming exhausted.

This County has the unique distinction of having three rivers from which it can get its supply of sand. It is bounded on the east by Saline River, on the south by Little River, while the Cossatot River crosses the County from north to south. The supply of sand from these streams is practically unlimited. At the present time most of the sand produced is dredged from Little River in the vicinity of Horatio, in the southwestern part of the County.

The Kansas City Southern Railway, which crosses the County from north to south in the western part; the De Queen & Eastern Railway, which runs from west to east through the County, with its terminus at Dierks in Howard County, and the Graysonia, Nashville & Ashdown, which crosses the extreme southeastern part of the County, constitute the rail transportation. Federal Highways No's 70 and 71, and State Highways No's 24, 27 and 41 give good overland service.

U.S.G.S. quadrangle map De Queen covers the northern half of the County. The southern portion has not been mapped in detail. Highway and State topographic maps are available.

SHARP COUNTY

Sharp County, situated in the northern part of the State, is bounded on the north by Missouri and Fulton County; on the east by Lawrence and Randolph Counties; on the south by Independence County, and on the west by Izard County. It has a land area of 387,760 acres.

This County lies in the Salem Plateau, which is a part of the Ozark Highlands. A part of the County is rough and broken, but a greater portion of it is slightly rolling and level. The bottom lands are very fertile and can be made to produce abundantly.

In the northern part of Sharp County appears the Powell limestone, which was named from Powell, Marion County, which is now an abandoned railroad station. The Powell limestone, at some places, 200 feet thick, consists of magnesium limestone, calcareous green shale, and, at many places, of a conglomerate which occurs at its base. The formation is exposed in a large area in Sharp County.

Most of the Powell limestone effervesces readily with cold dilute hydrochloric acid, a reaction which cannot ordinarily be obtained with rock from the underlying Cotter dolomite. The exposed layers are somewhat rounded, and the rock breaks with conchoidal fracture into many small angular fragments. White chert, in the form of concentrically banded nodules, is distributed through parts of the limestone, but no place abundantly.

The Powell limestone rests unconformably upon the Cotter dolomite, and is unconformably overlain at different places by the Everton limestone, the St. Peter sandstone, and the Chattanooga shale. The deposits of early Powell time are in places conglomerate ,and some of the material at the base of the Powell formation may be a residual mantle of erosional material formed in post-Cotter time and recemented. As the depositional conditions were favorable to the presentation of fossils, and as only a few gastropods, cephalopods and trilobites are found in the Powell limestone, the implication is that most of that limestone was formed as a chemical precipitate.

The Powell limestone formation is of the Ordovician age. It does not contain any bed that may be regarded as a potential oil or gas reservoir.

In the southwestern part of the County is what is known as the Cotter dolomite. The Cotter rests unconformably upon the Jefferson City dolomite, but as the two formations are lithologically similar and the contact is exposed only at a few places, it is not anywhere easy to distinguish the one formation from the other. After the Cotter formation was

deposited, the region must have been uplifted and slightly folded, because the overlying Powell limestone rests upon a weathered and somewhat undulating surface.

The Cotter dolomite was so named from Cotter in Baxter County, Arkansas, where it is typically exposed, and is also exposed, to some extent, in Sharp County.

The Cotter dolomite consists largely of dolomite rock, but it includes shale, chert and sandstone, though in minor amounts. The dolomite covers considerable area and the thickest outcrop measures over 500 feet. The City of Berryville, Carroll County, is built upon the Cotter dolomite formation. The beds are made up of two kinds of dolomite, a massive, medium-grained, gray rock, which becomes dark on exposure, and a fine-grained, earthy white to buff rock. A rather prominent layer near the top of the formation contains hemispherical algal masses of chert showing concentric structure. They are of considerable stratigraphic value, for they are not found above the top of the Cotter dolomite in Arkansas, and they occur but rarely in the underlying Jefferson City formation. The fossils are molluscs, chiefly gastropods and cephalopods. The early Ordovician age of the Cotter dolomite is therefore well established.

In the northeastern part of Sharp County is recognized the Jefferson City dolomite, which is the oldest formation in Arkansas north of the Arkansas River. It is exposed in the extreme northeastern part of the area of Paleozoic rocks of the Ozark region in Arkansas, with a slight exposure in Sharp County.

The beds of this formation consist of gray crystalline dolomite, ordinarily with considerable chert, alternating with thin-bedded, fine-grained, lighter dolomite without chert. The formation includes also thin beds of sandstone, shale, and colite; but these beds are not widely distributed and their aggregate thickness is not great. They are, in places, ripple-marked and they show mud cracks, so that they were probably deposited in shallow water. Some of the more argillaceous layers are laminated and are darkened by organic material. When rock taken from these layers is freshly broken, it gives off a fetid odor somewhat like that of petroleum; but hydrocarbons are not widely distributed through the formation.

Either the conditions for the preservation of organisms were unfavorable, or marine life was scanty in the sea where the Jefferson City dolomite was deposited, for the formation contains practically no fossils. From its position in reference to the overlying and underlying strata, however, it is placed in the lower half of the Canadian division of the

Ordovician system.

Its known thickness in Arkansas is at least 350 feet; but its base is not exposed and it may be much thicker, particularly as it is 1,000 feet thick in southern Missouri.

The Roubidoux formation, which underlies it, may outcrop in the extreme northeastern Paleozoic area, for the contact between that formation and the Jefferson City dolomite is not easily found and as determined is drawn arbitrarily.

The Jefferson City dolomite cannot be regarded either as a possible source or a potential reservoir of oil or gas. It has been penetrated by the drill at several places with uniformly unpromising results.

The lowest elevation in the County, 321 feet, is at Williford Station. Highest elevation, 808 feet, is 4.4 miles south of Ash Flat on Highway No. 11. A few of the representative towns with their respective elevations are as follows:

Calamine	500 feet	Hardy	362 feet
Cave City	641 feet	Evening Shade	457 feet
Stuart	721 feet	Poughkeepsie	550 feet

The County is drained by Spring and Strawberry Rivers and their tributaries. Spring River rises at Mammoth Spring in Fulton County and flows across the northeastern part of Sharp County. Strawberry River flows through the central part of the County from west to east and empties into Black River in Lawrence County. Piney Fork and Williams Creek are tributaries of Strawberry River. Statistical records do not reveal any overflows having occurred in the County. There are no stream gaging stations in the County, but one is needed on Strawberry River near Evening Shade.

Sharp County is in the mineral belt of the State. There are numerous mineral deposits in the County, among which are zinc, lead, manganese, iron phosphates, onyx and dolomite. Of these the most profitably produced at this time, are zinc, lead and dolomite.

The north Arkansas zinc and lead field has a larger area of ore-bearing formations than any other zinc and lead field in the United States. It takes in Boone, Baxter, Marion, Newton, Searcy, Carroll, Lawrence and Sharp Counties.

One of the first zinc smelters in the United States was located at Calamine in Sharp County late in the 1850's.

Three kinds of zinc ore is mined in the County: Sulphide (jack), silicate of zinc, and carbonate of zinc. The

sulphide ore is the primary ore and runs approximately 60 per cent in metallic zinc. The carbonate is a secondary ore found in the limestone formations, and the silicate ore is a secondary ore found in and around deposits of silica. The two latter ores run approximately 40 per cent metallic zinc. The carbonate ores produce the highest grade slab zinc that can be produced from virgin ores. During the World War this ore was in strong demand as it filled Government specifications for slab zinc after it was smelted, without further treatment.

The carbonate and silicate ores are found frequently in free deposits; that is, the ore is not disseminated in the rock formation surrounding it, and is ready for market as it comes from the ground. This is the kind of ore that gives a poor man a chance; he can sell it as it comes from the ground.

Disseminated ore is that ore scattered through the rock formations in which it occurs. Most of the sulphide ore in north Arkansas occurs in this form, and lots of the carbonate and silicate ore of this nature has to be milled and concentrated before it is ready for the market.

Lead ore is not as widely distributed in the County as zinc. This ore is also found in both free and disseminated forms. The free ore is ready for market as it comes from the ground. The disseminated ore has to be milled. Most of the lead produced in this section has been free ore. At the price to-day a full wheelbarrow load of free ore is worth a little more than $20.00

One of the adjuncts necessary to a permanent mining field in north Arkansas is the installation of a smelter (the nearest at this time being in Fort Smith, Arkansas) or electrolytic reduction plant, which would open up a local market for the ore. A regular smelting plant seems out of the question for the district because of lack of fuel; but the electrolytic plant seems feasible. The only promised development of water power on White River, would take care of the increased demands for current as the industry developed.

In these upland regions Dr. Geo. C. Branner, State Geologist, sees the possibility of a large industrial growth based on such a nonmetallic mineral as dolomite. Just to mention a few of the uses dolomite is put to: It goes into the manufacture of dead burned dolomite refactories, as a flux in smelting iron, steel, etc.; in the manufacture of high magnesium lime, as agricultural limestone, as crushed stone, rip-rap and rubble, as a building stone, when pulverized, as a substitute for whiting, as stucco dash, concrete block facing, etc.

Dolomite from Hardy, north Sharp County, takes a high polish and is of a red brown color. In the past few years thousands of dollars worth of dolomite has been produced.

Clay deposits are also found in different parts of the County, of nearly every variety of both pottery and paint clays.

