



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.

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SOIL SURVEY OF NEWTON COUNTY,  
MISSOURI.

BY

A. T. SWEET, IN CHARGE, AND E. S. VANATTA, OF THE U. S.  
DEPARTMENT OF AGRICULTURE, AND E. W. KNOBEL,  
OF THE UNIVERSITY OF MISSOURI.

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HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

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[Advance Sheets—Field Operations of the Bureau of Soils, 1915.]



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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,

*Washington, D. C., June 21, 1916.*

SIR: Under the cooperative agreement with the State of Missouri a soil survey of Newton County was carried to completion during the field season of 1915.

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 1915, as authorized by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

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

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## MAP.

Soil map, Newton County sheet, Missouri.



## SOIL SURVEY OF NEWTON COUNTY, MISSOURI.

By A. T. SWEET, In Charge, and E. S. VANATTA, of the U. S. Department of Agriculture, and E. W. KNOBEL, of the University of Missouri.—Area Inspected by HUGH H. BENNETT.

### DESCRIPTION OF THE AREA.

Newton County lies near the southwest corner of Missouri. Jasper County bounds it on the north and Lawrence and Barry Counties on the east. McDonald County on the south separates it from the State of Arkansas, while Ottawa County, Okla., and Cherokee County, Kans., border it on the west. Newton County has an area of 622 square miles, or 398,080 acres.

The topography as a whole is that of an upland plain sloping gently toward the west. The surface is prevailingly level. From the uplands 3 miles west of Neosho, Diamond Grove Prairie, 10 miles to the northeast, is seen across the valley of Shoal Creek and the adjacent hilly region as a part of the prevailing even plain. The upland region west of Neosho as viewed from Diamond Grove Prairie presents the same appearance.

In the eastern part of the county the plain has an elevation of approximately 1,300 feet above sea level and in the western part an elevation of a little more than 1,100 feet, the slope toward the west thus being about 6 feet to the mile. The county lies near the outer western border of the Ozark Uplift, which caused but slight tilting here, and little displacement or folding of the rock beds.

Into this westward-sloping plain numerous streams have cut deep and in places broad valleys, which are bordered in many places by slopes too steep and rocky for profitable cultivation and in some places by almost perpendicular bluffs. The elevation of the Shoal Creek bottoms at the wagon bridge 2 miles north of Neosho is 985 feet above sea level; that of the prairie uplands 3 miles south and east of this city, near June, is approximately 1,275 feet. The difference in altitude between these points is fairly representative of the elevation of the main part of the uplands above the valley floors of the larger streams. This depth of valley dissection represents the total fall of the branch streams and is also a measure of the work that



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



has been done in reducing the old upland level, the surface relief being due almost entirely to erosion.

Considered in detail, there are four distinct topographic divisions in Newton County: The almost level or smooth uplands, the hilly region, the terraces or second bottoms, and the stream flood plains. The smooth uplands are the remnants of the formerly continuous plain, which has not yet been entirely reduced by the streams. These remnantal areas form the divides between the principal stream courses and include the principal tracts of prairie.

The most important area of upland prairie, in the northeastern part of the county, is of large extent, reaching from a point 3 miles east of Saginaw in an east and southeast direction to the county line near Wentworth. It forms the divide between Center Creek and Shoal Creek. A second area of prairie extends from a point about 4 miles east of Neosho eastward and southeastward to the county line near Fairview, dividing the Shoal Creek and Indian Creek basins. A third rather large area of smooth upland occupies that part of the county south, west, and northwest of Neosho. This area is quite irregular in outline and has been almost divided into three parts, one extending toward the south between the Buffalo Creek and Bullskin Creek basins, another toward the southwest as a divide between Buffalo Creek and Lost Creek, and the third toward the northwest as a watershed between Lost Creek and Shoal Creek. Swars Prairie in the southwestern part of the county and Burkhart Prairie between Lost Creek and Fivemile Creek are other important upland areas. A small upland area extends from Round Prairie School northward to Spring City, and another occupies the extreme northwest corner of the county.

All these areas of smooth upland are quite irregular in outline, each having numerous extensions which form the divides between the smaller streams. The topography varies from level to slightly undulating.

Strips of flood plain or bottom land extend along all the principal stream courses, varying in width from a few rods to one-half mile or more. They are fairly level, usually having a gradual slope downstream as well as from the outer margin toward the stream channel. In many places, especially along the valley of Shoal Creek, there are narrow terraces or second bottoms, which are in most places separated from the present flood plain by an abrupt slope 10 to 30 feet or more in height. On the outer side, however, they merge gradually into the adjacent uplands. Along many of the smaller streams there is very little development of true flood plain, the valley consisting almost entirely of gentle colluvial slopes. The small valleys are usually quite narrow and are bordered by steep slopes near the point

where they enter the larger valleys, but as they extend back into the more nearly level uplands the valleys become much broader and the slopes shorter, and in many places less abrupt.

