

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.
IN COOPERATION WITH THE UNIVERSITY OF MISSOURI AGRICULTURAL
EXPERIMENT STATION, F. B. MUMFORD, DIRECTOR;
M. F. MILLER, IN CHARGE SOIL SURVEY.

SOIL SURVEY OF TEXAS COUNTY, MISSOURI.

BY

W. I. WATKINS, IN CHARGE, EARL D. FOWLER AND HENRY I.
COHN, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND
J. A. MACHLIS AND H. H. KRUSEKOPF, OF
THE UNIVERSITY OF MISSOURI.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1917.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1919.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., October 15, 1918.

SIR: In the extension of the soil survey in the State of Missouri, a survey was made of Texas County during the field season of 1917. This work was done in cooperation with the State of Missouri, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of field operations of the Bureau of Soils for 1917, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Texas County sheet, Missouri.

SOIL SURVEY OF TEXAS COUNTY, MISSOURI.

By W. I. WATKINS, In Charge, EARL D. FOWLER, and HENRY I. COHN, of the U. S. Department of Agriculture, and J. A. MACHLIS and H. H. KRUSEKOPF, of the University of Missouri.—Area Inspected by HUGH H. BENNETT.

DESCRIPTION OF THE AREA.

Texas County is the largest county in the State of Missouri, having an area of 1,159 square miles or 741,760 acres, about the area of the State of Rhode Island. It is situated in the south-central part of the State, near the center of the Missouri Ozark Region. The drainage divide of the region stretches across the southern part of the county from Summersville, on the eastern line of the county, through Sterling, Howell County, 5 miles south of Sargent, to Mountain Grove, near the western county line in Wright County. On account of the dissection that has taken place since the plateau assumed its present or approximately its present level, only relatively small remnants of the ancient surface remain intact. By far the larger part of the county has a surface lower than that of the old plateau, produced by erosion subsequent to the formation of the plateau surface.

The plateau remnants are found only along the watershed ridges, the largest lying between Big Piney and Roubidoux Creeks along the western side of the county. The rather broad watershed ridge occupying the eastern part of the county contains several areas that seem to lie at the ancient level, but most of it lies apparently at a slightly lower elevation on a surface that is very old but somewhat younger than the oldest. The absence of topographic maps makes the definite determination of the relationship of the surfaces of the two main ridges impossible at present. The high ridge on which Tyrone stands, a small high area south of Mountain Grove, and small areas in the eastern part of the county are remnants of the ancient surface. One of the largest areas of the practically unchanged ancient surface lies in the vicinity of Dykes. It constitutes the remnant of the oldest land surface in the State and occupies considerable areas in Wright, Dent, Laclede, Phelps, and other counties



FIG. 1.—Sketch map showing location of the Texas County area, Missouri.

to the north and west, but does not seem to exist east of Texas County. A very narrow and poorly defined belt lies along Roubidoux Creek. The lower and somewhat younger plateau referred to above lies in broad belts along the main streams of the central Ozark region, the belt along Big Piney Creek in Texas County being one of the best defined. Its western boundary, coinciding with the eastern boundary of the ancient plateau remnant in the western part of the county, lies a mile east of Ladd, about the same distance east of Roby, just west of Ellis Prairie, and 2 miles east of Dykes, and swings thence in broad curves up and around the basins of Hamilton Creek, Big Piney Creek, and Elk Creek. In its southern part its surface is interrupted by a number of low hills, representing fragments of the ancient surface. It seems to occupy also a large part of the eastern half of the county. Its general surface lies about 100 feet below that of the ancient plateau.

The remnants of the ancient plateau are smooth. They represent fragments that have not yet been invaded by the advancing heads of small tributaries working backward from the main streams. They are traversed by shallow valleys occupied by small streams, but only at relatively wide intervals.

The lower plateau is dissected, since it lies wholly within the area invaded by the short drainage ways working directly into the large streams. An exception to this general statement should be made for the extreme eastern part of this plain, if it covers, as suggested, the whole eastern part of the county. The dissection of its surface is least and its surface smoothest along a narrow belt lying immediately east of its western boundary and on the smooth watershed ridges in the eastern part of the county, such as the Piney-Big Creek divide and the Summersville country. Dissection is most complete and deepest along the main streams. Over a belt 5 to 8 miles in width along Big Piney Creek below the mouth of West Piney Creek the topography is very rough, the dissection being complete and extending to a depth of more than 300 feet. Beyond this belt and a corresponding belt along Roubidoux Creek below Plato and along Big Creek the surface is rolling to strongly rolling, but only a small part of the land is too rough for cultivation. The basins of Hog and Elk Creeks, upper Big Piney Creek, Hamilton Creek, Roubidoux Creek, and Beaver Creek are predominantly rolling to moderately hilly. The Jacks Fork country is hilly.

Sink holes occur throughout the county, but are most numerous in the eastern and southeastern parts. Some of the larger ones, in the southeastern part of the county along Jacks Fork, are shown on the map. They are usually very small, having a diameter of 25 to over 100 feet, and being 15 to 75 feet deep.

Texas County is one of the more elevated counties of the State. The general elevation is about 1,100 to 1,300 feet above sea level. The highest determined point in the county, at Dunn, has an elevation of 1,481 feet. The bald knob at Dunn is probably 75 feet higher. Cabool has an elevation of 1,244 feet and Sargent one of 1,320 feet. The larger valleys are from 300 to 500 feet lower than the highest uplands.

Texas County was settled largely by people from Kentucky, Tennessee, and Virginia. They chose locations along the streams and in the better valleys near large springs. The first settlers arrived about 1828 and settled along Big Piney Creek. The county was organized in 1846. The population, all classed as rural, numbered 21,458 in 1910, or an average of 18.5 persons to the square mile. The 1910 census showed a decrease in population of 700 since 1900. This was probably due partly to the fact that the fruit industry did not prove so profitable as advertised during the infancy of the industry. At present there seems to be an influx of new settlers caused by the good crop of 1917, which has offset the poor years of 1913 to 1916. The population is not evenly distributed, as there are large tracts of land, fit only for grazing and live-stock raising, which are sparsely populated.

The principal towns of Texas County are Houston, Cabool, and Licking. There are several smaller villages, such as Summersville, Raymondville, Simmons, Dunn, Plato, Elk Creek, and Tyrone. They are usually situated in rather well-developed farming sections.

Houston, the county seat, is situated near the center of the county and about 20 miles northeast of Cabool. It has a population of about 1,000. Practically all shipping to and from Houston is done through Cabool, the chief railroad town in the county. Cabool has about the same population as Houston. Licking has a population of about 500, and is the principal town in the northern part of the county. The nearest railroad points are Salem, in Dent County, about 23 miles distant, and Rolla, about 35 miles distant. Summersville is the principal trading point in the southeast part of the county. Most of its shipping is done through Mountain View, which is about 16 miles distant in Howell County. The northwest part of the county is supplied through Plato, which ships through Lebanon, 35 miles west, in Laclede County. Most of the shipping in the vicinity of Huggins, Success, and Dykes is done through Mountain Grove, in Wright County, 3 miles west of Dunn. Willow Springs, in Howell County, is a shipping place for a small area of the county.

The public roads of Texas County are in general only fairly good. The main traveled routes between the towns and villages are good. The Ozark Scenic Highway, which traverses the county from Sherrill to Dunn, is an exceptionally fine road. As a rule, the roads wind

along ridges or stream courses, and they are found on the land lines only in the smoother sections. Marked progress in road improvement has been made in the last three years.

The principal markets for the agricultural products of Texas County are St. Louis and Kansas City. Springfield is also an important market. The products of the northern third of the county go mainly to St. Louis, while those of the southern two-thirds are shipped chiefly to Kansas City. The only railroad in the county is the Memphis branch of the St. Louis & San Francisco system. It enters the county near Dunn and cuts across the southwest corner, having a total length within the county of about 20 miles. Railroads have been surveyed to pass through the county north and south, but none has been built.

CLIMATE.

Texas County, like all of the Ozark region, has a very healthful climate. The average rainfall for the year, according to the records of the Weather Bureau station at Houston, is about 43 inches. The rainfall for the driest year on record was 28 inches, and for the wettest year 53 inches. The rainfall is rather evenly distributed throughout the year, but is lightest from October to February, inclusive. The average for the summer months is 13.31 inches and for the period from May to September, which comprises the growing season, 21.7 inches.

The mean temperature for the year is 55.6° F. The absolute maximum on record is 111° and the absolute minimum -34°. The mean for the summer is 74.3° and the minimum 36°. The mean for the winter is 34.5° and the maximum 88°. Cold waves sometimes occur, but seldom last more than a few days at a time.

The average date of the last killing frost in the spring is April 24, and that of the first in the fall October 10. This gives an average growing season of about 5½ months. The date of the latest killing frost recorded in the spring is May 28, and that of the earliest on record in the fall September 18.