The St. Louis & San Francisco Railroad traverses the northeastern part of Sharp County, passing through the town of Hardy, the County Seat of the northern district. Evening Shade is the County Seat of the southern district. Federal Highways No's. 62 and 63, and State Highways No's. 11, 58 and 115 give the County good overland transportation.

The extreme southeastern part of the County is covered by M.R.C. quadrangle map Strawberry. The rest of the County has not been mapped in detail. Highway and State topographic maps are available.

ST. FRANCIS COUNTY

Named for the river which courses through its center, the valley of which composes a good part of the area, St. Francis County is the sixth county south of the Missouri line. It is bounded on the north by Cross and Crittenden Counties; on the east by Crittenden County; on the south by Lee County, and on the west by Woodruff County. It has a land area of 401,920 acres.

This County lies in the Gulf Coastal Plain. Crowley's Ridge bisects the County, and on the west side there is a level plateau of rich farm land, extending beyond the County line to the valley of White River. The soil of the eastern part is embraced entirely in the great St. Francis Basin, and the most productive soil to be found in the World. The level lands to the west are well suited to the growth of southern crops.

A little west of the center of St. Francis County is Crowley's Ridge, which is a belt of hilly land one and one-half to six miles wide, trending north and south. The crest of the ridge is about 350 feet above sea level, or 140 to 160 feet above the lowlands to the east and west.

The part of the County west of Crowley's Ridge is included in the Advance lowlands, a gently undulating plain 230 to 260 feet above sea level. The part of the County east of Crowley's Ridge is included in the Mississippi lowland, a heavily timbered, nearly level, or gently undulating plain, 220 to 230 feet above sea level. Swamps, lakes, bayous and abandoned stream channels are numerous.

The oldest formation appearing at the surface in St. Francis County is the Jackson, which crops out in a narrow band on the flanks of Crowley's Ridge. The Jackson is unconformably overlain by sands and gravels of the Lafayette formation of Pleistocene age.

Over the remainder of the County the materials at the surface are alluvial loams, clays, sands and gravels of Recent and Pleistocene age. The Tertiary strata range from 1,900 to 2,900 feet in thickness, and the Cretaceous from 400 to 900 feet or more in thickness.

The Coastal Plain sediments were deposited upon a nearby level floor and truncated Paleozoic rocks. This floor, owing to subsequent warping, now slopes toward the southeast from about 2,100 feet below sea level in the northwestern part to about 3,900 feet below sea level in the southeastern part of the County.

The characteristics of the basement rocks are not definitely known, but are probably similar to the rocks present

at the surface in the area west of the Coastal Plain.

The Cretaceous strata (Gulf series) underlying St. Francis County are composed of shales, sands, limestones and chalks, which have an estimated thickness of about 400 feet in the northwestern part and about 900 feet in the southeastern part of the County. The following formations are represented:- Arkadelphia marl, Nacatoch sand, Saratoga chalk and, Marlbrook marl; and probably older formations in the extreme eastern part. The Marlbrook marl is probably absent in the western part, and the Tokio formation, or its Mississippian equivalent (the Tuscaloosa formation) is perhaps present in the eastern part of the County.

The Eocene strata have an estimated thickness ranging from 1,800 feet in the northwestern to 2,800 feet in the southeastern part of the County. The basal Eocene (the Midway clays) are 400 to 600 feet thick, consisting principally of gray and bluish-gray clay, containing an abundance of siderite concretions. The larger part of the total thickness of the clay is noncalcareous.

The sediments overlying the Midway belong to the Jackson, Claiborne and Wilcox formations; but, owing to lack of detailed data, it has not been possible to differentiate accurately these formations in St. Francis County. Their thickness ranges from 1,200 feet in the western part to 2,200 feet in the eastern part of the County. These beds are made up principally of sands, clays and sandy clays, in part lignitic; but they also contain beds of glauconite sands and clays, which are most abundant in the basal part of the Claiborne formation.

The Jackson formation of Crowley's Ridge is unconformably overlain by irregularly bedded gravels and sands reaching a thickness of about 40 feet or more. These sands and gravels are correlated with the Lafayette formation.

The Lafayette formation in Crowley's Ridge is overlain by loess of Pleistocene age, ranging in thickness from a few feet to 80 feet or more.

The Quaternary alluvium which immediately underlies the surface in the Advance lowlands west of Crowley's Ridge, to a depth of 140 to 200 feet is, in part, of Pleistocene and, in part, of Recent age. The Quaternary alluvium which underlies the Mississippi lowland to a depth of 120 to 200 feet, consists of loams, clays and gravels. The materials at the surface are present between the Recent and the underlying Eocene strata.

The Nacatoch sand lies at a depth of about 1,600 feet below sea level in the northwestern part, and about 3,000 feet or more below sea level in the southeastern part of the County. The dip is to the southeast at the rate of 30 to 50 feet per mile.

The information concerning different formations was obtained from a list of wells drilled in St. Francis County.

The lowest elevation in the County, 188 feet, is at Wheatley, Missouri & Arkansas Railroad Mile Post No. 22. Highest elevation, 375 feet, is about 0.2 of a mile north of the Chicago, Rock Island & Pacific Railroad on Crowley's Ridge. A few of the representative towns with their respective elevations are as follows:-

Forrest City	372 feet	Caldwell	233 feet
Madison	165 feet	McDaniel	325 feet
Rawlinson	201 feet		

The County is well drained by the St. Francis and the L'Anguille Rivers and their tributaries. The St. Francis flows through the central part from north to south, and the L'Anguille River parallels the St. Francis in the western portion of the County. Floods occur only in extreme high water in the lowlands along the rivers. There are no stream gaging stations in this County.

In the past few years the principal mineral production of St. Francis County has been sand and gravel. In this part of Arkansas along Crowley's Ridge there are immense quantities of gravel which is frequently exposed in road cuts and in a few of the railway cuts. In many instances the gravel extends to the tops of the Ridge. These gravels consist almost entirely of chert, quartz and "flint" rock. Chert, or "flint" rock, is hard and resistant to frictional wear. It usually is associated with, and occurs in, residual clays that make a good stiff natural binder that does not readily wash or become dusty. Consequently, the natural occurrences of "flint" rock offers one of the best road metals that occurs in Arkansas. Chert is an amorphous or crypto-crystalline form of quartz, and the residual materials in which it is usually imbedded are clays highly impregnated with iron oxides, and some carbonates of lime and magnesia, all of which have a hardening, or cementing, effect, under the combined influence of weathering and traffic.

The sand that is produced in the County is dredged from the bottom of the St. Francis River, or taken from the bars along the river.

Both these minerals are produced by the Crow Creek Gravel and Sand Company. Their plant is located one mile west of Madison, this County. The capacity of this plant is ten cars of sand and twenty cars of gravel per day.

There is brick clay and yellow loess on and near Crowley's Ridge which burns a uniform red. These clays are used at Forrest City in the manufacture of brick.

There are deposits of marl (calcareous and shell marls) in the County which have been mined.

The rail transportation of St. Francis County consists of the Missouri Pacific and Chicago, Rock Island & Pacific Railroads. The Missouri Pacific traverses the County from north to south, connecting with the Rock Island at Forrest City. A branch of the Missouri Pacific runs through the extreme southeast corner of the County. The Rock Island traverses the County from the northeast to the southwest.

Federal Highways No's. 70 and 79, and State Highways No's. 1, 50, 75 and 149 give the County excellent overland transportation.

M. R. C. quadrangle maps Hunter, Wynne, Whitmore, Edmondson, Horseshoe, Park Place, Marianna and Brinkley completely cover the County.

Highway and State topographic maps are also available.

STONE COUNTY

Stone County, situated in the northern part of the State, is bounded on the north by Izard and Baxter Counties; on the east by Izard and Independence Counties; on the south by Cleburne and Van Buren Counties, and on the west by Searcy County. It has a land area of 201,040 acres.

This County lies in three distinct areas of the Paleozoic uplift in Arkansas. The extreme northeastern part is within the Salem Plateau; the central part in the Springfield Plateau, and the southern portion in what is known as the Boston Mountain area. The Salem Plateau is separated from the Springfield Plateau by the well defined northward-facing Eureka Springs escarpment. The general surface of the County is broken; about one-fourth of it being mountainous and the remainder hilly.

Below the chert and cherty limestone of the Boone formation in the eastern and north central parts of Stone County, lies the St. Joe member, a well marked bed of gray to pink crystalline limestone, easily recognized by its freedom from chert, its color, its texture and its general contrast with the underlying and overlying beds. The St. Joe ranges in thickness from a feather edge to about 100 feet, and is exposed in practically continuous outcrop, of dendritic pattern, near Mountain View in Stone County, to the Arkansas-Missouri boundary near Seligman, Missouri.

The St. Joe limestone generally stands out on the lower part of the Eureka Springs escarpment as a low bluff, which was formed by the undermining of the Chattanooga shale and the rapid weathering of the lower part of the St. Joe itself. The upper linnit of the St. Joe is commonly marked by the cherty overlying beds of the Boone formation, but not by an abrupt change in the texture or color of the limestone, which weathers like a shale. Its lower part is another gray, crystalline limestone containing some lenses of brown chert.

The St. Joe limestone is described as a marble, and it will take a good polish. It is available for quarrying at many places, but the beds are too thin to permit its extensive use as an ornamental stone.

The Arkansas stone in the Washington Monument was taken from a ledge of St. Joe limestone, about 4 feet thick.