Between the almost level flood plains and terraces on the one hand and the smooth highlands on the other there extends the hilly region. In point of area covered this is by far the most important topographic division of the county. The slopes vary from those too steep for cultivation to those which have merely enough gradient to afford good drainage. In general, the steeper and more stony slopes occur adjacent to the broader valleys or to the smaller valleys near their junction with the larger ones. Much of the hilly slope land is under cultivation and it includes the principal areas of intensively cultivated farms.

In much of the hilly region there is a close relation between the underlying rock beds and the topography. Where alternating beds of limestone and chert are exposed to weathering, the limestone beds break down with comparative ease, but the heavy, more resistant chert beds check erosion and in places give rise to low, flat ridges, with rather sharply defined bounding slopes. Ridges of this character are quite conspicuous around the headwaters of North and Middle Indian Creeks between Stark City and Fairview, forming in places a rather distinct escarpment. In places two or more of these benches occur along the course of some of the small streams or about their heads, as is the case along the small streams which flow west immediately to the south of Fairview Church.

There are a large number of permanent streams in Newton County, fed by numerous large limestone springs. One such spring on Elm Spring Branch supplies water for the city of Neosho. The "Big Spring" at Neosho flows from the earth through a channel about 6 feet wide and several inches deep.

Shoal Creek drains the central part of the county, Indian Creek the southeastern part, Bullskin Creek the south-central part, and Buffalo Creek and Lost Creek the southwestern part. The northeastern part of the county is drained by Center Creek. These streams all have gravelly and rocky bottoms and clear water, and are swift flowing. Shoal Creek furnishes power for several large flour mills.

The population of Newton County, according to the census of 1910, is 27,136. The population remained practically stationary during the preceding 10 years. Native whites constitute 96.5 per cent of the total number of inhabitants, and negroes 2 per cent. The population of Newton County is much more cosmopolitan than that of the counties in Missouri along the Mississippi and Missouri Rivers, which were settled earlier and largely by people from Kentucky, Tennessee, and Virginia. The early settlers in Newton County came from many States, largely those of the North and East. The more recently immigrating settlers have been attracted, through extensive advertising

of the possibilities in fruit and berry growing, from all sections of the country. The mining industry also has attracted settlers.

Of the total population of the county, 86.5 per cent is classed as rural. Settlement is rather uniform throughout the county, the density of rural settlement, including inhabitants in places of less than 2,500 population, averaging 37.7 persons to the square mile.

Neosho, the county seat, had in 1910 a population of 3,661. Neosho is a thriving town, its post-office receipts having doubled in the last five years. The city is supplied with electric light and power from the White River in Taney County. It has large flour mills, a canning factory, a Government fish hatchery, a large nursery, greenhouses, several factories of importance, a large cold-storage plant, and several grain elevators.

Granby, with a population in 1910 of 2,442, has been the center of an important lead and zinc mining region for many years. The first lead mine in southwestern Missouri was opened here in 1854 and has been in operation continuously since. Seneca, in the western part of the county, is an important business center. Here are operated the largest flour mills in this part of the State. It is also the center of an important tripoli industry. Other towns of considerable local importance are Diamond and Wentworth, in the north-central and northeastern parts of the county, respectively, and Fairview, Stella, Newtonia, and Stark City, in the southeastern part.

Newton County has good railroad service. The St. Louis & San Francisco Railroad crosses the county east and west and gives direct communication with St. Louis, Kansas City, and the Southwest. The Kansas City Southern traverses the county north and south, affording a direct route to Kansas City and to Port Arthur on the Gulf of Mexico. The Missouri & North Arkansas, the southern terminus of which is Helena, Ark., uses the tracks of the Kansas City Southern as far as Neosho, extending thence southeasterly. A branch line of the Missouri Pacific extends from Webb City, in Jasper County, to Granby.

Kansas City furnishes the principal market for the agricultural products of the county. Strawberries and grapes are shipped in carload lots to Denver, St. Paul, Detroit, Chicago, St. Louis, and other northern and eastern markets. Poultry and poultry products are shipped to Chicago, New York, and other points. Joplin, an important mining center in Jasper County, furnishes an excellent near-by market for much of the orchard, truck, dairy, and poultry products.