In some years the summer rainfall is not sufficient for crops. The total summer rainfall for the dry year of 1901 was about 7 inches. Such dry years and the less dry years from 1913 to 1916 have had a decided influence upon the agriculture of the county, the more drought-resistant crops being gradually adopted by the farmers.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation as compiled from the records of the Weather Bureau station at Houston:

Normal monthly, seasonal, and annual temperature and precipitation at Houston.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1905).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	36.2	88	-12	2.12	4.56	2.34
January.....	34.0	74	-34	2.18	1.35	3.25
February.....	33.3	83	-20	2.48	2.02	2.08
Winter.....	34.5	88	-34	6.78	7.93	7.67
March.....	46.8	88	6	4.66	3.76	4.66
April.....	55.6	89	20	4.76	3.22	2.19
May.....	67.0	97	27	4.45	.24	5.61
Spring.....	56.5	97	6	13.87	7.22	12.46
June.....	71.9	101	36	5.01	3.84	2.02
July.....	75.8	111	46	4.76	1.65	14.39
August.....	75.2	106	39	3.54	1.43	5.60
Summer.....	74.3	111	36	13.31	6.92	22.01
September.....	68.8	106	29	3.99	1.07	5.64
October.....	57.0	91	11	2.47	2.63	3.70
November.....	45.9	83	5	2.54	1.91	1.46
Fall.....	57.2	106	5	9.00	5.61	10.80
Year.....	55.6	111	-34	42.96	27.68	52.94

AGRICULTURE.

The first settlers in this region usually located near the streams and large springs, cultivating the bottom lands and the more easily cleared and fertile valley slopes. The rougher and more heavily timbered areas were used to graze live stock. Most of the county was covered with open timber, but there were prairie areas covered with a luxuriant growth of blue stem. Hay was cut from the prairies as well as from some of the more open timbered lands. The prairies occupied the flatter situations and had only an occasional clump of trees. Examples of such areas are now seen around Dykes and Raymondville. The farmers tilled only enough land to produce grain for their stock and other products for home consumption. The native pasture was burned off each year, and this kept the brush and small timber from growing up. As settlement extended more of the land was fenced and cultivated, and the practice of burning off the range gradually stopped. The result was that numerous young trees sprang up and choked out part of the range. Later sawmills were brought in and the best timber cut, the young timber growing up thicker in its

place. This also reduced the area of pasture. Considerable land grew up in brush during the Civil War, as the farms were neglected at that time.

The shortleaf pine on the sandier land along Big and Ashley Creeks and on Big Piney Creek was cut first. Only small areas of shortleaf pine remain, principally in the Big Creek and Ashley territory, and they are being rapidly removed by lumbermen. The oak timber that remains in the county is used principally for railroad ties, of which several thousand are shipped out of the county each year, being rafted down the Big Piney Creek to the railroad at Arlington and thence shipped to St. Louis. At present the main bodies of timber occur along Jacks Fork, Big Creek, and Ashley Creek, or, generally speaking, at the points farthest from the railroad and convenient streams for rafting. Lumbering still remains a source of income to a large percentage of the population of the county. Several thousand cords of fuel wood are shipped to Springfield each year, to be used in the limekilns. The shipping of piling is also of considerable importance.

Formerly the land when cleared was allowed to grow up in brush and whatever grasses would grow, but at present the cleared land is often sown with cultivated grasses, such as orchard grass, bluegrass, lespedeza (Japan clover), timothy, and some red clover. These grasses are usually sown at the time of removing the timber, and by the time the brush has been killed through grazing with goats the land is ready for pasture. Bluegrass does best on the Baxter soils. It does not make a good growth on the gravelly and stony Clarksville soils, on which orchard grass gives the best results.

The census gives a total value of all farm products for 1909 as \$2,606,966. Of this, live stock sold or slaughtered formed the largest item, amounting to \$835,202. The cereals were valued at \$714,822.

Corn is the most important crop. It was grown on an area of 51,474 acres in 1909, with a production of 941,910 bushels. This is an increase of about 30,000 acres as compared with the area planted in 1879, but the production was only about 300,000 bushels greater. The larger yields in former years are probably due to the fact that the first settlers cultivated only the best lands, while at the present time much inferior land is cultivated. All the corn crop is used locally.

Wheat ranks second in importance among the cereal crops. In 1909 wheat was grown on 13,149 acres, which represents an increase of 3,000 acres over the area in 1879 but a decrease of 8,000 acres from the area in this crop in 1899. Wheat has not been grown very extensively the last few years, but in 1916 and 1917, owing to the high prices, the area seeded was probably more than 25,000 acres. Wheat growing had previously declined because of low yields, averaging

only 7 to 10 bushels per acre. In some years considerable loss results from heaving and from the ravages of the Hessian fly. The latter may be combated to some extent by late sowing. The wheat is sold or used for home consumption, being ground at numerous mills scattered throughout the county.

Oats are grown to a small extent. The crop is cut and fed in the sheaf.

Hay and forage crops rank third in importance. The value of all hay and forage produced in 1909 amounted to \$326,016. Timothy and clover mixed were grown on 24,143 acres in 1909, producing 19,747 tons. The production of timothy alone amounted to 15,334 tons and of clover alone to 12,289 tons. Timothy fields become very weedy if allowed to stand more than two or three years. In general the yield of hay on the upland soils averages about one-half ton per acre. Except in favorable seasons the hay produced is barely sufficient to supply the local demand. Alfalfa is grown on some of the better bottom lands, and usually three or four cuttings are obtained. The crop is not always a success, because frequently the plants are crowded out by grass and weeds.

Kafir or some of the grain sorghums is grown on almost every farm as a forage crop. Millet is not grown extensively, but is sometimes sown as a catch crop after wheat or oats.

Potatoes are grown to a small extent, in part for shipment but mostly for local trade. Tobacco is grown only for local use, and is of little importance.

Attempts at commercial fruit growing have thus far been a failure, primarily on account of unfavorable soil and climatic conditions. There has been a conspicuous decrease in apple and peach production. The number of apple trees in the county fell from 501,709 in 1899 to 291,575 in 1909, and of peach trees from 160,759 to 125,691 for the same period. The orchards seem to be declining rapidly. Very few new trees for commercial purposes are being set out, and the old orchards are poorly kept. Only a few are sprayed, and the fruit is of an inferior quality. Much damage is done to fruit by spring frosts. At one time this region was highly advertised as a fruit section and large orchards were set out, but at present stock raising and general farming are taking the place of fruit growing.

Small fruits, especially strawberries and the brambleberries, are easily grown. Wild blackberries and blueberries flourish throughout the county. Walnuts and hazelnuts are gathered and sold in the local markets, and small quantities are shipped. At one time ginseng was grown extensively in the vicinity of Houston.

Beef cattle and hogs are the most important live-stock interests. Both cattle and hogs graze to a large extent upon the limited open

range which exists mainly in the rougher sections of the county. The cattle feed upon the wild grasses, of which lespedeza is the most important. This is established on most of the soils throughout the county and makes good pasturage, except on very brushy land. The value of this pasture can be greatly improved by cutting the brush or by grazing it with goats, and much land is being cleared and fenced. As a rule the cattle are poorly sheltered, being allowed to remain out in the open at all times of the year. They are only "roughed" through the winter, as most of them are put on the market as feeders or stockers. The cattle are generally mixed beef and dairy stock and consequently are not of the best beef quality. More interest is being taken in the breeding of good cattle, and the quality is gradually being improved.

Hogs are raised in considerable numbers. They are allowed to run on the range. In some years there is such an abundance of acorns that little or no feeding is required to fatten the hogs. They are grown principally for feeders, but some are fattened and sold for slaughter. The hogs are, as a rule, of better quality than the beef cattle.

Sheep and goats are raised in increasing numbers. Angora goats are most popular, as they not only clear brush land but are marketable for meat. Goats are more valuable than sheep in clearing brushy areas, and at present they are in almost as great demand for their meat.

Many horses and mules of good quality and size are raised each year. The horses on the whole are of better quality than the cattle.

In 1909 the value of dairy products produced in Texas County was \$113,721. Dairy farming is rapidly becoming one of the more important industries of the county. In 1912, 182,666 pounds of butter and 7,613 gallons of cream were shipped by rail from Texas County, in addition to shipments equally large made from Mountain Grove, Willow Springs, Lebanon, and other railroad points outside the county.

The value of eggs and poultry products produced in 1909 was \$189,267, and poultry raising is steadily becoming more important.

The topography markedly influences the agricultural value of the soils of this region, as does also the content of rock fragments and the character of the soil itself. The rougher and more stony uplands (the rougher areas usually represent the more stony lands) constitute the less valuable farm lands, aside from some of the small areas of intractable soils such as the areas of Colbert soil having intractable clay near the surface. These rough stony soils are used largely as pasture land or are left in timber. The richer bottom lands are nearly all cultivated, but many areas of smooth uplands still remain

in timber, partly for the reason that a farm often includes more of such soil than can be farmed and partly because the farmer prefers to expend his efforts on the more productive bottom lands.