The Boone formation is generally very fossiliferous and may be considered a potential source of hydrocarbons. At a few places the limestone, when freshly broken, gives off the distinctive odor of crude oil; but this does not necessarily indicate that it will yield oil upon drilling. Neither can the Boone be regarded favorably as a potential reservoir of

oil or gas, for its beds are ordinarily too broken to retain either, and are generally overlain by pervious beds. The formation, however, has yielded some gas in several wells, and probably it is worth further testing. The Boone is also of value to the petroleum geologist as a horizon marker. The porcellanous chert cuttings are so distinctive that they are at once recognized by the driller and the geologist alike; and this horizon can usually be ascertained in all wells, no matter how incomplete or contradictory the rest of the record may be.

Many clearly defined minor structural features may be seen near the surface of the Boone in the area of its outcrop, but most of these were formed by the slumping of chert beds due to the removal of the unequally distributed calcareous material inter-bedded with them. All such features in the Boone should therefore be carefully examined before they are set down as a reflection of deeper folding. Wells started on the Boone formation in Arkansas do not have a good chance of reaching commercial supplies of oil and gas.

The Sylamore sandstone, Mississippian series, so named from Sylamore Creek in Stone County, where it is clearly exposed, is here considered a formation, although in recent reports on the geology of northern Arkansas it is regarded as the basal member of the Chattanooga shale, which occurs in Stone County. The Sylamore sandstone is generally two to five feet thick, but its thickness changes greatly within short distances.

The Sylamore sandstone generally consists of one or more massive beds, but at some places it is thin-bedded. It is typically very porous, and it is so friable that a fragment of it struck by a hammer falls into loose sand. At some places, however, it is more tightly cemented, and at others it is somewhat bituminous. Its color is dominantly light, though in places it is darkly mottled. In its general appearance it is not unlike the St. Peter sandstone, and where it is thick and rests on Ordovician limestone it has been mistaken for that formation.

The typical Sylamore, however, is darker than either the Kings River or the St. Peter sandstone; it weathers to more rounded surface forms, and is neither so cross-bedded nor so finely laminated as those sandstones.

The Cason shale, which in places is 20 feet thick, is exposed in Stone County in the north central part. The shale received its name from its exposure at the Cason manganese mine north of Batesville. The shale consists of calcareous shale and small amounts of sandstone, argillaceous limestone, and phosphate rock. Phosphate is widely disseminated through

the formation, but at only a few places is it found in commercial quantities. The basal conglomerate is made up of ferruginous phosphate material, manganese oxides, some rounded quartz grains, and a few phosphatic fossiliferous pebbles.

The Cason shale rests disconformably upon the Fernvale at most places. The formation is overlain disconformably in some places by the St. Clair limestone, but generally Silurian and Devonian rocks are missing; and the St. Joe limestone rests, probably with slightly angular unconformity, upon Cason shale.

The Cason shale is of no consequence in the search for oil and gas in Arkansas, except that it may complicate the record of wells drilled east of Harrison, in the Boston Mountains.

The Plattin limestone, which ranges in thickness from a feather edge to 250 feet, is well exposed in Stone County. This limestone is an even-bedded limestone, which occurs in both thin and thick layers. Its dominant color is blue-gray, and its texture is homogeneous; so that it commonly breaks with a conchoidal fracture. Lithographic stone has been found in the Plattin formation, but no stome of commercial value has been discovered. The limestone is suitable both for building stone and for making lime.

The surface of the Plattin limestone, in marked contrast to the surfaces of the Joachim and Kimmswick formations, is ordinarily nearly free from lichens and other plants, a fact due, in part, to the denseness of the rock.

This smoothness, although it is not an infallible guide, may be conveniently used to identify it. At some places the formation is rather cherty, but in general it is notably free from chert. At some places also the limestone may be so coarsely crystalline that it greatly resembles the Kimmswick limestone, but this phase of the formation is not widespread.

The Plattin limestone is at some places disconformably overlain by the Kimmswick limestone, and at others by either the Fernvale limestone, the Sylamore limestone, or the St. Joe limestone. The Plattin rests disconformably upon the Joachim limestone. The Plattin limestone is only an unimportant source of oil and gas and can not be regarded as a potential reservoir for them.

The Kimmswick limestone, which in places reaches a thickness of 50 feet, is exposed in Stone County. This formation is the same as the lower part of the "Polk Bayou" limestone,

formerly included in the "St. Clair Marble." The Kimmswick limestone rests disconformably upon the Plattin limestone and is disconformably overlain by the Fernvale limestone. The contacts of these formations with one another, however, as seen in the field, are strikingly even. This formation may be regarded as a potential source of oil or gas, but one of no great value in northern Arkansas.

The Fernvale limestone is a widespread formation which, in Arkansas, is well exposed in Stone County. The limestone is generally a coarsely crystalline, massive somewhat cross-bedded, medium to pinkish gray, fossiliferous limestone, which makes a good building stone.

The Fernvale limestone is a potential source of hydrocarbons, but it is of no importance in that respect in Arkansas.

The lowest elevation in the County, 300 feet (estimated) is at Sylamore. Highest elevation, 1557 feet (estimated) is at Fox. A few of the representative towns with their respective elevations are as follows:-

Alco	1,125 feet	Mountain View	767 feet
Arlberg	693 feet	Rushing	1,080 feet
Fifty Six	750 feet	Timbo	820 feet

The County is drained by White River and its tributaries. Statistical records do not disclose any overflows in this County.

It might be said that Stone County is on the outskirts of the mineral belt of the State. It has deposits of iron, manganese, zinc and marble; and while these deposits are not as large as those found in some of the other counties in this part of the State, they are of sufficient quantity to be profitably produced.

In the past few years there has been no commercial production of these minerals, owing to the low prices and lack of railroad and highway transportation. While there are two railroads in the County, they cover only the extreme northeastern, eastern and the extreme southwestern portions; so this service is inadequate for the transportation of minerals out of the County.

Recently, however, probably due to the war in China and Spain, and to the armament race in Europe, the price of zinc is about twice what it was a year ago. Only last week (March 20th. 1937) zinc was up around the $50.00 mark per ton. At this price, zinc could be profitably mined in the County with the present transportation facilities.

It has been reported that over one hundred men have started in the zinc mining industry in the past few weeks, and that conditions in the field to-day are much the same as they were a few months before the World War broke out.

Iron ore is of common occurrence throughout many parts of Arkansas, but in only a few places is it found in important quantities. The value of an iron ore deposit depends as much on its geographic position, its relation to transportation and markets, and the facilities for mining, as it does on the quality of the ore. Moreover, if furnaces are to be erected for the manufacture of pig-iron, the distance of fuel and of limestone for fluxing purposes are most important points to consider. In determining the value of an iron deposit, therefore, four main subjects must be taken into consideration:

(1) The quality and quantity of the ore.
(2) The facilities for mining the ore.
(3) The relations of the deposits to transportation and to markets.
(4) The relations of the deposits to fuel and limestone.

The nearest means of transportation for the ore of northern Arkansas (Stone County) is the Missouri Pacific Railroad, which is from eight to twenty miles distant from the more important deposits. The White River flows through the northeastern part of the State (Stone County), and in some localities freight might be shipped down it to the Mississippi. The transportation facilities, however, can not at present be considered as good, since, unless a branch road were built, a haul by wagon or truck of from eight to twenty miles would be necessary to reach either the railroad or the river.

This County also has deposits of chalk and phosphate rocks. Traces of gold have been found in the County.

Stone County is also known for its mineral waters, there being large springs near Mill Creek.

The transportation of Stone County consists of The Missouri Pacific Railroad, which forms the northeastern and eastern boundary; the Missouri & Arkansas Railroad, which runs through the extreme southwestern part of the County, and State Highways No's 5, 9, 14 and 66. There are no Federal Highways in this County.

White River flows along the northeastern and eastern parts of the County. It is navigable only to small boats

and barges.

U.S.G.S. quadrangle maps Mountain Home, Mountain View and Batesville completely cover the County. Highway and State topographic maps are also available.

UNION COUNTY

Union County, situated in the southern tier of Counties of the State, is bounded on the north by Ouachita County. The Ouachita River, forming the eastern and northeastern boundaries, separates Union County from Ashley, Bradley and Calhoun Counties. It is bounded on the west by Columbia County and on the south by the State of Louisiana. The County has a land area of 670,720 acres.

This County lies wholly within the Gulf Coastal Plain. The principal oil producing fields of the Coastal Plain of Arkansas are within, or in part within, this area. The leading types of soil, as a rule, are sandy loam with a red clay subsoil; some clay mixed with sand predominating, and some rich loam bottom soil.

The Cockfield formation, uppermost member of the Claiborne group of Tertiary age, forms the surface rocks over Union County except over the flood plain of Ouachita River and Smackover Creek, where these strata are mantled with sands, gravels and loams of Pleistocene and Recent age. Deep wells have penetrated all of the Tertiary and the Upper Cretaceous strata, and a considerable part of the Comanche strata. A well drilled by one Company penetrated the Comanche strata and was abandoned in rock salt.

Alluvial deposits of Pleistocene and Recent age underlie the flood plains of Ouachita River and Smackover Creek to estimated depths of 75 feet.

The Tertiary strata increase in thickness to the northeast. The Midway formation is from 400 to 500 feet thick. The Wilcox formation is about 550 feet thick in the western part and 600 to 675 feet thick in the eastern and northeastern parts of the County. The Claiborne sediments range in thickness from 850 feet in the northwestern to 1,200 feet in the northeastern part of Union County.