Excellent public roads surfaced with chat, or finely crushed rock from the mines, connect Seneca, Neosho, Granby, and Diamond with Joplin. Over these highways automobile lines operate as common carriers, affording cheap and rapid transportation.

## CLIMATE.

The climate of Newton County is healthful and temperate, well suited to general farming, stock raising, and fruit growing. A comparison of the temperature and precipitation records of the Neosho station of the Weather Bureau with those of the station at Oakfield, in the east-central part of the State, near the junction of the Missouri and Mississippi Rivers, shows a mean temperature for the winter season  $2.9^{\circ}$  higher than that at Oakfield and a mean for the spring season  $1.7^{\circ}$  higher. The mean annual precipitation at Neosho is 4.16 inches greater, each month, except July, showing a slight excess over that recorded for Oakfield. The mean annual temperature is  $7.2^{\circ}$  higher than that recorded at Maryville, in the northwestern corner of the State, the greatest difference being in the winter and spring months. The mean annual precipitation at Neosho is 8.54 inches greater than at Maryville, although the Maryville records show that there is a slightly greater summer precipitation in the northern part of the State than in Newton County.

The summer season is long and warm, but is usually without prolonged periods of excessive heat. The winters, although cold, are not severe. On account of the dry atmosphere, extremes of temperature are less oppressive than in regions of greater humidity.

The apple crop is rarely destroyed by extreme cold in the winter or by late frosts in the spring. Peaches bear almost every year. Strawberries are ready for the market between May 15 and 25. The marketing of the earliest variety of grapes begins about August 1, and of sweet potatoes between August 1 and 10. A crop of cowpeas, soy beans, kafir or feterita may follow wheat or oats the same season, after the harvesting of which the land may be put into wheat. Wheat is sown principally between the 1st and 20th of October. Alfalfa, if moisture conditions are favorable, may be cut four times within a season and a succession of garden vegetables may be grown on the same ground.

On account of the higher altitude and drier air, nursery stock grown here is said to be much more free from diseases and insect pests than that grown at lower altitudes in the eastern part of the State.

As in all other parts of the Middle West, serious injury to crops occasionally results from severe droughts, hot winds, excessive precipitation or untimely frosts, but such injury is rare and with the great diversity of crops grown farmers very seldom suffer the loss of all or even the greater part of the money crops.

The mean annual temperature, as recorded at the Neosho station of the Weather Bureau, is  $57^{\circ}$  F. The mean for the spring and fall seasons is about  $58^{\circ}$  F., and for the summer  $76.3^{\circ}$ . The mean for



the winter is considerably above freezing. The absolute range in temperature recorded is from  $-30^{\circ}$  F. in February to  $106^{\circ}$  F. in July.

The rainfall is favorably distributed throughout the year. The mean annual precipitation is recorded at Neosho as 45.74 inches. The heaviest rainfall occurs in the spring, the mean for this period being 14.01 inches. The season of least rainfall is winter, with a mean of only 7.67 inches. The mean precipitation for May is 6.38 inches and for February 2.42 inches.

The average date of the last killing frost in the spring is April 24 and that of the first killing frost in the fall October 15. The average length of the growing season is thus 174 days. Killing frost has been recorded at the Neosho station as late in the spring as May 22 and as early in the fall as September 28.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation for Newton County, as recorded by the Weather Bureau station at Neosho.

*Normal monthly, seasonal, and annual temperature and precipitation at Neosho.*

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	$^{\circ}$ F.	$^{\circ}$ F.	$^{\circ}$ F.	Inches.	Inches.	Inches.
December.....	36.7	73	-12	2.74	1.25	12.21
January.....	34.8	77	-18	2.51	0.75	2.45
February.....	35.7	80	-30	2.42	2.30	0.25
Winter.....	35.7	80	-30	7.67	4.30	14.91
March.....	48.0	93	- 2	3.54	1.25	3.34
April.....	58.3	94	18	4.09	3.50	2.23
May.....	66.4	96	25	6.38	4.00	7.51
Spring.....	57.6	96	- 2	14.01	8.75	13.08
June.....	74.7	105	40	5.53	4.50	6.11
July.....	77.4	106	43	4.34	1.50	8.06
August.....	76.8	104	45	4.00	3.75	4.76
Summer.....	76.3	106	40	13.87	9.75	18.93
September.....	70.1	103	30	4.22	1.00	11.24
October.....	59.2	92	20	3.20	1.00	0.41
November.....	46.3	81	7	2.77	3.25	4.61
Fall.....	58.5	103	7	10.19	5.25	16.26
Year.....	57.0	106	-30	45.74	28.05	63.18