The adaptation of soils to particular crops is recognized and followed to some extent, but generally the main crops, wheat, corn, and grass, are grown on all farms and all soils. Some farmers, however, use certain types of soil for the crops to which they are believed to be especially adapted, excluding other crops as much as local conditions and availability of other soils for other crops permit. The Lebanon silt loam, for example, is said to be best suited to wheat and the grain sorghums, and the Guthrie silt loam best suited to grass, and there is a noticeable tendency among farmers to follow this adaptation in their farming operations. The well-drained alluvial soils, such as the Dunning and Huntington, which are known to be excellently adapted to corn, are used to a relatively greater extent for corn than the upland types, which are poorer corn soils. Farmers recognize that strawberries and apples will succeed on many of the soils, but economic conditions, poor market facilities particularly, are largely responsible for the lack of development of these crops.

A number of soil and vegetative features are recognized as being indicative of soil productiveness. North and east slopes are considered more productive than south or west slopes. Soils with red clay subsoils, such as those of the Baxter series, are classed as stronger soils generally than those with yellow subsoils or with mottled yellow and gray subsoils, and the rich-brown and black alluvial soils are known to be more productive than the gray and light-brown bottom lands. A growth of black oak or a mixed forest of white oak, black oak, and hickory is supposed to indicate better soil than a growth composed largely of either blackjack oak or post oak, which trees in largely predominant growths are supposed to indicate droughty soils and cold-natured soils, respectively. Pine land is supposed by some farmers to be poor land, but the contrary is very often the case, particularly if pine grows on land with red subsoil.

The prevailing methods of farming are similar to those of the Ozark region in general. The land is commonly prepared and planted in the spring, except for wheat, which is sown in October or November. Wheat usually is sown on corn ground. Fall plowing is gradually becoming more popular, since wet weather in the spring sometimes delays preparation of the land.

The farm equipment is fairly good. Most farms have good houses and rather substantial barns and sheds, and are fenced with wire fence. The best improved places are generally those which depend to a considerable degree upon live stock and dairy and poultry products as a source of income.

Crop rotation is not practiced as much as good farming methods demand. Clover, cowpeas, and grass, however, often are grown in rotation with wheat and corn. The crop to be grown depends largely upon the demand, the prospective market value, and the character of the soil.

Commercial fertilizers are used rather extensively, but in light applications of 75 to 100 pounds per acre. Fertilizer is used on most of the upland wheat and to a lesser extent on corn and oats. Barnyard manure has not been generally conserved in the past, but its importance as a fertilizer is becoming better known, with the result that it is being saved and used more extensively. On account of the very small amount of straw available and because cattle are not stall fed, only a small amount of manure is produced. The necessity of growing green manure crops, such as clover, cowpeas, or rye, in order to maintain the fertility of the soil, is therefore apparent. Lime has been found to give rather encouraging results, particularly on the gray soils and ridge land. The occasional outcrops of lime rock could be used for the production of agricultural lime.

There was a total of 3,613 farms in the county in 1910, or 116 less than in 1900. Farms comprise 63.2 per cent of the area of the county. Their average size in 1910 was 129.7 acres. At present the average size is probably larger, as the farmers are more generally coming to realize the value of a large acreage of pasture. This is necessary because sufficient feed is not always produced and with a large acreage pasturing may be continued through the more open winters. The percentage of improved land in farms is 45.7, or an average of 59.3 acres per farm.

The total area of unimproved land in 1910, including that in farms, was 526,000 acres, or approximately 70 per cent of the total area. This unimproved land is largely included in areas of rough topography with the surface more or less stony. There are, however, considerable areas which could be tilled if economic conditions were such as to warrant it. Much of this land is located at considerable distances from the railroad, and even if it were cleared it would not be possible to cultivate it without considerable difficulty. It is valued principally at this time as rough range pasture. The greater part of it is covered with a second growth of oak timber, much of which is of small size and so dense as to prevent the free growth of range grasses. The timber varieties are mostly slow growing ones and of comparatively low commercial value.

As range land this timber area is best handled in connection with some of the valley or bottom land occurring along the streams. The latter can be depended upon to supply winter forage and some grain, while the larger areas of upland range can be used for summer pasture. When properly handled this combination of valley or

bottom land with large areas of range upland can be made to bring fair returns in the production of feeder cattle and hogs. Where the timber has reached a fair size and is not dense the range improves. Where dogs and wolves are controlled sheep can be successfully handled.

The improvement of this uncultivated land is comparatively expensive. The original cost of clearing is not particularly high, but permanently freeing the land of sprouts is very difficult. As a matter of fact, the principal problem in the improvement of this land is one of controlling sprouts. This is best solved through the use of goats or sheep, but killing sprouts by such means is necessarily slow and the animals require rather careful attention. Where this is given, however, it is possible to develop pastures of much greater value than those of the wild range.

Where land is cleared for the purpose of putting it in cultivation the matter of killing the sprouts is less difficult, since the cultivation of corn for two or three seasons is fairly effective in getting rid of them. After clearing, however, the land is of relatively low fertility, and it deteriorates rather rapidly under cultivation. Consequently there is no great incentive for the improvement of any large proportion of this land. Doubtless its utilization will be confined pretty largely to the better phases of the untilled land now in farms, and the process will be a gradual one. The development of the dairy interest in the county, which is making considerable progress, will be an incentive to the utilization of such of this rough land as can economically be cleared.

The average value of farms in 1910 is given as \$2,714 per farm, the land representing 60 per cent, buildings 16.2 per cent, implements 3.6 per cent, and domestic animals 20.2 per cent. The selling value of farms varies from \$2 to \$75 an acre, depending upon the soil and location. The most highly valued lands are near Cabool, west of Dunn, around Licking, near Turley, in the Roubidoux Creek bottoms, and in other large stream bottoms.

The 1910 census reports 78.8 per cent of the farms operated by owners and 20.8 per cent by tenants. Under the usual leasehold the owner receives one-third of the grain crops and one-half of the hay, all the implements and stock being furnished by the tenant and the fertilizer expense being equally divided between tenant and landowner.

SOILS.

The soil material of Texas County has been derived from the country rocks, consisting of a series of cherty limestones underlying by far the greater part of the county and of sandstones underlying a portion of the extreme northern part and small strips along Big

Piney Creek. The materials have been accumulated by weathering and have been converted into soils simultaneously with their accumulation. As a whole the rocks are well covered with the products of weathering, exposures of country rock being rare except in the almost vertical cliffs along the larger streams. Even on moderately steep slopes the accumulated mass of soil and of unconsolidated clay and chert beneath the true soil and subsoil is several feet thick. In addition to the exposures on the creek bluffs, rock exposures are found in small areas where the local rock character has retarded weathering and in places where local erosion is unusually active.

The soil material, as derived from the limestone rock, consists of a mass of clay, usually red in color, mixed with varying amounts of chert fragments, usually less than 8 inches in diameter, ranging from practically none to as much as 80 per cent of the mass. Where derived from sandstone the soil material consists of reddish sandy clay, ordinarily free from chert.

The upland soils from limestone material are those belonging to the Lebanon, Clarksville, Baxter, Gasconade, Guthrie, and Colbert, while those derived from sandstone belong in the Hanceville series.

The various soils of the county derived from limestone material differ in those characteristics due either to conditions under which the soil develops or to the stage of development in which the particular soil stands at the present time. The term stage in development may be stated also as the age of the soil. The latter, however, should not be confused with the age of the rock from which the soil material is derived. It refers to the presence or absence of those soil characteristics which are usually regarded as the product of soil-making forces acting either through a considerable period of time or very intensely through a shorter period of time; or, in other words, it refers to the accumulated effects of the operation of soil-forming processes. Those soils whose characteristics show long-continued operation of soil-forming processes may be designated as old and those showing a short period of such operation may be designated as young.

The characteristics of old soils developed under normal conditions existing in the Ozark region are a light-gray to nearly white color of the surface soil, a rather thick layer of such soil, the formation of a rather heavy subsoil as well as a deeper horizon, usually at about 3 feet, of compact silt or clay usually overlain by a horizon marked by evidences of retarded drainage. Young soils, on the other hand, are not marked by such differentiation into horizons, exhibiting a vertical section much more uniform throughout. Old soils are more thoroughly leached in their surface horizon, often have lower contents of organic matter, have heavier and more intractable subsoils, and may have more or less well-defined hardpan development.

Those soils of Texas County derived from limestone material may be arranged in two groups, which may be described as (1) those developed under average Ozarkian conditions and (2) those developed under unusual Ozarkian conditions. The former group includes the Lebanon, Clarksville, Baxter, Colbert, and Gasconade, while the latter includes but one soil series, the Guthrie. Those in the first group are named in the order of their age, beginning with the oldest.

The Lebanon soils are old because they cover the smoothest parts of the county and because of that fact they have lain for a long period of time in this position, being subjected to the processes of weathering throughout the whole period. The leached-out surface layer has not been removed by erosion as fast as it became leached, because of the weakness of the forces of erosion on the smooth surface on which these soils lie, no new surface soil being continually formed from unleached underlying material to which the surface is brought by erosion. The subsoil becomes "stagnant" because of the absence of those mass movements by creep which take place on all soils lying on slopes. Through the long-continued stagnation and lack of any movement it becomes more and more compact and hard, and through the translocative action of percolating waters it becomes progressively heavier by the washing of clay particles into it from the surface soil. The flat topography under which these characteristics develop most perfectly and most rapidly is responsible from the beginning for a certain degree of imperfect drainage, but that it is not mainly due to that condition is shown by the fact that these features develop on gentle slopes where drainage is not poor. On flat areas, where the development is most rapid, the subsoil is progressively more imperfectly drained as the compact and heavy-textured subsoils develop.