The Cockfield formation of the Claiborne group is estimated to be 225 feet thick in the northeastern part of the County. The Cook Mountain is estimated to range in thickness from 150 to 200 feet. The Sparta sand is estimated to be about 375 feet thick in the western part and about 275 feet thick in the northeastern part of the County. The Mount Selman is estimated to be about 350 feet thick in the western and about 400 feet thick in the eastern part of Union County.

The Gulf series increase in thickness from east to west. They are less than 600 feet thick in the southeastern corner; 1,000 feet thick along the Ouachita River in the northern part, and 1350 to 1400 feet thick in the southwestern corner

of the County. There are corresponding variations in the distribution and the character of the formational units included in the Gulf series.

The Tokio-Woodbine section is made up of an upper, non-red member which ranges in thickness from 100 to 400 feet, with the greater thickness in the western part; and a lower member consisting chiefly of red clays inter-bedded with sand. The lower member varies in thickness from about 50 feet in the northwestern part and 375 feet in the central part of Union County.

The Brownstown marl is 100 to 110 feet thick in the western part, thins eastward, and is overlapped by the Ozan formation in the eastern part of the County. The Ozan formation is about 125 feet thick in the eastern part where it consists of marls with the Buckrange sand at the base. It decreases in thickness and becomes increasingly sandy to the east.

The Marlbrook marl, which probably includes beds of Annona age, ranges in thickness from 80 feet in the southeastern part to 200 feet in the western part of the County.

The Nacatoch formation and the Saratoga chalk are not readily differentiated in the central and eastern parts of the area; their combined thickness ranges from 230 to 275 feet.

The Arkadelphia marl thins to the southeast and is not recognized as a formational unit in the southeastern corner of the County.

The base of the Gulf series rests unconformably on the truncated edges of Comanche strata ranging in age from Upper Glen Rose in the southwestern part to early Travis Peak in the eastern part of the County.

Most of Union County, except the eastern and southeastern parts, is believed to be underlain by a series of marine beds which have been provisionally assigned to the Neocomian. These rocks are believed to rest directly on pre-Cretaceous rocks and at the top are in contact with the Travis Peak formation of Trinity age. The Travis Peak formation consists of red clays and sands which, in the western part, are 2,000 feet or more thick and probably are not more than 500 feet thick in the southeastern part of the County.

The lower Glen Rose formation is about 1,000 feet thick in the western part and is absent in the eastern part of the County. These strata change laterally to the east and northeast as evidenced in the thinning of the limestone members,

in the appearance of sands and red clays inter-bedded with Calcareous shale and impure limestones.

The Upper Glen Rose and the anhydrite zone of the Glen Rose formation are present only in the southwestern part of Union County where they have a maximum aggregate thickness of 500 to 600 feet.

The basement rocks, not definitely known to have had the rock salt penetrated in the Smackover field, are older than Mesozoic and may be of Permian age.

The lowest elevation in the County, 59 feet, is at P. R. P. Lake, Wilmington. Highest elevation, 350 feet (estimated) is at Trull. A few of the representative towns with their respective elevations are as follows:-

Blanchard Springs	174 feet	Bolding Station	110 feet
El Dorado	230 feet	Huttig	92 feet
Norphlet	169 feet	Smackover	121 feet

A well marked ridge forms the drainage between the north flowing streams emptying into Smackover Creek, and the south and southeast flowing streams emptying into the Ouachita River. The Ouachita River forms the eastern and northeastern boundaries of the County, and has for its tributaries Smackover Creek, Caney Bayou and Bayou Lapile. Other streams and bayous are Little Cornie Bayou, Bayou De Loofre, Holmes Creek and Three Creek, all of which contribute to the drainage of the County. According to maps showing Emergency Control, part of Union County was flooded in 1935 by overflow of the Ouachita River.

There are no stream gaging stations in the County, but Station No. 41 is recommended for installation at Banks on Moro Creek.

Union County is the largest oil and gas producing County in the State. There are a number of other minerals produced in the County, among which are sand and gravel, lignite, brick and pottery clays. The oil and gas production in the County outshadows all other minerals; and at this time there are three large oil and gas fields in the County, known as (1) El Dorado field, (2) Smackover field and (3) the Lisbon field.

The transportation of Union County consists of two main line railroads, two Federal Highways and four State Highways.

The Missouri Pacific traverses the County from the north

central to the southeastern part, passing through Elliott, Kirkland, Louann, Griffin, Smackover, Norphlet, El Dorado, Lawson, Strong, Golding Spur and Huttig.

The Chicago, Rock Island & Pacific enters the County from the northeast and runs to El Dorado, passing through Calion and Quinn.

Federal Highway No. 82 extends through the County from the west to the southeast, and Federal Highway No. 167 traverses the County from north to south.

State Highways No's. 7, 15, 57 and 129 give excellent overland service in practically all parts of the County.

Union County is covered in the eastern and southern parts by U.S.G.S. quadrangle maps Moro Bay, Dilolo, Felsenthal and El Dorado. The north central, western and a portion of the southeastern parts have not been mapped in detail. Highway and State topographic maps are available.

VAN BUREN COUNTY

Van Buren County, situated in the north central part of the State, is bounded on the north by Searcy County; on the east by Cleburne County; on the south by Conway and Faulkner Counties, and on the west by Pope County. It has a land area of 467,200 acres.

This County lies within two topographic areas. The Boston Mountains occupy the northern half, while the southern portion lies in the Arkansas valley. The soil in this County varies: The light fine sand, the dark sand, red gravel, stiff mulatto and black limestone. The subsoil runs from a deep red to a light yellow.

In the extreme northwestern corner of the County is located the Bloyd shale. Kessler limestone lentil, Baldwin coal, Brentwood limestone lentil and Hale formation, of the Pennsylvanian age, Morrow Group. Also Pitkin limestone, Fayetteville formation, Wedington sandstone member, Basal limestone, Mayes formation, Batesville sandstone, Hindsville limestone member, and Moorefield shale, of the Mississippian period, Chester Series.

The Bloyd shale consists of shale and two lentils of limestone. The Brentwood, or lower limestone, is generally separated from the Hale formation by 5 to 20 feet of black fissile clay shale; but at some places the shale is either covered or absent. This lower shale is thickest in the southern part of its outcrop.

The Kessler is separated from the Brentwood by beds about 20 feet thick, consisting mostly of black, carbonaceous shale, but including some lower sandy beds. Between the Brentwood and the Kessler limestone is a shale containing at some places a thin seam of coal, called the Baldwin coal. This coal seam is in this part of the formation and ordinarily lies nearer to the Kessler than to the Brentwood lentil. At an abandoned mine the Kessler is less than 5 feet above the top of the coal.

The Kessler limestone member is less widely distributed than the Brentwood, and it is at all places thinner. The beds generally lie within 60 feet of the top of the Bloyd, but the overlying shale is irregular in thickness. The Kessler lentil is a compact, gray to brown, fossiliferous limestone, which is conglomerate at some of its exposures. Its ordinary thickness is less than 10 feet, and its outcrops are inconspicuous. This limestone resembles the Brentwood but is of darker color and, unlike the Brentwood, it weathers into thin, shaly plates.

The Hale formation consists mainly of sandstone and shale, but includes some beds of limestone and conglomerate, all of which are extremely valuable in lithology, distribution and thickness.

In places where the Hale rests on the eroded edges of the Pitkin limestone, or where the Pitkin has been removed, there is at the base of the Hale a conglomeratic layer made up of well rounded small limestone pebbles cemented in a ferruginous limestone matrix. These pebbles were obviously derived from the Pitkin formation, and the matrix of the conglomerate contains also water-worn pitkin fossils.

At the base of the formation, but above the conglomerate, there is ordinarily a black clay shale containing thin beds of ripple-marked sandstone. Above this part of the formation the beds are made up of sandstone, shale and limestone. The shale is generally intercolated between two beds of sandstone. The upper bed is more massive and more calcareous than the lower and is generally thicker.

The Pitkin formation consists of massive layers of compact, bluish-gray limestone, which is at many places ferruginous and porous. Where the rock is rather sandy indistinct cross-bedding is apparent on its weathered surfaces. The Pitkin does not weather to rounded surfaces like those presented by pure limestone, but breaks down into angular blocks and thin plates having sharp edges. Owing to the weathering of the non-resistant subjacent Fayetteville shale, the Pitkin stands out at many places as a steep cliff, whose height is ordinarily the thickness of the formation. Both the Fauna and the Stratigraphic position of the Pitkin indicate that it is of late Chester age.

The Fayetteville formation is generally a black, fissile carbonaceous shale having near its top a prominent sandstone known as the Wedington sandstone.

The Fayetteville is the surface rock over moderately large areas, but it is most commonly exposed on rather steep slopes. Most of the areas of its exposure are forested; for, after land, where it is the surface rock, has been cleared, the soil formed by its disintegration has been found to be not very fertile. The shale itself is generally concealed by surface material or soil, and its exposures are limited to steep hillsides and the valleys of actively eroding streams.

The Wedington sandstone member is a dense, hard, gray to brown sandstone, commonly fine-grained and at many places calcareous. It is ordinarily thin to medium bedded, and its upper layers are generally flaggy; but at some places it is

relatively massive. The sandstone ordinarily forms a narrow bench above a low, steep escarpment; and, where it has been undermined by the erosion of the shale, great blocks of it accumulate in the stream valleys.