## AGRICULTURE.

The early settlers in Newton County established their farms near the streams, cultivating the bottom lands and the adjacent hill lands. Wheat, corn, oats, rye, tobacco, and buckwheat were the principal crops grown. Stock raising was relatively more important than at present, herds of cattle and small numbers of horses ranging over the prairies and forested uplands. With increase in population and the development of mining at Granby and later in the Joplin district, cultivation gradually extended over the uplands and stock raising declined in importance as other forms of agriculture received more attention. Some of the early settlers, those of French or German descent, gave special attention to the planting of vineyards and orchards for home use and to growing vegetables and small fruits. Gradually fruit growing and trucking have developed, until in some parts of the county this branch of agriculture has for the last 25 years surpassed in importance either grain growing or stock raising. In those sections in which fruit and truck growing received the most attention, dairying and poultry raising are also important, and diversified farming is carried on to a greater extent than in almost any other part of the State.

Corn has apparently occupied a larger acreage than any other crop since the beginning of agricultural development. The area in this grain has steadily increased from 40,613 acres in 1879 to 63,026 acres in 1914.<sup>1</sup> The average yield has apparently remained practically the same, the lowest average yield, that of 1909, being practically 22 bushels per acre and the highest, that of 1914, about 27 bushels per acre.

The area in wheat increased from 21,947 acres in 1879 to 61,711 acres in 1899, but for 1909 only 29,190 acres are reported in this cereal. The Missouri Crop Review reports 31,671 acres in wheat in 1914, with an average yield for the county of about 18 bushels an acre. The wheat acreage for 1915 was increased materially over that of 1914 on account of the prevailing high prices, but owing to the ravages of the Hessian fly, to rust, and to unfavorable weather conditions at harvest time the yield was much below normal, the average yield for the county being estimated by many farmers and thrashing-machine operators at less than 10 bushels per acre.

The area in oats has varied at the last four census years from 10,742 acres in 1879 to 22,019 acres in 1889. For 1914 the Missouri Crop Review reports only 7,538 acres in oats. The yield has ranged from an average of 12 bushels per acre in 1879 to 26 bushels in 1909.

Small acreages of rye and buckwheat have been reported at each census period since 1880. Several fields of buckwheat were noticed

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<sup>1</sup> From Missouri Crop Review, 1914.

in the course of the soil survey field work in 1915. Flax increased in acreage from 24 acres in 1889 to 1,440 acres in 1899. The census of 1910 reports a decrease to 99 acres, and at the present time little flax is grown. Barley is reported on 152 acres in 1909, a larger acreage than is reported in this grain at any preceding census year. Kafir and milo together are reported on 109 acres. Broom corn is grown to a small extent. Sorghum has been a rather important crop for many years, and at the present time it is grown extensively both for the sirup and to supply roughage.

Field crops which have become rather important within the last few years are cowpeas, kafir, feterita, shallu, milo, soy beans, and Sudan grass. Cowpeas now have a recognized place in the crop rotation on many of the farms. The area in this legume undoubtedly amounts to several thousand acres. Soy beans receive less attention than cowpeas, but there are a number of fields in this crop. Feterita and shallu, although comparatively new crops in this region, are rapidly becoming important, the acreage in these sorghums in 1915 being large. Kafir and milo are also becoming more important crops. Sudan grass is grown in an experimental way in many parts of the county, and there are a few small fields of good alfalfa.

The 1880 census reports 29 acres in tobacco, and the 1890 census 45 acres. In both 1899 and 1909 only 18 acres were in tobacco, and the crop at present is not important in Newton County.

A small acreage has been reported in tomatoes at each census period since 1880. Tomatoes are an important crop locally, and the acreage is reported to be increasing. In 1915, 500 acres of tomatoes were planted under contract within a radius of a few miles of Neosho. The canning factory at Neosho contracts with the growers, before the plants are set out, for all the tomatoes grown, at the rate of 50 cents per hundred pounds. Plate I, figure 1, shows a field of tomatoes on extremely cherty soil.

Irish potatoes and sweet potatoes have been important crops in Newton County since an early stage of the agricultural development. The 1910 census reports 1,674 acres devoted to Irish potatoes and 474 acres to sweet potatoes. The acreage in sweet potatoes has apparently increased considerably since the last census period, and at the present time this crop probably ranks next to tomatoes in importance as a truck crop. About 200 acres of sweet potatoes were planted in 1915 in the immediate vicinity of Neosho.