Such conditions develop most perfectly in silty, chert-free soils, so that the Lebanon silt loam has the age characteristics better developed than any of the other types of the series. All the soils in the region that exhibit any marked degree of subsoil stagnation and compaction are placed in this series.

The Clarksville soils occur only on the valley slopes in the limestone region and in such a position that no subsoil stagnation has taken place because of the continual though imperceptible movement down the slopes and the consequent slow but continual mixing of the materials, as well as the accumulation of new material from beneath the subsoil. The soil and subsoil are continually renewed, so to speak, by the incorporation of this new material and kept "alive" by its continual movement. The soils placed in this series have gray or light yellowish brown surface soils and yellow subsoils. The yellow color is due in the more stony types to the leach-

ing-out of a considerable part of the iron oxide in the subsoil because of its easy penetrability to water. In other cases it seems to be due to a low content of iron in the parent limestone. These soils are rather well leached in the surface horizon, and a little less so in the subsoil, but no compaction or tendency to specially unfavorable subsoil conditions exists, though the subsoil is usually a little heavier than the soil, owing probably more to the washing out and away of the finer particles in the soil horizon than to the translocation of soil material from the surface downward.

The soils of the Baxter series occur in intimate association with those of the Clarksville series. They are less leached in both soil and subsoil, having a light-brown soil and a reddish lower subsoil with yellowish upper subsoil. These are considered to be somewhat more productive than the soils of the Clarksville series.

The soils of the Colbert series, as mapped in Texas County, have the characteristics of imperfectly developed soils, consisting to a considerable extent of freshly weathered clay of limestone derivation. This latter is true of the subsoil to a much greater extent than of the soil. The surface or soil horizon is light brown to light yellowish brown to grayish, while the subsoil consists of greenish, yellowish, or grayish sticky clay, the parent limestone lying usually at a depth of less than 3 feet. These soils have a tendency to excessive wetness in wet weather, due to a certain amount of seep water from the shallow underlying rock, and to excessive dryness in dry weather due to the thinness of the total soil and subsoil material.

The Gasconade soils are dark brown to nearly black in color, with rather heavy clay subsoils as a rule but with no compaction. They are deeper than the Colbert soils as well as darker in color, owing to the fact that they developed under treeless conditions. They are young and fertile, though they grade imperceptibly into the Colbert soils and in those phases approaching the characteristics of the latter soils are inclined to have somewhat unfavorable moisture conditions.

The second group of limestone soils includes only one series, the Guthrie series. The soils of this series have been developed under poorly drained conditions on the floors of upland depressions. The soils are gray and the subsoils are mottled because of their unevenly oxidized condition, due to water-logging. They occur in very small areas.

The Hanceville soils have been developed from sandstone material. Since they occur in general on rolling surfaces, have grayish soils and reddish subsoils, with no compaction or as a rule other unfavorable subsoil development, they should be best considered as the equivalent of the Baxter soils, but developed from sandstone rather than from limestone material.

The soils developed from stream-terrace material have been identified as members of the Cumberland, Elk, and Robertsville series.

The soils of the Cumberland series have developed under conditions of good drainage either on undulating or rolling topography or in areas of material too recently accumulated to have developed any of the characteristics of old-age soils. The surface horizons are light brown in color and the subsoils are red, being also a little heavier in texture than the soil. These soils are the terrace equivalents of the Baxter soils, but on account of their freedom from chert fragments they are more productive and more easily cultivated.

The Elk soils differ from the Cumberland soils in the somewhat lighter brown to yellowish color of the soils and the yellow subsoil. Soils of the Elk series occupy the lower terraces, and have about the same position in relation to the present flood plains as the Robertsville soils.

The Robertsville soils are the terrace equivalents of the Guthrie soils or approximately such. They have developed from terrace material under conditions of excessive moisture. The soils are light brown to gray and the subsoils are mottled and usually rather heavy intractable clays.

On the present alluvial plains of the streams of the county two soil series are identified. The well-drained brown alluvium is mapped in the Huntington series, while the less well drained, dark-colored alluvium is mapped in the Dunning series.

The following table gives the actual and relative extent of the several soils of the county:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Clarksville gravelly loam.....	248,256	33.4	Huntington gravelly loam.....	12,224	1.6
Clarksville stony loam ¹	138,432	18.7	Baxter stony loam.....	10,688	1.4
Rough stony land.....	61,568	8.3	Hanceville gravelly fine sandy loam.....	10,304	1.4
Lebanon silt loam.....	41,728	7.3	Huntington silt loam.....	8,640	1.2
Shallow phase.....	11,840		Hanceville fine sandy loam.....	7,744	1.0
Slope phase.....	256		Huntington fine sandy loam.....	5,312	.7
Lebanon gravelly loam.....	53,440	7.2	Huntington loam.....	4,928	.7
Baxter gravelly loam.....	33,792	4.6	Elk silt loam.....	3,072	.4
Baxter silt loam.....	19,456	2.7	Gasconade stony clay.....	1,664	.2
Shallow phase.....	896		Guthrie silt loam.....	1,344	.2
Dunning gravelly loam.....	19,136	2.6	Cumberland silt loam.....	1,280	.2
Colbert gravelly loam.....	15,872	2.1	Robertsville silt loam.....	448	.1
Hanceville stony fine sandy loam.....	15,360	2.1			
Colbert stony loam.....	14,080	1.9	Total.....	741,760

¹ Includes areas of Baxter, Lebanon, and Colbert stony loams.

LEBANON GRAVELLY LOAM.

The Lebanon gravelly loam is very similar to the Lebanon silt loam, shallow phase, but it differs in being more gravelly. The soil is a gray silt loam, 5 or 6 inches deep, overlying yellow silt loam which quickly passes into yellow or reddish-yellow clay or brownish clay with a reddish cast. This is underlain at 15 to 20 inches by mottled gray and yellow silty clay loam, often passing beneath into bluish-gray, tough clay mottled with yellow or red, or both. Angular chert fragments are abundant on the surface and in the soil and subsoil. A very cherty layer known as hardpan is found at depths ranging from near the surface to about 24 inches.

This is the most droughty of the Lebanon soils. It occupies rather narrow ridges and undulating country. The greater part of the type occurs through the northern two-thirds of the county. The timber growth consists largely of blackjack oak, with some small post oak.

A considerable part of the type is in cultivation. Corn is probably the principal crop. The grain sorghums give best average results, and should be grown more generally. The greater part of the type is used for pasture, to which purpose it seems best suited. Most of the abandoned farms in the county seem to be on this type of soil. The Lebanon gravelly loam is deficient in organic matter, and responds well to phosphatic fertilizers in favorable years.

This land can be bought for \$10 or less an acre, except in the better located areas.

LEBANON SILT LOAM.

The surface soil of the typical Lebanon silt loam is a brownish-gray silt loam grading at 6 to 8 inches into yellow silty clay loam or silt loam that quickly passes into silty clay loam. This grades at depths of 10 to 14 inches into moderately stiff, yellow to reddish-brown clay. At 18 to 24 inches there is encountered a mottled yellow and gray, somewhat friable silty clay loam or silty clay, which passes beneath into a tough clay of a mottled bluish-gray and light-gray color. In places red mottling occurs in the lower subsoil. The lower subsoil is plastic and rather impervious, having the features of a claypan.

In many places angular chert fragments are present in the lower part of the three-foot section, immediately above which in many places lies a somewhat crumbly layer. The gravelly material is often compact or cemented. In some places as over the rather low flat just east of Licking, the soil is brown and the subsoil is a very tough claypan mottled dark bluish gray and red. Such areas have the characteristics of the Gerald silt loam, but are not shown separately

on the map owing to their small extent, and consequent lack of importance. In places there is less gray mottling, and the lower subsoil is less tough and impervious than typical. Such areas probably represent Clarksville silt loam, but they are of too patchy occurrence and of too little importance to separate. Small black concretions occur on the surface and through the soil and subsoil in places, particularly in the slightly depressed or flat areas. Here also, the soil is generally a lighter gray at the surface. Some small bodies such as those at Bendavis, 1 mile east of Dykes and three-fourths mile west of Raymondville, have a tough clay near the surface. Crops suffer more on such soil during extremes of dry and wet weather than on the typical soil. In places there are a few small fragments of chert and occasionally large sized fragments, but the typical soil is stone free.

The principal areas of Lebanon silt loam are found in the vicinity of Licking, Success, Roby, Yukon, Huggins, Raymondville, Houston, Upton, Dykes, and Bendavis.