Where the rock is not calcareous it is very hard, and the blocks commonly have sharp edges. In some areas the sandstone is coextensive with the upper shale; but at a few places it is of larger areal extent and is directly overlain by the Pitkin limestone. At such places it forms the base of the escarpment made by that formation.

The Basal limestone of the Fayetteville formation carries an abundant and diverse fauna.

The Batesville sandstone is a light yellow or buff rock, which, at many places, grades into a brown rock. It is generally medium-grained, but at some places it is coarse-grained and at others it is fine-grained.

The Batesville sandstone has been extensively quarried. At many places in fresh exposures it is so calcareous that it is regarded as a compact limestone. However, in the same quarry, the rock may vary from porous sandstone to compact limestone, which may be only slightly arenaceous.

The Hindsville limestone, first recognized as distinct from the Boone chert, is coextensive with the Batesville sandstone. At some places, however, the Hindsville is the only part of the Batesville that is seen; but at still other places it is overlapped by the sandstone of the Batesville.

The Hindsville consists mainly of limestone, with which is inter-bedded at some places thin beds of sandstone. The limestone is cross-bedded at a number of its exposures, as is shown by the configuration of the sandy streaks left after the solution of the calcium carbonate. The rock contains hydrocarbons and gives off a strong odor of petroleum when freshly fractured.

The Atoka formation, Pennsylvanian age, the youngest that crops out in the Boston Mountains, consists of a rather unvarying series of alternating beds of sandstone and shale, and, although some of the beds are, or have been, somewhat calcareous, no limestone has been found among them in the Boston Mountains.

The Atoka formation has a larger areal extent than any other Paleozoic formation exposed in Arkansas. It is the surface rock at the crest of the Boston Mountains. It occurs on the tops of outlying ranges north of those Mountains, and

it is the only formation that crops out over large areas on their southern slopes; though older formations are exposed at a few places in the deeper ravines.

The Atoka formation consists of alternating beds of sandstone and shale and a few beds of calcareous sandstone of small areal extent. The sandstone beds range in thickness from less than one foot to more than 125 feet. Near or at the base of the formation there are one or two thick beds of conglomeratic sandstone that contain small water-worn quartz pebbles.

The sandstone of the Atoka exposed in the Boston Mountains are very valuable in character; but most of them are medium-grained and are light to dark brown in color. Most of the thin beds are ripple-marked and many of the thick beds show cross-bedding.

The Atoka formation is essentially non-fossiliferous; but a few poorly preserved fossils have been found in its more calcareous parts and in the basal beds of sandstone.

The Atoka is of Pottsville age. The formation yields natural gas in the Arkansas valley, but has not yielded either oil or gas in commercial quantities in the Boston Mountains. In large areas in the northern part of those Mountains the cover over the possible producing beds is very thin; but near the Arkansas valley the cover is sufficiently thick and impervious to hold oil and gas in the underlying beds.

The shales of the Atoka are potential sources of oil and gas and its thicker beds of sandstone are suitable reservoirs for both.

The lowest elevation in the County, 424 feet, is at Englantine Post Office. Highest elevation, 1,900 feet (estimated) is on Fork Mountain. A few of the representative towns with their respective elevations are as follows:-

Clinton	507	Shirley	542 feet
Dennard	1,362 feet	Morgantown	800 feet
Dabney	1,488 feet (Est)		

The drainage of Van Buren County consists of numerous creeks. Middle Fork, the largest stream in the County, flows through the extreme northeastern part. Other streams in the County are South Fork, Archey Fork and Point Remove Creek, all of which furnish adequate drainage for the County. Statistics available do not disclose any overflows in Van Buren County. There are no stream gaging stations in this County.

Van Buren County has a number of valuable mineral deposits, but with little commercial production in recent years due largely to lack of transportation facilities. The Missouri & Arkansas Railroad, which crosses the extreme northeastern and north central portions, is the only rail transportation in the County. Federal Highway No. 65, which is an all paved route, crosses the County from north to south.

This County, as well as several others in the mineral belt of northern Arkansas, needs a mineral survey so that each and every mineral in the County may be determined as well as the extent of the deposit. This information would not only increase the valuation of the land in the County, but it would also serve as an inducement to some mining company that would be glad to locate in the County if the mineral they desired could be had in paying quantities.

Some prospecting and development work has been done at six or seven different places. These prospectors have found coal deposits, or veins, running from an inch to ten inches in thickness. In several places traces of silver, copper, lead, zinc and nickel have been found. Some low grade gold ore has also been found, running about $3.00 per ton.

The only mineral deposit that has been operated commercially in the County in recent years has been limestone. Limestone is used in various ways; such as the manufacture of brick, tile, glass and cement. It yields chemicals employed in purifying water, dissolving fibers, and bleaching cotton cloth. It also enters into the manufacture of glue, soap, spraying materials, paint, explosives, rubber and paper.

There was an attempt made in 1930, 1933 and 1934 to produce commercially from the limestone deposits in Van Buren County. The total production for the three years was about 80,000 short tons; but this did not prove profitable, and our records do not disclose any limestone production for this County since that time.

The nearest means of rail transportation to the more important deposits of limestone is from eight to twenty miles distant. Federal Highway No. 65 crosses the central part of the County, and in some localities freight might be shipped over this highway to a market or a railroad shipping point. The transportation facilities, however, can not at present be considered as good, since, unless a branch road were built, a haul by wagon or truck of from eight to twenty miles would be necessary to reach either the railroad or the Federal Highway.

The Missouri & Arkansas Railroad passes through the

County in the extreme northeastern part. Federal Highway No. 65 extends through the central part of the County from north to south. State Highways No's 9, 16, 27, 95 and 110 give excellent overland service in practically all directions.

U.S.G.S. quadrangle maps Marshall and Mountain View cover the County except the southeast corner, which has not been mapped in detail.

Highway and State topographic maps are available.

WASHINGTON COUNTY

Washington County is situated in the northwestern part of the State, bordering the Oklahoma line on the west, and is the second County south of the Missouri Line. It is bounded on the north by Benton County; on the east by Madison County, and on the south by Crawford County. It has a land area of 611,200 acres.

This County lies in the Paleozoic region. The northern part is in the Springfield Plateau, while the southern portion lies in the Boston Mountain area. In many areas of Washington County the land is only gently undulating. Such areas, which are locally called prairies, are near Prairie Grove, Farmington and West Fork.

Located in Washington County is the Bloyd shale, Brentwood and Kessler limestone, and the Hale formation, Pennsylvanian period. Pitkin limestone, Fayetteville formation; Batesville sandstone, Boone formation (St. Joe limestone member) Mississippian period.

The Bloyd shale is named from Bloyd Mountain, Washington County, where it is well exposed, and where it consists of dark, carbonaceous shales, with which are interstratified two members, or lentils, of limestone. The upper limestone is called Kessler, and the lower, Brentwood limestone.

Between the Brentwood and the Kessler limestone is a shale containing, at some places in Washington County, a thin seam of coal, here called the "Baldwin" coal, formerly called the "coal-bearing" shale.

The Brentwood, or lower limestone, is generally separated from the Hale formation by 5 to 20 feet of black fissile clay shale; but at some places the shale is either covered or absent. This lower shale is thickest in the southern part of its outcrop.

The Kessler is separated from the Brentwood by beds about 20 feet thick, consisting mostly of black carbonaceous shale, but including some lower sandy beds. The coal seam is in this part of the formation and ordinarily lies nearer to the Kessler than to the Brentwood lentil. At an abandoned mine the Kessler is less than 5 feet above the top of the coal. The shale overlying the Kessler is variable in thickness.

The Hale formation was named from Hale Mountain, in the western part of the Winslow quadrangle, where it is exposed in typical form. The formation consists mainly of sandstone and shale, but includes some beds of limestone and conglomerate, all of which are extremely variable in lithology, distribution and thickness.

In places where the Hale rests on the eroded edges of the Pitkin limestone, or where the Pitkin has been removed, there is at the base of the Hale a conglomeratic layer made up of well rounded, small limestone pebbles cemented in a ferruginous limestone matrix.

The Pitkin limestone is the upper formation of the Mississippian system in northern Arkansas. Its name was taken from the Post Office of Pitkin, Washington County, where the formation is well exposed.

In its typical phase the Pitkin formation consists of massive layers of compact, bluish-gray limestone, which is at many places ferruginous and porous. Where the rock is rather sandy, indistinct cross-bedding is apparent on its weathered surfaces. The Pitkin does not weather to rounded surfaces like those presented by pure limestone, but breaks down into angular blocks and thin plates having sharp edges.

Fossils are common in the Pitkin limestone. The Pitkin probably rests upon the Fayetteville shale, conformably at some places and disconformably at others.

Solid hydrocarbons have been found in the Pitkin limestone, especially in the shells of fossil brachiopods, and concretionary masses in the formation contain oil of fairly high gravity, especially near Fayetteville. These facts, however, do not show that oil in commercial quantities may be obtained from the formation.

The Fayetteville formation of Arkansas, named from Fayetteville in whose environs it is extensively exposed. This formation consists chiefly of black shale, but it includes, near its top, a member known as the Wedington sandstone. This member has been mapped throughout a relatively large area in the central and western parts of the outcrop of the Fayetteville.