Of the fruit crops, the most important are apples, peaches, grapes, strawberries, and blackberries. The census reports 289,159 apple trees, 72,907 peach trees, 29,980 grapevines, 1,559 acres of strawberries, and 91 acres of blackberries in Newton County in 1909. Fruit growing is steadily increasing in importance. The development of grape and strawberry growing is receiving most attention

at the present time, and the acreage in these two fruits is rapidly increasing. Plantings of grapes on a commercial scale began about 10 or 12 years ago. Records of fruit growers' associations show that 161 carloads of strawberries were shipped from Newton County in 1915, each car containing 448 crates of 24 quarts each. The value of the crop was \$145,000, of which about \$33,000 was paid for labor. Prices received ranged from \$1.75 to \$2.75 a crate, the average price being about \$2. Some growers report yields of 200 crates or more an acre.

Observations made during the progress of the soil survey indicate that the acreage of apples is increasing only very slightly if at all. Several small orchards have been planted recently, but there have been no plantings on a commercial scale. On the other hand, several rather large orchards have been neglected and the trees are either dying out or are being removed to give way to other crops. The unsuccessful orchards are mainly those that were planted without regard to soil adaptation; this mistake is being avoided to a large extent in recent plantings. Newton County apples received medals at the Panama-Pacific Exposition at San Francisco, Neosho furnishing one of the four carloads sent from Missouri.

The agriculture of Newton County at the present time may be divided rather broadly into three types, dependent primarily upon the soil and topography of the different sections.

On the prairies, especially on the flat lands, wheat and hay are the principal money crops, the hay including both timothy and wild grasses. These are supplemented by corn, oats, cowpeas, millet, sorghum, kafir, feterita, and other crops grown principally for home use. Live stock is raised in a small way.

In the larger valleys corn and wheat are the leading money crops, supplemented by clover, alfalfa, cowpeas, and other hay and forage crops. In many cases small dairy herds or other live stock are kept, pastured in part upon the adjacent hilly lands.

Farms in the gravelly and rocky, hilly lands, especially those situated conveniently to a shipping point, are devoted to diversified farming, in which fruit growing is combined with dairying, poultry raising, stock raising, and trucking. Nearly every farm combines two or more of these branches of agriculture. Probably in no other part of the State is such a great diversity of crops grown within an area of similar extent as in this section of Newton County. Plate I, figure 2, shows the diversification of crops in a small, intensively cultivated valley. This diversification of crops is further illustrated in figure 2, which shows the crops growing in secs. 22, 27, and 34, T. 25, R. 32, in June, 1915. Nineteen different crops are mapped in fields of 2 acres or more in size, in addition to which there are small areas in miscellaneous crops, such as garden vegetables, and in small