Typically this soil occupies flat and gently undulating upland areas, occasionally extending down the gentler slopes for some distance but usually passing into gravelly soils, such as the Clarksville gravelly loam, on the steeper slopes. The underdrainage is imperfect on account of the denseness of the mottled portion of the subsoil, and the surface drainage of the flat area is slow, so that crops suffer in wet seasons. The subsoil apparently also retards the capillary movement of moisture and the circulation of air, thus interfering with normal growth of crops in dry seasons. This is considered a cold-natured soil on which crops are apt to be backward in spring. It dries out rapidly during dry weather in summer.

The greater part of this type is under cultivation, and almost all of it is fenced. It is used for all the general farm crops grown in the region, but most extensively in the production of wheat and corn. It gives, on the whole, the best results with wheat and the grain sorghums, such as kafir. Wheat ordinarily yields only 7 or 8 bushels per acre, but the yield, where fertilizer is used, sometimes amounts to 20 bushels or more. Corn does very well in seasons with well distributed rainfall. The yields ordinarily range from 15 to 20 bushels per acre, but in very dry or very wet seasons are much lower. In exceptionally favorable years as much as 35 bushels per acre has been obtained.

The type is used to some extent for pasture, but too close pasturing seems to bring about a very weedy condition, plaintain sometimes practically covering the ground. Japan clover grows wild and affords valuable grazing. Red clover does not succeed unless the land is heavily manured, and lime also is usually essential. Originally this was a prairie soil, supporting only scattered clumps of trees, consisting mainly of post oak and blackjack oak, with occasional

hickory, white oak, and red oak trees. The soil has a low content of organic matter. It gives an acid reaction with litmus.

Many farmers on this soil use fertilizers for wheat. A common fertilizer is bonemeal, applied at the rate of 75 to 125 pounds per acre.

Land of this type of soil is valued at \$15 to \$30 an acre.

The Lebanon silt loam may be improved by providing ditches for the removal of surface water, by increasing the supply of organic matter, through the addition of barnyard manure or plowing under green manure crops, especially the legumes, such as lespedeza or cow-peas, by the use of phosphates, and by the addition of lime. All the Lebanon soils may be improved in the same way.

Lebanon silt loam, shallow phase.—The Lebanon silt loam, shallow phase, differs from the typical Lebanon silt loam chiefly in having the gravelly layer nearer the surface. It consists of brownish-gray to gray silt loam, 4 or 5 inches deep, over yellowish silt loam, which passes quickly into silty clay loam. This, at about 12 inches, changes into brownish, moderately stiff clay with a reddish cast.¹ A horizon of mottled gray and yellow, compact silty clay or silty clay loam lies at 15 to 20 inches, and at 20 to 24 inches a compact or cemented layer of cherty gravel is encountered. Below this stratum is found yellow and reddish-brown, heavy, compact, tenacious clay. Gravel occurs on the surface over most of the phase.

Areas of this phase are scattered through the northeastern part of the county, in the vicinity of Hartshorn, in the region north, northeast, and northwest of Houston, in the vicinity of Success, and between this place and Eveningshade. It is confined to the lower lying divides, and has a more uneven surface than the typical soil.

The tree growth on this phase consists of rather small post oak, white oak, black oak, blackjack oak, and hickory, with pine in places where it borders the Hanceville soils.

This soil is slightly inferior to the typical Lebanon silt loam in agricultural value, as it is more droughty. The same crops are grown as on the typical soil. The grain sorghums do well and should be grown more extensively than at present.

This land can be bought for prices ranging from \$2 to \$20 an acre.

Lebanon silt loam, slope phase.—The slope phase of the Lebanon silt loam consists of a brownish-gray or gray silt loam, underlain at about 8 inches by yellow silt loam which grades into a silty clay loam or silty clay at about 12 inches. This material extends to about 20 inches, below which the clay is mottled with gray and brown to a depth of about 34 inches, where brownish-red clay is usually encountered. Angular chert gravel is present in the lower subsoil in

¹The subsoil of the phase has a more distinct red color than the subsoil of the typical soil.

many places. The hardpan is rarely present or only faintly developed.

This soil is often associated with the Baxter silt loam and it frequently occupies the slopes between the Lebanon and the Baxter silt loams. It is mapped mainly between Oscar and Licking.

This soil has better drainage than the typical Lebanon silt loam and is more productive. It is more resistant to drought. The average yield of corn is about 25 bushels per acre. Wheat ordinarily yields 12 to 15 bushels. For clover and timothy it is far superior to the typical soil.

Farms on the Lebanon silt loam, slope phase, are valued at \$40 to \$50 an acre.

This soil needs replenishment of the organic content for best results. This can best be accomplished by growing such crops as clover and cowpeas in the rotations or by applying manure. It also needs phosphatic fertilizers and often lime.

CLARKSVILLE STONY LOAM.

The Clarksville stony loam differs from the Clarksville gravelly loam chiefly in the greater abundance of the larger chert fragments and in the generally rougher topography. As mapped it includes many areas of Baxter stony loam and gravelly loam and some areas of Lebanon gravelly loam. Areas of Clarksville gravelly loam and some Hanceville stony loam and gravelly loam also are included.

The typical Clarksville stony loam is a brownish-gray to gray silt loam, underlain at 3 to 5 inches by pale-yellow silt loam, this passing at depths of 12 to 18 inches into yellow or reddish-yellow silty clay loam. The lower subsoil in places consists of clay often reddish in color. Where the red color is well developed the soil would be classed as Baxter stony loam. Small and large fragments of chert are strewn thickly over the surface of most of the type and are disseminated throughout the soil and subsoil.

A conspicuous development of the included Lebanon gravelly loam occurs on the divide south of Sargent. Here the soil is a gray silt loam about 5 inches deep, overlying yellow silt loam to silty clay loam with gray mottlings below 20 inches and with reddish clay at about 30 inches. In the northern part of the county in those areas closely associated with the Hanceville soils and including some Hanceville material, the soil contains more sand and is more friable.

The Clarksville stony loam is an extensive soil and widely distributed through the county. It occurs in close association with the Clarksville gravelly loam, and usually occupies the steeper slopes and sharper ridges. Many of the more deeply dissected ridges are

occupied by this soil, such as that between Jacks Fork and Pine Creek and between Bear and Hamilton Creeks.

The greater part of the typical soil is used for pasture. Much of it is covered with oak forest. Included areas of Clarksville and Baxter gravelly loams are frequently cultivated, and also some of the smoother areas of the type itself. The growth of wild grasses, lespedeza, and other plants affords fair to good grazing.

Land of this type can be bought for \$10 or less an acre with the exception of an occasional smoother, less stony area.

The raising of stock is apparently the best means of using most of the soil. In general it is a nonagricultural soil and should remain in forest.

CLARKSVILLE GRAVELLY LOAM.

The soil mapped under the name of Clarksville gravelly loam includes many areas of Baxter gravelly loam and Lebanon gravelly loam, separation not being made owing to the intimate association of these types in patchy areas, and the difficulty or impossibility of boring deep enough to determine the exact character of all areas.

The Clarksville gravelly loam averages a brownish-gray or gray silt loam, passing at about 6 inches into pale-yellow silt loam which grades below into yellowish silty clay loam. This often has a reddish cast at depths of 24 to 28 inches. In places the lower subsoil has the texture of clay, often being reddish and approaching in character the lower subsoil of the Baxter gravelly loam.

The content of angular chert gravel is high, in places 50 per cent of the mass, making this a very gravelly soil. Gravel is abundant both on the surface and through the entire 3-foot section. Much of the type is so gravelly that plowing is difficult.

In the section west of Licking, where there are occasional outcrops of sandstone, the content of fine sand in the soil is relatively high. There are also some included patches of sandstone soil—Hanceville gravelly loam—and some areas having a greenish-yellow, plastic clay subsoil, representing the Colbert gravelly loam or a soil closely approaching that type.

The Clarksville gravelly loam is the most extensive soil in the county. It is distributed throughout the county, but is less extensive in certain localities, as in the vicinity of Cabool, where the Baxter soils predominate, and in the section around Licking and east of that place, where the Lebanon, Baxter, and Hanceville soils predominate. The surface is prevaillingly rolling to rough or hilly, but most of the type is not too hilly to allow cultivation. Owing to its gravelly nature this soil has good, often excessive drainage. It absorbs water rapidly and this tends to retard erosion.

While a large part of the Clarksville gravelly loam is timbered many farms include this as the principal cultivated soil.

Wheat and corn are the principal crops. Clover does fairly well, particularly on the lower slopes. Among other crops oats, cowpeas, and the grain sorghums are important. Some beef cattle and hogs are raised for market.

Corn averages about 20 bushels per acre, but yields sometimes reach 40 or 50 bushels in the most favorable years under the best treatment. Wheat yields from 10 to 15 bushels per acre and hay 1 to 1½ tons. In excessively dry years the yields sometimes are very low. The type is a good pasture soil.

The abundance of gravel in this soil makes the upkeep of farm machinery rather expensive. Plowing and cultivating the land is difficult, and on the very gravelly areas impracticable.

Cleared land of the Clarksville gravelly loam can be bought for \$20 to \$50 an acre, according to the location, buildings, fences, and general improvements, and in some measure the topography and abundance of gravel. The most highly improved area of this type is in Big Piney Valley, between Cabool and Houston.