The Batesville sandstone is a light yellow or buff rock, which at many places grades into a brown rock. It is generally medium-grained, but at some places it is coarse-grained and at others it is fine-grained. The Batesville has been extensively quarried, particularly near Batesville. At several places the formation contains thin beds of siliceous colitic limestone, but these beds form only a small part of it.

The Batesville, although it is in places calcareous and contains fissils, is not a probable source of hydrocarbons. The sandstone however, is very porous and may serve as an excellent reservoir for either oil or gas. These products might migrate to the sand either from the underlying

Moorefield or Hindsville, or from the overlying Fayetteville shale. Many wells have been drilled into the Batesville, but most of them have yielded only water.

The Boone formation consists of chert and limestone, which vary in amounts both horizontally and vertically, a feature that makes the sub-division of the beds very difficult. Over large areas, however, the basal member of the formation, the St. Joe limestone, which is free from chert, is well exposed, and at most places the middle part of the formation also carries less chert than the higher and lower beds. The Boone formation is of large areal extent, being widely exposed in Washington County.

The Atoka formation consists of a rather unvarying series of alternating beds of sandstone and shale; and, although some of the beds are, or have been somewhat calcareous, no limestone has been found in the Boston Mountains (Washington County.)

The sandstones of the Atoka are widely exposed in Washington County, and are very variable in character; but most of them are medium-grained and are light to dark brown in color. Most of the thin beds are ripple-marked, and many of the thick beds show cross-bedding.

The Atoka formation is essentially non-fossiliferous, but a few poorly preserved fossils have been found in its more calcareous parts and in the basal beds of sandstone. The formation has yielded neither oil or gas in commercial quantities in Washington County.

The lowest elevation in the County, 987 feet (estimated) is at Morrow. Highest elevation, 2250 feet (estimated) is at Sunset. A few of the representative towns with their respective elevations are as follows:-

Barbara	1,236 feet	Springdale	1,325 feet
Fayetteville	1,426 feet	Winslow	1,729 feet
Gulley	1,176 feet	West Fork	1,339 feet

The drainage system of Washington County consists of the White and Illinois Rivers and their tributaries. White River flows through the northeastern and east central parts of the County, and has for its tributaries, West Fork and Middle Fork. The Illinois River flows through the northwestern part, its tributaries being Osage Creek and Clear Creek. Available records do not disclose any area in Washington County subject to overflow. There are no stream gaging stations in this County; one is needed however, on West Fork, a tributary of White River, near Fayetteville.

Washington County has a number of mineral deposits. The most profitable produced at this time, are limestone (used for both building and hydrating purposes) and coal.

The greater part of the County is underlain with Paleezoic limestones. There are limestones in the Tertiary and Cretaceous areas of the central and southwestern portions of Arkansas, yet the Paleozoic limestones of the northern part of the State (which includes Washington County) are so superior for lime burning that it is to them the State must look for its lime supply. The chalk beds will no doubt become valuable in the manufacture of Portland cement, but for common lime it cannot compete with the Paleozoic limestones.

The limestones produced in this County are taken from a quarry located near Johnson, Arkansas, on the St. Louis & San Francisco Railroad. These limestones, in addition to being used for building purposes, are utilized in the manufacture of burnt lime and hydrate.

Chemically, lime is calcium oxide; but commercially the term is applied to the product of complete calcination of a "limestone" which may vary from a calcium carbonate to a dolomite or calcium, magnesium carbonate. Thus, commercial lime may contain as high as 45 per cent magnesium oxide, as well as such impurities as silica, iron oxide and alumnia.

The coal beds, or deposits, of Washington County are found in three different parts of the County: (1) about five and one-half miles southeast of Springdale; (2) at Cane Hill in the southwestern part, and (3) in the vicinity of Baldwin in the eastern part.

The Washington County coal was formed during the early Pennsylvanian period of the carboniferous era from vegetable matter which grew in the dense swamps of that time. This vegetable matter fell into water and was preserved from decay and eventually changed to "peat". This was covered by some impervious material, probably mud or clay; and the land slowly submerged until the original bed was deeply buried. While covered this way, the "peat" probably changed to lignite and eventually into harder coal, while the sands and clays which covered it slowly changed into sandstones and shales.

The coal beds, or seams, in Washington County run from five inches to eighteen inches in thickness, and at the present time there are three mines in operation.

The main line of the St. Louis & San Francisco Railroad traverses the central part of Washington County from north

to south, passing through Springdale, Johnson, Fayetteville, Vale, Greenwood, West Fork, Woolsey, Brentwood, and Winslow. A branch of the Frisco runs from Fayetteville through the western part of the County, passing through Farmington, Prairie Grove, Lincoln, and Summers.

The overland routes are Federal Highway No. 71, which crosses the County near the central part from north to south, and State Highways No's. 16, 45, 59, 62, 68 and 112; thus giving Washington County excellent rail and highway transportation.

U.S.G.S. quadrangle maps Winslow, Watalula, Talequah, Siloam Springs, Fayetteville and Eureka Springs cover the County except the extreme eastern part.

Highway and State topographic maps are also available.

WHITE COUNTY

White County, situated in the north central part of the State, is bounded on the north by Cleburne and Independence Counties; on the east by Woodruff County; on the south by Prairie and Lonoke Counties, and on the west by Faulkner and Pulaski Counties. It has a land area of 663,680 acres.

The northwestern and the extreme southwestern parts of the County lie in two provinces of the Paleozoic region in Arkansas: The northwestern part in the Arkansas valley region, and the southwestern portion in the Fourche Mountain area. The remainder of the County, the eastern and southeastern parts, lie wholly within the Gulf Coastal Plain. About one-half of the area of White County is upland and about one-half bottom land. The soil ranges from a light sandy loam, with a clay subsoil in the uplands, to heavy loam in the bottoms.

The Ozark Province is underlain by Paleozoic sandstones and shales of Pennsylvanian age. The Paleozoic rocks pass beneath the Coastal Plain sediments and extend eastward with increasing depths, estimated to be about 1,250 feet below sea level in the southeastern corner of White County. The Quaternary alluvium, which immediately underlies the surface of the Coastal Plain area to estimated depths of 100 to 150 feet, is of Pleistocene and Recent age. These deposits rest unconformably upon Paleozoic and Eocene strata.

Upon Cretaceous strata of Arkadelphia and Nacatoch age, underlie most of the Coastal Plain area of White County. They are a few feet thick in the area bordering the Ozark Province, but increase in thickness to the southeast and are estimated to be 150 feet thick in the southeastern corner of the County. The strata dip to the southeast. The top of the Nacatoch formation is estimated to lie at depths of 1,100 feet below sea level in the southeastern corner of the County.

The lowest elevation in the County, 193 feet, is 3.5 miles north of Georgetown R. R. bridge. Highest elevation, 660 feet, is on summit of Mount Pisgah. A few of the representative towns with their respective elevations are as follows:-

Armstrong Springs	264 feet	Judsonia	220 feet
Bald Knob	222 feet	Searcy	239 feet
Beebe	245 feet		

The County is well drained by the White and Little Red Rivers and their tributaries. White River forms the eastern boundary of the County, its tributaries being Departee Creek, Cypress Bayou and Salado Creek. Little Red River flows through the County from northwest to southeast; its tributaries are

Indian Creek, Buff Creek, Big Creek and East Fork. The only overflows recorded are those in the lowlands of White River in extreme high water. There are no stream gaging stations in this County.

That part of White County west of a line running southeast-southeast, a few miles west of the Missouri Pacific Railroad and the Southern Railway, is in the Ozark Province. The remainder of the County lies in the Gulf Coastal Plain.

White County has a number of mineral deposits, among which are coal, clays, sandstone, sand, gravel, limestone and mineral water. About seven miles west of Beebe, on the farm of Mrs. George Boardman, there is a coal bed, or seam, of from three inches to a foot thick. This deposit is mined in a small way.

At Beebe, Searcy and Judsonia, clay is mined for common brick. There is also a deposit of Argillaceous shales or clays that are suitable and can be used in the manufacture of sewer pipe and paving brick.

There are several stone quarries in the County, probably the most important being the ones north of Searcy and those near Bald Knob.

The Mississippi River Commission of the United States Government, operates one of the large sandstone quarries near Searcy on the Little Red River. Broken carbonaceous sandstone is shipped from this quarry to be used for revetment work along several rivers in Arkansas. Large quantities of sandstone from this quarry is also used by the Government in its work on the Mississippi River.

This County could be one of the largest producers of sand and gravel in this section of the State, as the bed and bars of White River can furnish very large quantities of these minerals. At the present time, however, the production is just large enough to take care of local consumption.

Tertiary limestone, belonging to the Midway formation, has been found at several points along the edge of the Coastal Plain embayment. At Bradford, this County, there is a bed of fossiliferous limestone about ten feet thick. This deposit has been quarried from time to time, but there is no production at the present time. However, this deposit may in the future prove to be a very valuable asset.

About seven miles northwest of Searcy is the famous Armstrong Mineral Springs, from which the town of Armstrong Springs is named. A Sanitorium is located there, and these mineral

waters are used in the treatment of diseases such as gout, rheumatism, nervous affections and muscular contraction.

For a number of years hundreds of people have visited this resort annually, either to recreate or recuperate. These springs are not as well known nationally as the famous hot springs in Garland County, but we do know that they have wonderful curative properties. The waters are clear, odorless and sparkling and have a slight chalybeate taste.