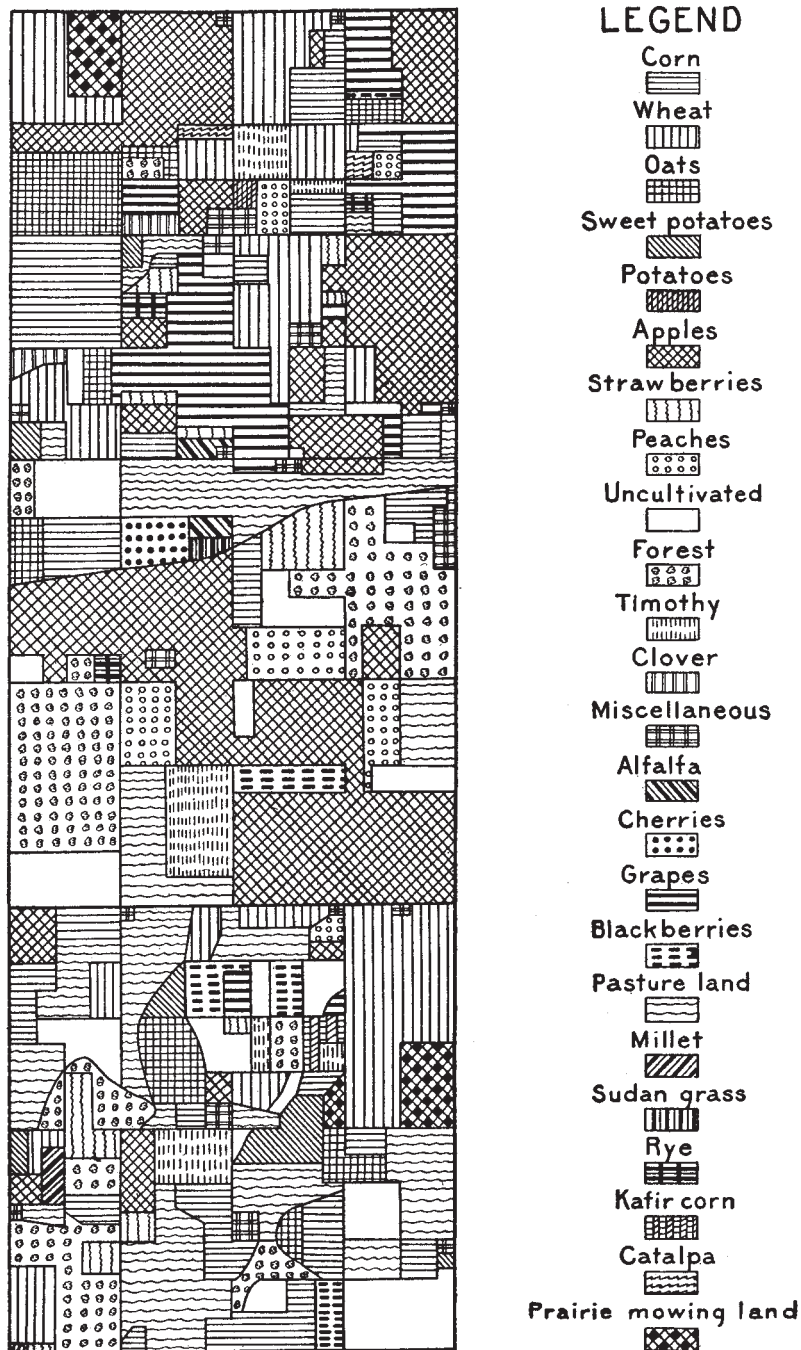


FIG. 2.—Chart showing crops growing, June, 1915, in sections 22, 27, and 34, Township 25, Range 32.

orchards. The greater part of the area classed as uncultivated was later planted to cowpeas, millet, sorghum, kafir or feterita.

In some of the areas shown on the chart two crops are grown on the same land, as where strawberries are planted in young peach orchards; where oats, wheat or cowpeas are sowed in apple and peach orchards; where peach trees are alternated with apple trees; and where grapes are grown with tomatoes between the rows. In each case the more permanent crop has been shown on the chart.

The most important crops shown include apples, covering 20 per cent of the three square miles; wheat, 10.5 per cent; corn, 9.5 per cent; grapes, 4.7 per cent; oats, 4 per cent; peaches, 2.8 per cent; and strawberries, 1.9 per cent. Almost any other area of the same size in this part of the county would show as great diversity of crops grown, although not in the same ratio, the three square miles selected probably showing a rather high relative acreage in apples and grapes and possibly a rather low relative acreage in strawberries, tomatoes, sweet potatoes, alfalfa, and clover.

The peculiar adaptation of certain crops to particular soils is quite generally recognized in Newton County, and crops are grown to the largest extent on the individual soil types to which they are naturally best suited. To some extent, however, nearly every crop is grown on the entire range of soils. The farmers realize that the level and poorly drained soils with heavy subsoil, whether on uplands, terraces or in the first bottoms, are best suited to wheat and timothy, with the use of commercial fertilizers, and that these soils are not suited to tree fruits, grapes, clover or alfalfa, and are not especially suited to corn. The deep, well-drained soils are considered desirable for corn, clover, and alfalfa. The gravelly soils are recognized as the best for fruit, the gravel and stones giving porosity to the soil and serving to some extent as a surface mulch. Red gravelly land is recognized as more productive than white gravelly land, and the soil on north and east slopes is considered better than that on south and west slopes.

The equipment of the farms in general is good. On the prairies the greater part of the breaking is done with three and four horse riding plows. A few tractors are in use. Disk harrows and 3-section and 4-section spike-tooth harrows are also in common use. Self-binders are used in harvesting grain, much of which is stacked, though some is thrashed from the shock. Timothy and wild prairie hay are, to a large extent, baled directly from the windrows. Some of the hay, however, is stacked.

On the bottom lands much of the same equipment is used as on the uplands in preparing the ground for corn and wheat. Two-horse riding and walking cultivators are used extensively in cultivating corn. Much of the corn is cut by hand, but there are some corn

binders in use. Alfalfa, clover, and cowpeas are often put into small cocks until cured, when the hay is either baled or hauled to the barns loose.

On the intensively cultivated gravelly soils two-horse implements are used in breaking and preparing the land. Most of the work is done with spring-tooth and spike-tooth harrows. The greater part of the cultivation is done with one-horse implements. Much of the handwork is done with heavy, narrow-bladed hoes.