Native grasses afford valuable pasturage. Stump land and partly cleared areas can generally be made fair pastures when seeded with a mixture of tame grasses. It is probable that if a larger proportion of the land were seeded to clover and grass, so that more live stock, particularly sheep, could be kept, the returns from this soil type could be increased. Market conditions and transportation facilities are in general not very favorable at present for the production of fruits or other perishable crops.

This soil has a low content of organic matter, and crops such as cowpeas, clover, and grass should be given place in the rotation if it is to be kept in the best productive condition.

BAXTER STONY LOAM.

The Baxter stony loam is essentially the same as the Baxter gravelly loam except for its rougher topography and the greater abundance of large chert fragments.

Most of the soil is mapped in the vicinity of Cabool. It is fairly extensive. The type is used chiefly for grazing beef cattle, but some of the smoother areas are cultivated to the general farm crops of the region. Where the surface is not so steep as to cause serious erosion, and where the stones and gravel are not too abundant about the same yields are obtained as on the Baxter gravelly loam.

Land of this type can be bought for \$10 or less an acre, depending on the stand of timber (which is chiefly black oak, with other oaks and some hickory) and proximity to railroad stations.

BAXTER GRAVELLY LOAM.

The Baxter gravelly loam in its most typical development consists of a brownish-gray to light-brown silt loam passing at 5 or 6 inches into yellow silt loam, which quickly grades into yellow or yellowish-red silty clay loam. This is underlain at any depth from 8 to 15 inches by light-red, brittle, or moderately friable clay, the color usually becoming darker with increasing depth. In some places there are gray mottlings in the layer above the red clay, such soil representing an approach toward the Lebanon series. As mapped the type includes some Lebanon gravelly loam, as in the region northeast of Houston. There are also some slopes of Clarksville gravelly loam. Angular chert fragments are abundant on the surface and through the soil and subsoil, but in general the gravel content is less than in the corresponding type of the Clarksville series.

This type is most extensive in the section to the south and west of Cabool, in the vicinity of Licking along Indian Creek and its tributaries, and along Elk Creek and its tributaries. The surface is mainly rolling, but there are many gentle slopes and ridge crests which are smooth enough for easy cultivation except for the hindrance caused by an excess of gravel.

The Baxter gravelly loam is an important type, and much of it is cultivated, the percentage of tilled land being greater than in the case of the Clarksville gravelly loam. The principal tree growth in the forested areas is black oak, but there is also some white oak, post oak, blackjack oak, and hickory.

Corn and wheat are the chief crops. Corn ordinarily yields 25 to 35 bushels per acre, and the yield reaches 50 bushels in the most favorable years and under the best management. Wheat yields from 12 to 20 bushels per acre, with small applications of fertilizer, and oats about 30 bushels. From 1 to 1½ tons of timothy hay per acre is obtained when the season is not too dry. Alfalfa has been successfully grown on an occasional farm.

This soil is held in higher esteem than the Clarksville gravelly loam, owing in part to the more favorable location and in part to its greater productiveness. As a clover soil it is one of the best in the county.

Replenishment of organic matter, which can best be done by including cowpeas, red clover, alfalfa, and grass in rotation with such crops as corn and small grain, is one of the principal means of maintaining the productiveness of this soil where barnyard manure is not available. Phosphatic fertilizers are also needed. Because of its superiority as a clover and grass soil, the raising of live stock is the most important industry. In the more favorably located areas,

as near Cabool, dairying could be developed with profit. Slopes steep enough to be washed should be terraced and the rows made to follow the contours.

BAXTER SILT LOAM.

The Baxter silt loam typically consists of 6 to 8 inches of brownish-gray to light-brown silt loam overlying yellowish silt loam which passes at depths of 10 or 12 inches into reddish-yellow silty clay loam. This quickly grades into yellowish-red, moderately friable clay, which becomes redder with increased depth until bright-red or deep-red, brittle clay is reached, generally within the 3-foot section. In nearly level areas there is slight grayish mottling in the subsoil. Where there is much gray the soil represents an inclusion of Lebanon silt loam. On the eroded slopes the soil is usually of a brown or red color. Some of the included areas, such as the area just north of Licking along the south side of the headwaters of Spring Creek, really consist of Hagerstown silt loam.

The principal areas of Baxter silt loam occur in the valleys between Oscar and Licking and west of Dunn. Other small bodies are scattered throughout the county. The greater proportion of the type is confined to gentle slopes near the headwaters of streams. The surface is undulating, gently rolling, and gently sloping. Both the surface drainage and underdrainage are good. Because of its productiveness and the absence of stones the Baxter silt loam is one of the most valuable upland soils. Practically all of it is in cultivation. It ranks high as a wheat and clover soil.

Corn, wheat, and grass are the main crops. Corn yields 30 to 40 bushels per acre ordinarily, with lower yields in the driest years and considerably higher yields when conditions are favorable. Wheat averages about 13 bushels per acre, but the yield frequently reaches 25 bushels. Oats are grown only to a very small extent and are seldom thrashed, although yields of 35 to 40 bushels per acre are reported. Timothy and clover frequently give $1\frac{1}{2}$ to 2 tons per acre. A little alfalfa has been grown.

The soil responds remarkably well to manure and phosphatic fertilizers. Applications of lime are said to have had noticeably beneficial effects.

The best improved and well situated land of this type is valued at about \$75 an acre.

The growing of leguminous crops in rotation with corn and small grains would be advisable in order to maintain an adequate supply of organic matter. Slopes steep enough to be washed should be terraced, and the rows should follow the contours.

Baxter silt loam, shallow phase.—The Baxter silt loam, shallow phase, occurs in a few small scattered areas and is of a variable na-

ture. Part of it consists of light-brownish silt loam underlain at shallow depths by yellowish silt loam which quickly passes into yellowish-red silty clay loam and this into red clay. This is the typical shallow phase of the Baxter silt loam. Other areas consist of dark-gray to gray, heavy silt loam passing at 8 to 10 inches into yellow silty clay loam. This latter soil approaches the characteristics of the Clarksville series. The area about 4 miles northeast of Cabool has a plastic, sticky, heavy clay at about 8 inches and is mottled yellow and gray, with some dark concretions in the lower subsoil. This area represents an inclusion of Colbert silt loam.

This phase is used mainly for pasture, because it is better adapted to grass than to any of the cultivated crops. Some corn and wheat are grown, but the yields are somewhat lower than on the typical soil.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the typical Baxter silt loam:

Mechanical analyses of Baxter silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
344400.....	Soil.....	0.1	1.9	2.4	11.8	4.7	66.7	12.6
344401.....	Subsoil.....	.3	1.4	1.8	9.6	4.3	62.0	20.8
344402.....	Lower subsoil...	.5	1.3	1.8	10.2	3.5	56.9	26.0

COLBERT STONY LOAM.

The Colbert stony loam is a rather variable soil. It consists of grayish to brownish silt loam underlain at 4 or 5 inches by yellow silty clay loam, which passes into yellow or grayish-yellow, plastic, heavy clay, sticky when moist. In places red, plastic clay is encountered in the subsoil, but this is unlike the red clay of the Baxter series, not being nearly so friable. The limestone bedrock is encountered usually within 2 feet of the surface, in some places only a thin veneer of soil overlying the rock. There are occasional limestone outcrops. In places the soil is black, especially where there is any seepage. Chert and limestone fragments are abundant.

The Colbert stony loam occurs in scattered and rather small areas. There are important bodies in the vicinity of Walnut Grove School, Coats Store, Pleasant Hill School, Zion Church, Cleveland School, along Mill Creek, and at Mahan. The surface drainage is generally good, where there is no seepage, but the dense subsoil interferes with the internal movement of moisture. The type is encountered about the head of hollows, and on slopes, ridges, and "bald knobs." It also occurs along stream slopes as narrow strips associated with

ledges of limestone. Rather small post oak and blackjack oak comprise the tree growth. In places the natural growth is sparse, and some areas approach the characteristics of glades. Much of this type is too stony for cultivation. Its principal value is for pasture land.

COLBERT GRAVELLY LOAM.

The Colbert gravelly loam typically consists of gray to dark-gray silt loam 4 or 5 inches deep over pale-yellow silt loam to silty clay loam, underlain at about 8 inches by yellow or greenish-yellow, plastic clay. Bedrock consisting of limestone is reached at depths of less than 3 feet, and fragments of chert and limestone are present on the surface and through the soil and subsoil. The clay of this soil is heavier and stiffer than the clay underlying the Baxter, Lebanon, or Clarksville soils. In places the subsoil is reddish, but all of it is very heavy and stiff, differing distinctly from the much more friable red clay of the Baxter subsoils. On exposure it cracks in a way peculiar to very heavy, plastic clays.

The principal areas of Colbert gravelly loam occur in the vicinity of Dunn, between Simmons and Cedar Grove Church, and southwest and southeast of Houston. It is found in flattish areas, on slopes, and in gently rolling to undulating areas. The surface drainage is good, but the dense clay subsoil doubtless impedes under-drainage.