White County is served by three railroads; one Federal Highway and four State Highways. The Missouri Pacific traverses the County from the northeast to the southwest, passing through Bradford, Russell, Bald Knob, Judsonia, McRae, Beebe, Ward, Higginson and Garner. The Missouri & Arkansas Railroad runs through the west central part of the County to the southeast and passes through Mt. Pisgah, Armstrong Springs, West Point, Andrews, White, Enright and Georgetown. A branch of the Chicago, Rock Island & Pacific Railway runs from Searcy through the southeastern part of White County, connecting with the main line of the Rock Island at De Valls Bluff in Prairie County.

Federal Highway No. 67 parallels the Missouri Pacific Railroad from the northeast to the southwest part of the County, and State Highways No's 5, 11, 16, 31 and 36 cross and cris-cross the County in practically every direction; thus giving to White County most excellent transportation facilities.

The eastern part of White County is covered by M.R.C. quadrangle maps Kensett and Bald Knob; the northern portion by U.S.G.S. quadrangle map Batesville. The central, southern and western parts of the County have not been mapped in detail. Highway and State topographic maps are available.

WOODRUFF COUNTY

Woodruff County lies immediately on the east bank of White River, equal distance from Memphis and Little Rock. It is nearly 40 miles long from north to south and about 20 miles wide from east to west. It is bounded on the north by Jackson County; on the east by Cross and St. Francis Counties; on the south by Lee and Monroe Counties, and on the west by White and Prairie Counties. It has a land area of 369,280 acres.

This County lies wholly within the Gulf Coastal Plain. Generally, the County is a part of a system of low land farm country, which extends from Black River southward to the confluence of the White and Mississippi Rivers. The soil is a rich, dark sandy loam and is very fertile.

The three principal topographic subdivisions of the upper Mississippi embayment are: Crowley's Ridge, the Advance lowland, and Mississippi lowland, lying respectively west and east of Crowley's Ridge. Woodruff County lies entirely within the Advance lowland, the surface of which is in general a gently undulating plain 190 to 235 feet above sea level.

The materials at the surface throughout Woodruff County consist of loams, clays, sands, and gravels of Recent and Pleistocene age, which conformably overlie strata of Eocene age. The Eocene strata ranges in thickness from about 100 feet in the northwestern part to 1,950 feet in the southwestern part of the County. The Cretaceous strata increase in thickness from about 100 feet in the northwestern part to about 425 feet in the southwestern part of the County.

Quaternary alluvium of Pleistocene and Recent age underlie the surface to depths estimated at 50 to 150 feet. Although irregularly bedded, they grade downward in general from fine silty loams or clays at the surface through fine sands to course sands and gravels at the base.

The Tertiary, Eocene strata have an estimated thickness of about 150 feet in the northwestern part, and about 1,900 feet in the southeastern part of the County.

The available data do not permit accurate correlation of the strata, which includes the equivalents of the Midway, Wilcox and Claiborne formations. The Midway is estimated to range in thickness from about 50 feet in the northwestern part to about 550 feet in the southeastern part of the County. The Claiborne is not believed to be represented in the northwestern part of the area.

The Cretaceous strata, Gulf series, decrease in thickness

and change laterally in character from east to west as the margin of the Mississippi embayment is approached. The Cretaceous strata are estimated to be 100 feet thick in the northwestern corner of the County, represented by the Arkadelphia marl and Nacatoch sand, and about 500 feet in the southeastern corner of the County, where the Marlbrook marl is believed to be present, in addition to the above named formation.

The Arkadelphia marl consists of gray Calcareous shale, which, toward the west, becomes slightly sandy.

The Nacatoch is made up principally of sand and sandstone, in part glauconitic, with subordinate beds of shale and limestone. The Marlbrook, when present, is in part marl and chalk and in part sandy shale, with the sand content increasing from east to west.

The top of the Nacatoch sand is from a few feet to about 100 below sea level in the northwestern, and about 1,900 feet below sea level in the southeastern corner of the County. The dip is toward the southeast at the rate of 35 to 70 feet per mile.

The Coastal Plain sediments were deposited upon a nearly level floor of folded and truncated Paleozoic rocks. Subsequent warping has lowered the floor and tilted it toward the southeast, until it now lies at a depth of about 100 feet below sea level in the northeastern corner and about 2,400 feet below sea level in the southeastern corner of the County. The basement rocks are believed to be essentially the same as the Paleozoic rocks at the surface in the adjacent part of the Arkansas valley region.

The lowest elevation in the County, 178 feet, is 170 feet southwest of cotton gin, eight feet east of Woodruff-Prairie County line, near the town of Little Rixie. Highest elevation, 237 feet, is at Bemis Station. A few of the representative towns with their respective elevations are as follows:-

Augusta	218 feet	Cotton Plant	192 feet
McCrory	211 feet	Hunter	233 feet
Grays	195 feet		

The drainage system of Woodruff County consists of the White and Cache Rivers and their tributaries. White River forms the western boundary of the County, and Cache River, a tributary of White River, flows through the central part of the County. Overflows are recorded only during extreme high water.

There are no stream gaging stations in the County. The nearest station is No. 4 on White River at De Valls Bluff, Prairie County.

Woodruff County is located just out of the so-called mineral belt of the State of Arkansas. This County, however, has a number of minerals, among which are sand, gravel, brick and tile clays.

This County could be one of the largest producers of sand and gravel in this section of the State, as the bed and bars of White River can furnish very large quantities of these minerals. At the present time, however, the production is just large enough to take care of local consumption.

There are large deposits of surface clay in Woodruff County; these are used in the manufacture of common brick at Cotton Plant, Arkansas. At another plant at New Augusta "Buckshot" clay is used in the manufacture of drain tile and common brick.

The St. Louis Southwestern Railway traverses the County in the southeastern part, passing through Penrose, Bemus, Hilleman, and Hunter. The Missouri & Arkansas Railroad runs through the County from west to east and passes through McClelland, Dixie, Cow Mound, and Cotton Plant. A branch line of the Missouri Pacific out of Memphis runs through the extreme northern part of the County from east to west, passing through Augusta, New Augusta, Patterson and McCrory.

A branch line of the Chicago, Rock Island & Pacific, which formerly operated between Newport and Brinkley, has been discontinued.

Federal Highway No. 64 extends east from Bald Knob through the northern part of Woodruff County and on into Memphis. State Highways No's. 17, 33, 37, 38, 39 and 145 serve the County in practically every direction. White River is also a means of transportation for Woodruff County, and each year hundreds of tons of incoming and outgoing freight are shipped by way of this river.

M.R.C. quadrangle maps Gregory, Augusta, Tilton, Hunter, and De Valls Bluff completely cover the County. Highway and State topographic maps are also available.

YELL COUNTY

Lying just south of the Arkansas River, in the west central part of the State, is Yell County. It is bounded on the north by Logan County; on the east by Perry County; on the south by Montgomery and Garland Counties, and on the west by Scott and Logan Counties. It has a land area of 611,200 acres.

Yell County is divided nearly equally between the Arkansas valley area in the northern part, and the Fourche Mountain region in the southern portion, both being in the Paleozoic uplift. The highland soil is mostly a red loam, although in the creek and river bottoms it is a rich, black sandy loam.

The sandstone of the Savanna formation, Pennsylvanian age, is generally fine-grained and compact and is brown or grayish-brown in color. The formation is from 200 to 500 feet in thickness. The character of the rocks is massive, and some conglomerate beds, which carry chert and quartz pebbles of the size of peas, are exposed only at tops of isolated mountains in the Arkansas valley in Arkansas.

The Paris shale, Pennsylvanian age, is composed of clay shale, arenaceous shale, and minor amounts of sandstone; and it contains at least one workable coal bed. It is the upper division of the McAlester group. The formation is about 650 feet thick. The character of the rocks is mostly sandy shale and shaly sandstone, which do not form prominent features. There are several coal beds, of which the Paris is the thickest. The distribution is rather wide in the western part of the Arkansas valley in Arkansas.

The Fort Smith formation, about 400 feet in thickness, is ripple-marked, thin-bedded sandstone and sandy shale, ordinarily reddish. The formation contains thin coals, of which the Charleston is the thickest. The formation is rather widely distributed in the western part of the Arkansas valley in Arkansas, and crops out in Yell County; but its exposures are small and represent only the lower beds.

The shale is arenaceous at practically all its outcrops, and the soil it forms is sandy and yellow to red in color. This soil is so different from that formed by the disintegration of the enclosing formations, that it indicates, in a general way, the areal extent of the formation.

Coal is found at several horizons in the formation, but it is ordinarily of small extent, and it is too thin to be economically mined in Yell County.

The Fort Smith sandstone rests unconformably upon the

Spadra shale and is overlain without stratigraphic break by the Paris shale. The Fort Smith formation has yielded neither oil or gas in Arkansas; and, although some gas may be obtained from it in a few areas where the structure is favorable, neither will be obtained from it in commercial quantities in Arkansas.

The Spadra has at its base, the Hartshorne coal, and it comprises shales lying between the Hartshorne sandstone below, and the Fort Smith sandstone above. The Spadra shale is widely exposed over the Arkansas valley coal field, where it outcrops in Yell County, either from broad open valleys, or occurs as bands around synclinal basins. The formation ranges in thickness from 350 to 500 feet in its exposures in Yell County, where it has been measured in drill holes as well as at the surface.