Land to be put into wheat is apparently well cultivated. The thoroughness in tillage is due, in part at least, to the campaign which is being carried on to exterminate the Hessian fly. The land planted to strawberries is also well prepared and the soil kept thoroughly cultivated throughout the season. Sweet potatoes and tomatoes receive good cultivation. Corn, on the other hand, seems to receive less attention from many farmers than is given it in those parts of the State where it is a more important crop. Many corn growers plant on a poorly prepared seed bed, plow deep at the last cultivation, and leave the corn on high ridges, in direct opposition to the methods of the best corn growers in other sections of the United States.

Failures with alfalfa have been made in several cases on account of poor preparation of the soil and because grass and weeds were allowed to grow after a stand was obtained.

Strawberries are set out in the spring and kept well cultivated throughout the season, much hand labor being required to keep down grass and weeds. The plants come into bearing the following spring, the fruit ripening between May 15 and June 1. In this region strawberries are grown almost without exception in the matted row, and the plants under ordinary conditions are allowed to bear three, and occasionally four, crops. The beds are then plowed up, and the best growers keep the land in cowpeas or clover and other crops for a few years before again setting out strawberries. Berries are often planted in peach and apple orchards before the trees come into bearing, and also in young vineyards.

The Aroma berry has been found to be superior in flavor, yield, and shipping qualities to any other variety yet tried, and is grown almost exclusively. A variety of "ever-bearing" strawberries has been planted rather extensively near Stark City and to some extent in other parts of the county. Many crates of this variety were marketed at fancy prices in 1915, the season lasting from September 15 to October 15.

The bulk of the strawberry crop is grown in connection with other crops. There are few berry fields as large as 20 acres, and the greater number of them range from 2 to 8 acres. In these smaller fields the labor, except at picking time, is performed principally by the grower and his family.



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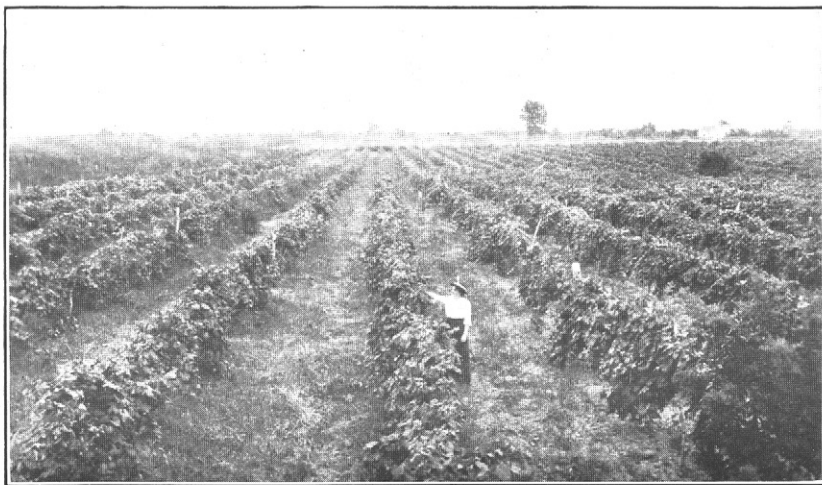
**FIG. 1.—FIELD OF VERY CHERTY SOIL PLANTED TO TOMATOES.**  
Trees in grove are mostly red oaks, indicating a fairly good subsoil.



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**FIG. 2.—VIEW ACROSS SMALL INTENSIVELY CULTIVATED VALLEY.**  
Sweet potatoes in foreground; strawberries on opposite slope to right; cowpeas and wheat following crop of oats on left; tomatoes across railroad on Baxter gravelly loam.





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FIG. 1.—FORTY-ACRE VINEYARD OF MOORE EARLY GRAPES ON LEBANON SILT LOAM.



FIG. 2.—ALFALFA READY FOR SECOND CUTTING ON A GOOD GRADE OF LEBANON SILT LOAM, TIMBERED PHASE.