This is a fairly extensive soil and a considerable proportion of it is cultivated. Part of it is forested, mainly with oak. Some areas are of a glady nature, having but a sparse tree growth. The Colbert gravelly loam is used for the production of wheat, corn, and grass, which give fair to good yields according to the season, the care in cultivation, and the depth of the soil above bedrock. Crops suffer in dry years on those areas where bedrock lies near the surface. In general it has its greatest value as pasture land. The land is valued at about the same price as the Clarksville gravelly loam.

GUTHRIE SILT LOAM.

The Guthrie silt loam consists of a brownish-gray or ash-colored silt loam about 8 inches deep, overlying mottled gray and yellow silty clay which usually contains an abundance of dark concretions and concretionary material. The dry surface soil has a light-gray or whitish color.

The principal areas of Guthrie silt loam occur east of Raymondville and in the vicinity of Licking. There is a small development south of Summersville. The type occupies flats and slight upland depressions of poor drainage.

This is not an extensive soil, and it is of little importance in the agriculture of the county. Corn does fairly well in years of moderate rainfall, but poor yields or complete failures may be expected in very wet years. Grass crops do fairly well. Ditching or tiling, the addition of barnyard manure, and the application of lime are means of improving the productiveness of this type of soil.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Guthrie silt loam:

Mechanical analyses of Guthrie silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
344433.....	Soil.....	0.3	1.2	0.4	1.1	2.0	72.6	22.4
344434.....	Subsoil.....	1.6	2.4	.8	1.5	1.4	67.4	25.1
344435.....	Lower subsoil...	.2	1.3	.9	2.2	1.8	54.6	39.2

GASCONADE STONY CLAY.

The Gasconade stony clay is a black clay loam to clay, underlain at 6 to 8 inches by yellowish, plastic, sticky, heavy clay, usually greenish yellow in the lower subsoil or just above bedrock. The bedrock, consisting of limestone, is reached at an average depth of 15 inches, though it may lie at any depth from a few inches to about 2 feet. Fragments of chert and limestone occur on the surface and through the soil and subsoil, and there are occasional outcrops of limestone. Some stiff red clay like that occurring in the areas included with the Colbert soils is encountered in the subsoil in places, but such material is not like either the Colbert or the Gasconade subsoil materials. It simply marks an included soil which is not given recognition as a separate type owing to its small extent.

There are two principal areas of Gasconade stony clay, one lying between Hog and Indian Creeks, and the other southeast of Ozark Church. The type occurs about the heads of drainage ways, on gentle slopes, and on flattish areas of the divides. Relatively large amounts of organic matter, due to moist conditions resulting from seepage and probably slow underdrainage, and a high lime content seem to be the causes of the dark color of the soil.

Some areas have a scant growth of trees, being of a glady nature. Post oak is one of the principal trees.

This soil is not of much importance owing to its small area and stony nature. It is used for pasture, grasses doing well on it. The land can be bought for \$10 or less an acre.

HANCEVILLE STONY FINE SANDY LOAM.

The Hanceville stony fine sandy loam differs from the Hanceville gravelly fine sandy loam mainly in the larger size of many of the rock fragments and the shallower soil, sandstone bedrock being encountered at 12 to 20 inches below the surface. Large and small sandstone fragments and in places chert fragments are scattered over the surface and disseminated through the soil and subsoil.

This type occurs in the northern part of the county, with the greatest area in the vicinity of Ashley School and along Arthurs Creek and Big Piney Creek. Most of it is rolling and traversed by numerous drainage ways. It is rather droughty and susceptible to erosion, owing to its shallow depth. The native timber consists of pine, black oak, white oak, and blackjack oak.

The greater part of the Hanceville stony fine sandy loam is forested and used for pasture. The cultivated areas represent the less stony patches and the included small bodies of Hanceville fine sandy loam. In general it is a nonagricultural soil.

HANCEVILLE GRAVELLY FINE SANDY LOAM.

The Hanceville gravelly fine sandy loam is much like the Hanceville fine sandy loam, except that it is much more gravelly and often somewhat lighter in the surface soil. It typically consists of a light-brown or grayish-brown fine sand, loamy fine sand, or fine sandy loam, which passes below into dull-red, friable fine sandy loam to fine sandy clay. In the lower subsoil there is frequently present the same grayish to pale-yellowish layer that is found in the fine sandy loam type. In places the subsoil consists of yellowish sand or loamy sand lying directly over sandstone. There are also included areas in which the subsoil is a yellowish fine sandy clay. Angular fragments of sandstone are abundant over the surface and through the soil and subsoil, with many chert fragments in places. In some areas bedrock is reached within the 3-foot section. This soil is derived from alternate beds of limestone and sandstone, which locally include some beds of chert.

The Hanceville gravelly fine sandy loam occurs in scattered areas in the northeastern part of the county. There are considerable areas north of Coulstone, in the vicinity of Prescott, and along Sherrill Creek. The type is more extensive than the Hanceville fine sandy loam. Much of it occupies slopes along streams, and it is generally more rolling than the fine sandy loam. It is well drained.

This soil is farmed to a considerable extent. It is used for the same crops as the Hanceville fine sandy loam, and gives about the same yields. Owing to its gravelly nature it is less susceptible to wash than the fine sandy loam, but the gravel content makes tillage

somewhat more laborious. This land is valued at about the same price as the Hanceville fine sandy loam.

HANCEVILLE FINE SANDY LOAM.

The typical Hanceville fine sandy loam is a grayish-brown or light-brown, fine sandy loam passing at about 6 inches into yellowish-brown fine sandy loam and grading beneath this into dull-red, friable fine sandy clay or moderately stiff clay. In places there is a grayish to pale-yellowish layer of quite sandy material in the lower subsoil, probably representing decomposed sandstone. The grayish material is not typical of the Hanceville soils as they have been mapped in other areas. This soil is derived from sandstone and limestone, which in places contain chert, and chert fragments occur in the soil in some areas.

The Hanceville fine sandy loam, which is not extensive, is found in scattered small areas in the northeastern part of the county. The surface is sloping or somewhat rolling. The type is thoroughly drained, but it nevertheless retains moisture very well.

A considerable proportion of this soil is in cultivation, principally to corn and wheat. Corn yields from 15 to 30 bushels per acre and wheat 10 to 15 bushels. Clover and timothy do especially well, and for these crops the soil compares favorably with the Baxter silt loam.

The Hanceville fine sandy loam washes easily. Hillside terraces should be constructed and the rows run with the contours of the hills.

This land sells for \$15 to \$35 an acre, according to the location, topography, and improvements.

Peanut growing and hog raising probably could be made a profitable combination on this soil. Peanuts generally do well on sandy loam soils of this general character. They can be grown between the rows of corn with little extra cultivation, and used as a field forage crop for hogs after the corn is harvested. Replenishment of the organic matter is necessary if the productiveness of this soil is to be maintained.

CUMBERLAND SILT LOAM.

The Cumberland silt loam consists of a brown to light-brown silt loam, underlain at 8 to 15 inches by yellowish to slightly reddish silty clay loam, which passes below into red or brownish-red, friable clay. In places slight gray mottlings are noticed in the subsoil. The better drained areas have the more brownish soil and deeper red subsoil. There are some included patches of Cumberland fine sandy loam.

The Cumberland silt loam occurs in small strips along Big Piney Creek and West Piney, Hamilton, and Possum Creeks, and in a few

other scattered areas. These are mainly small, but the soil is very productive, and hence important locally. It occupies the higher, flat to gently undulating second bottoms and is typically well drained. Nearly all of this type is under cultivation. Corn, wheat, and grass are the main crops. Corn yields 30 to 50 bushels, wheat 15 to 25 bushels, and hay 1 to 2 tons per acre. The land is valued at \$25 to \$50 an acre.

ELK SILT LOAM.

The typical Elk silt loam is a light-brown to brown silt loam passing at 6 or 8 inches into yellowish-brown silty clay loam and this at 14 to 24 inches into yellow, moderately friable silty clay. In some of the more poorly drained situations the lower subsoil is paler yellow, shows some grayish mottling, and contains some dark-colored concretions. Some areas are a little sandy. Gravelly areas are shown on the map with gravel symbol.

One of the principal areas of Elk silt loam occurs at Simmons. Others of the more important bodies occur along Potters Creek, near Cabool, and along Hamilton Creek. The type is not extensive, but most of it is under cultivation, and it is a soil of local importance. It occupies flat second bottoms but has good drainage. This is a productive soil used for wheat, corn, grass, and clover. Corn yields 35 to 50 bushels per acre and in some of the best years as much as 70 bushels. Ordinary yields of wheat range from 10 to 20 bushels per acre, and of oats from 25 to 35 bushels. Timothy and clover do well. This is considered one of the best soils in the county. It is valued at an average of about \$50 an acre.

Where clover or cowpeas are included in the rotations it is not difficult to keep this soil in good productive condition.

ROBERTSVILLE SILT LOAM.