The Spadra formation consists mainly of fine-grained, blue-black or gray clay shale, but in places it contains thick lenses of sandstone. The residual soil produced by the weathering of the Spadra shale is poor and thin and supports only a scant vegetation.

The Spadra shale has yielded neither oil nor gas from any of the many test borings that have penetrated it in prospecting for coal. Furthermore, there is no reason to suspect that it will produce either at any place in Arkansas.

The Hartshorne formation lies at the base of the production coal measures of Arkansas, and is the most widespread sandstone stratum in the Arkansas Valley Province. The formation outcrops in Yell County, and it ranges in thickness from 20 to 300 feet. The formation is essentially sandstone, but it is not markedly different from many of the heavier beds of sandstone of the Atoka or the Jackfork formation, except that it is more widespread and less variable in character.

Even where the formation is least typical, it may be identified by means of the Hartshorne coal, which is generally found immediately above the sandstone. The sandstone is generally brown or yellowish-brown, but at a few places it is nearly white, It is medium-grained and ordinarily well cemented; but locally it is sacharoidal and very porous.

The Hartshorne sandstone rests conformably upon the Atoka formation and is overlain without stratigraphic break by the Spadra shale. The Hartshorne formation has not yet yielded either oil or gas, and as it generally lies in small synclinal basins and occurs ordinarily at shallow depths, it is not likely to produce either in commercial quantities.

The sandstone would evidently serve as a suitable reservoir however, for it is a competent aquifer, a number of artesian wells producing water from it. It is a valuable horizon marker upon which structure may be mapped.

The Atoka formation, Pennsylvanian age, consists of alternating beds of sandstone and shale and a few beds of calcareous sandstone of small areal extent. The sandstone beds range in thickness from less than one foot to more than 125 feet. Near, or at the base of the formation, there are one or two thick beds of conglomerate sandstone that contain small waterworn quartz pebbles.

The formation ranges from 1,500 to over 9,400 feet thick. The rocks are sandstone of variable character and sandy micaceous, dark to black shale in varying proportions, but with the shale ordinarily predominant. The sandstones are commonly thin-bedded to medium-bedded, compact, and ripple-marked, although locally thin sporadic beds of coal are found.

The Atoka formation is essentially non-fossiliferous, but a few poorly preserved fossils have been found in its more calcareous parts and in the basal beds of sandstone.

The Jackfork formation, Mississippian age, is about 7,000 feet thick. The rocks are fine to coarse-grained, massive sandstone, usually light gray in color, with some millstone grit at the base. Green fossile clay shale is present at a number of horizons, but in minor amounts. There is a narrow belt of the formation in northwestern Yell County and north of Petit Jean Creek.

The Jackfork formation contains some beds that may be a potential source of hydrocarbons, and others that could serve as reservoirs for them, but the formation has not yielded either oil or gas.

In the Arkansas valley, where the structural conditions are favorable, it generally lies too deep to be encountered in an ordinary well; but at a few places the deeper test wells may reach it, and where the structural conditions are favorable, there appears to be no reason why it should not be productive.

The lowest elevation in the County, 300 feet (estimated) is at Fowler. Highest elevation, 2350 feet (estimated) is on Petit Jean Mountain. A few of the representative towns with their respective elevations are as follows:

Danville	387 feet	Coalgate	615 feet
Havana	375 feet	Onyx	940 feet
Centerville	350 feet	Belleville	368 feet

The drainage system of Yell County consists of the Arkansas, Petit Jean and Fourche La Fave Rivers and their tributaries, together with numerous creeks. The Arkansas River forms the northeastern boundary of the County. The Petit Jean and Fourche La Fave Rivers are tributaries of the Arkansas. Other streams contributing to the drainage of the County are Chickalah Creek, Shoal Creek, Dutch Creek, South Fork, Gifford Creek and Jones Creek.

The above water courses are ample drainage for the County. The only overflows recorded are those along the Arkansas River during extreme high water.

There are no stream gaging stations in this County. Two stations are needed however; one on the Arkansas River at Dardanelle and the other on Petit Jean Creek near Danville.

Yell County has a number of known mineral deposits, among which are coal, clays, sand, gravel and sandstone. There are also small deposits of zinc, lead and iron. This County seems to be on the outskirts of the large commercial coal deposits of Arkansas. There are, however, three coal deposits in the County, one at Dardanelle, one at Danville, and the other at Chickalah, all of which are being mined in a small way for local consumption.

There is a deposit of surface clay mined in the vicinity of Dardanelle and used in the manufacture of common brick. In the southeast quarter of Section 12, T 6 N., R. 21 W., there is a deposit of carboniferous shale that was formerly used. Rough pottery has also been made from the Pennsylvanian clay found in the vicinity of Dardanelle.

Practically the whole northeastern part of the County is underlain by undifferentiated carboniferous shales and sandstones. At the present time these deposits are being mined only for local consumption. The sandstone deposit is of excellent quality, and may prove to be a very valuable asset in the future.

The Chicago, Rock Island & Pacific Railroad runs from Little Rock west through the central part of Yell County, passing through Birta, Belleville, Havana and Waveland. A branch of the Rock Island runs from North to South in the eastern part of the County with Plainview as its terminus. The towns on this road are Prosperity, Centerville and Ola.

The Arkansas River forms the northeastern boundary of the County, and is navigable only to small boats and barges.

U.S.G.S. quadrangle maps Hot Springs, Mount Ida, Magazine

Mountain, Dardanelle and Morrillton completely cover the County. The north central and northeastern parts covered by Dardanelle and Morrillton quadrangles have been surveyed and maps engraved, but not ready for distribution.

Highway and State topographic maps are also available.

SCOTT COUNTY

Scott County, Arkansas, lies in two divisions of the Paleozoic uplift. The extreme northern part of the county lies in the Arkansas valley section, and the remainder in the Fourche Mountain area.

The county is made up of several wide valleys running east and west, with an intervening broken hilly country. The greater part of the soil is sandy loam with a clay subsoil. The lands in the valleys of the Fourche La Fave, Poteau and Petit Jean Rivers and Dutch Creek are very fertile.

The surface rocks of Scott County, consisting of sandstone and shale, are of Carboniferous age, and nearly all of them belong to the Pennsylvanian series. The topographic forms already mentioned owe their origin to the structure, which is that of a compound syncline. The beds have been closely folded and thrust faulted near the southern part of the valley, but they are open-folded and normal faulted near the Boston Mountains.

The rocks of the Fourche Mountains in Scott County are all of Carboniferous age, and belong to the Stanley, Jackfork and Atoka formations. They have been complexly folded and, to a certain extent, thrust faulted. Many of the folds have been overturned toward the north, so that southern dips are common; but some of the folds are overturned toward the south. Many of the mountains are anticlinal, and some of the larger valleys, such as that of the Fourche La Fave River, are topographic expressions of the underlying synclinal structure. In the Fourche Mountains there are a number of readily recognizable topographic basins.

The most profitably produced minerals in Scott County are natural gas and coal.

There are two natural gas producing areas in Arkansas: (1) the area in the southwestern part of the State, which includes Union, Ouachita, and Columbia Counties, and (2) the area in the western end of the Arkansas valley, east and south of Fort Smith, including Sebastian, Crawford, Johnson and Scott Counties. The gas produced in these two areas originates in two entirely different series of rocks. The western Arkansas fields obtain gas from the Atoka shales of Pennsylvanian age, while the south Arkansas fields are supplied from the Upper Cretaceous beds of the Coastal Plain.

The producing gas fields of the Arkansas valley area are known as the Massard Prairie, Kibler-Williams, Alma, Clarksville and Mansfield fields. All of these fields derive their production from the Atoka formation which underlies the productive coal measure beds and makes up the surface of the eastern portion of the Arkansas River valley of the State. The daily average production of this area is about 11,000,000 cubic feet per day.

The Mansfield field lies partly in Scott and partly in Sebastian County. The field was discovered in 1902, and covers an area of approximately 2,500 acres. Drilling in this area starts approximately 3,000 feet below which was once the top of the Atoka shale; and as the wells penetrate to over 2,000 feet, the indications are that at least the first 5,000 feet of Atoka shale is good for commercial gas production. Four producing sands have been encountered. The thickness of each of these sands are, respectively, 22 to 60 feet; 75 to 142 feet; 10 to 30 feet, and 10 to 101 feet. The initial rock pressure of the 1,200 foot sand, when the field was originally discovered, was 315 pounds; and the present day rock pressure is about 265 pounds. The open flow in the largest well in this field was about

4,500,000 cubic feet per day. There are eight wells reported as now producing in this field. The gas is used domestically in nearby towns, but the major portion is used for brick burning by the Choctaw Brick & Gas Company of Mansfield, Sebastian County. The cost of drilling in this field is about $8,000.00 for a 2,000 foot well.

There are other known mineral deposits in Scott County, among which are asphalt, dolomite, sandstone, iron and clays.

The production of these minerals, if any, has been small. A deposit of asphaltic dolomite has been found in the southwestern part of the County at the northern base of Fourche Mountain. This deposit occurs in the Jackfork sandstone of the Mississippian age. There has been no development, however, of this mineral.

The iron ores are too poor in quality and occur in too small quantities to be of any value at prices that have prevailed in the past. There are clays found in the county consisting principally of shales, and also alluvial clays of Recent age, located in the river bottoms and other lowlands.

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