The Robertsville silt loam is a gray silt loam, underlain at 6 to 8 inches by gray silty clay, mottled with yellowish and brownish colors, and passing at about 20 inches into mottled gray and yellow, plastic clay. In the better drained situations there is more yellow and less gray in the subsoil and the surface material is more brownish. The converse is true in the more poorly drained areas. The texture ranges to a silty clay loam in places. Black concretions are present, being most abundant in the more poorly drained situations.

This soil occurs in rather small strips on imperfectly drained second bottoms. A number of areas occur along Big Piney Creek. The type is not very extensive, but most of it is cultivated, grass, corn, and wheat being the principal crops. Corn yields from 20 to 35 bushels

per acre, according to the nature of the season and the soil treatment, and wheat from 10 to 15 bushels. Land of this type is valued at \$25 to \$50 an acre.

The incorporation of vegetable matter and the application of phosphates and lime probably are the best means of improving this soil. Ditching or tiling would improve much of it.

HUNTINGTON GRAVELLY LOAM.

The Huntington gravelly loam consists of a brown gravelly loam which changes but little through the 3-foot section, except that the subsoil usually is a little lighter colored. Some areas are composed almost entirely of gravel. The gravel consists of rounded, angular, and subangular chert.

This soil occurs along the smaller streams in all parts of the county. The narrow bottoms are gravelly to a larger degree than the broad ones. The type is subject to overflow, but it dries out rapidly after the recession of the water.

While this soil is very gravelly it is not difficult to till, and much of it is in cultivation. Corn is grown almost exclusively, the yields ranging from 15 to 30 bushels per acre. Very little wheat is grown, because fields located on this type are usually small. Clover and bluegrass do well.

HUNTINGTON FINE SANDY LOAM.

The Huntington fine sandy loam is a rich-brown fine sandy loam which passes at 10 to 20 inches into a subsoil of lighter brown or yellowish-brown fine sandy loam or loam. Frequently there is very little change in color, texture, or structure to a depth of 3 feet. In places the subsoil has a reddish cast, as in some of the bottoms in the northeastern corner of the county. In some places gravel is abundant. The soil is very easily cultivated with light implements and teams.

This soil occurs chiefly in the bottom lands in the northern and northeastern parts of the county, where part of the drainage comes from sandy uplands. Practically all of it is in cultivation, and it is considered one of the best corn soils. Wheat gives lower yields than on the Huntington silt loam and loam. The plowing under of a crop of cowpeas or clover at intervals of a few years will go far toward maintaining the productiveness of the soil.

HUNTINGTON LOAM.

The Huntington loam differs from the Huntington silt loam chiefly in its lighter texture. It has a wide distribution and is an important soil, used for the same crops and giving about the same yields, as the silt loam. It is well drained, although subject to overflow,

and is even easier to keep in good tilth than the silt loam. In places the surface soil is dark brown, as along the West Fork of Roubidoux Creek. This land is held at the same price as land of the Huntington silt loam.

HUNTINGTON SILT LOAM.

The typical Huntington silt loam is a brown, mellow silt loam, which passes at 10 to 15 inches into light-brown silt loam and below this into yellowish-brown silty clay loam. In some of the depressions which carry drainage but which do not have well-defined stream channels some of the soil included with this type does not have the rich-brown color of the typical soil, and in places shows some gray mottling and dark-colored concretions in the yellow clay subsoil. There are also a few grayish, poorly drained patches which would be mapped as Holly silt loam had they been of larger extent. The largest of this kind is north of Hazleton on Big Piney Creek. In places the subsoil has a reddish cast. The type as mapped on Roubidoux Creek near Turley has a dark-brown surface soil, approaching in this character the Dunning soils.

This is one of the most important of the stream bottom soils. It occurs along many of the streams of the county, in areas ranging from narrow strips to strips about one-half mile wide. The type is most extensive along Big Piney Creek and its tributaries.

Most of this type is subject to overflow, but it is well drained otherwise. It is a very productive soil, and much of it is in cultivation. It is highly esteemed, and farms including much of this soil or similar bottom land have a higher value than those composed entirely of uplands. The soil holds moisture in dry seasons, when crops on the uplands may be seriously damaged, and good yields consequently are more certain than on upland farms. Some damage, however, is occasionally done by overflows. Corn is the principal crop grown. Wheat, oats, sorghum, timothy, and clover are also grown. Corn averages about 30 bushels per acre, but yields as much as 65 or 70 bushels in the most favorable years, without fertilization. Wheat averages about 15 bushels per acre, and occasionally yields up to 25 or even 30 bushels. This soil is easy to handle. Land of the Huntington silt loam is valued at \$30 to \$60 an acre.

DUNNING GRAVELLY LOAM.

The Dunning gravelly loam is a very dark brown to black gravelly loam, passing beneath into brown, dark-brown, or black gravelly loam, silty clay loam, or silty clay. In places the dark color persists throughout the 3-foot section. The clay is rather plastic, and is in places mottled with brownish colors. Some included areas consist of Dunning silt loam. The soil is rich in organic matter.

This type has a rather wide distribution. Some important strips occur in the bottoms along the headwaters of Bear, Possum, and Elk Creeks and along Hamilton Creek. The type is subject to overflow, but drains out sufficiently for the production of very good crops; in fact, it is one of the most productive soils in the county, comparing favorably with the Huntington soils.

Corn is the main crop. Yields range from 25 to 50 bushels per acre. Wheat, sorghum, grass, and clover do well, but are not much grown.

ROUGH STONY LAND.

The roughest and most precipitous stony areas are classified as Rough stony land. This type includes very stony, steep slopes along streams, and ledges and cliffs of sandstone and limestone. Some of the limestone cliffs approximate 200 feet in height. Patches of other soils, mainly Clarksville and Hanceville, are included on the map in places where they are too small for satisfactory separation.

The principal areas of Rough stony land occur along Jacks Fork, Big Creek, and Big Piney Creek and its tributaries.

Land of this type is valuable only for range. All of it is forested.

SUMMARY.

Texas County, area 741,760 acres, or 1,159 square miles, is situated in the south-central part of Missouri. Its surface is predominantly rolling to hilly, with some fairly level areas in the uplands. The regional drainage is well established.

The population of the county in 1910 was 21,458. There are no large towns. The St. Louis & San Francisco Railway passes through the southwestern part of the county, supplying quick service to Memphis and Kansas City. The public highways generally are fairly good and some are very good.

A large part of the area is covered with forest. Much of this has been cut over for lumber and crossties, but lumbering is still an active industry.

The principal crops of Texas County are corn, wheat, grass, clover, grain sorghums, oats, and cowpeas. The raising of beef cattle and hogs is an important industry. Lespedeza and other wild plants supply valuable pasturage, and in some years there is abundant mast for hogs. Some sheep, goats, and mules are raised. Dairying is carried on to a small extent near the railroad towns, and is increasing in importance.

There are a few commercial orchards of apples and peaches, but fruit growing as an industry is declining rapidly.

Some fertilizer is used, chiefly for wheat. The applications are light, usually from 75 to 125 pounds per acre. There is increased

interest in the use of lime, and barnyard manure is conserved more extensively than in former years.

Grass and clover, and sometimes cowpeas, are grown in rotation with wheat and corn, with very good results.

Little attention has been given to selecting soils for the crops to which they are best adapted, except that wheat, grain sorghum, and grass are given some preference on the prairie (Lebanon) soils, while corn is grown to a greater extent than other crops on the alluvial soils.

The Clarksville gravelly and stony loams are the most extensive of the upland soils. Much of the gravelly loam is cultivated, but probably considerably more than half of it is forested and used only as a range for stock. Little of the stony loam is farmed. Corn yields from 10 to 40 bushels per acre on the gravelly loam, depending on the season and treatment. Wheat yields 10 to 15 bushels and hay 1 to 1½ tons.

The Baxter gravelly loam and silt loam are valuable soils, somewhat more productive than the Clarksville, but used for the same crops. They have red subsoils, while the typical Clarksville types have yellow subsoils.

The Lebanon silt loam represents the gray stone-free soil of the ridges. It is used for corn, wheat, and grass, but the yields are low.

The Colbert types have gray surface soils and heavy clay subsoils. The gravelly types are best suited for pasture.

The sandstone soils, classed in the Hanceville series, where not too stony, give fairly good results. On the fine sandy loam corn yields from 15 to 30 bushels, wheat 10 to 15 bushels, and clover and timothy 1 ton or more per acre. The Hanceville stony loam is best suited to forestry and pasturing stock, being largely nonagricultural.

The first bottom soils, classed in the Huntington and Dunning series, are largely in cultivation. Where there is not too much gravel good yields are obtained.

The second-bottom soils also constitute valuable, productive land, especially the well-drained types, the Elk and Cumberland silt loams. They give good yields of corn, wheat, timothy, and clover. Alfalfa probably could be made a profitable crop on these types. The Robertsville silt loam is a good soil, characterized by a light-gray surface soil and drab clay subsoil.

The price of land in Texas County ranges from \$2 or \$3 an acre for some of the more stony, rough lands back from the main highways to about \$60 an acre for the best bottom-land soils.

[PUBLIC RESOLUTION--No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture "

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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