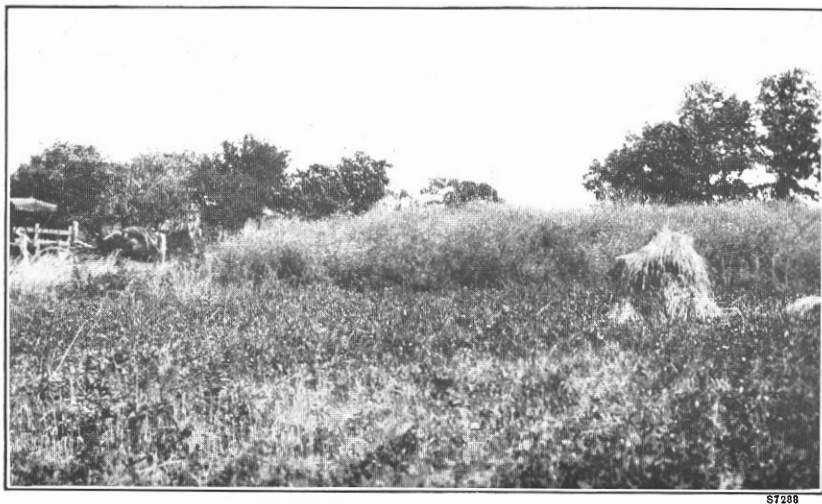


FIG. 1.—RANK GROWTH OF SWEET CLOVER ON LEBANON SILT LOAM, TIMBERED PHASE.  
Wheat stubble with red clover in foreground.

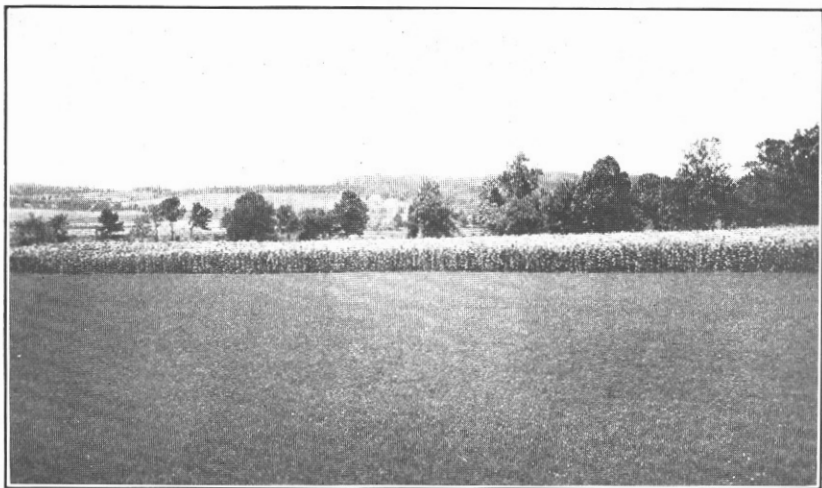


FIG. 2.—FIELD OF HUNTINGTON SILT LOAM, SHOWING ALFALFA AFTER SECOND CUTTING  
IN FOREGROUND.

Corn on old alfalfa ground in middle distance. Baxter gravelly loam on distant slopes.



The average yield of strawberries for a series of years is probably about 100 crates an acre and the average price received between \$1.25 and \$2 a crate. There are fruit growers' associations at Neosho, Aroma, Seneca, and Tipton Ford, which look after the cultivation, packing, and marketing of the fruit. At shipping time inspectors are maintained by the associations at the principal shipping points. They receive and inspect the berries, keep the association headquarters informed as to prices and the supply and demand, and if necessary sell the berries. The bulk of the crop, however, is sold on the track before leaving the shipping point.

There have been many failures in strawberry growing, attributable to a great extent to lack of preparation or experience on the part of the grower. Those who have followed proper methods have generally been successful, and some growers have made large profits.

In grape growing the best results have been had by using one-year vines for planting, setting the vines 8 by 10 feet apart. They are set deep in the furrows, so that the new growth comes just above the surface. As the vines grow, the soil is gradually worked around them so that the roots are deeply covered. As soon as the vines are large enough, they are tied to wire trellises supported on durable posts. Some farmers plant tomatoes or strawberries between the rows of grapes until the latter come into bearing. Grapes bear lightly the third year and come into full bearing, if well tended, the fourth year. The vines are kept well cultivated and are usually sprayed three times in the course of the season.

The crop is marketed between August 1 and 10, several days in advance of Concord grapes from Ohio and Michigan, thus commanding good prices. In the last few seasons they have been sold in car-load lots f. o. b. Neosho for prices ranging from 20 to 24 cents an 8-pound basket. A grape growers' association at Neosho superintends the disposal of the grapes grown by members.

Yields of grapes vary greatly with the season. Gross returns of as much as \$200 an acre are said to have been obtained from some of the vineyards near Neosho, but the average returns are very much less. On account of the lower cost of cultivating and marketing and less susceptibility to injury at shipping time from unfavorable weather, many fruit growers prefer grapes to strawberries.

Several varieties of grapes have been tried, and the Moore Early has been found best suited to local conditions (see Pl. II, fig. 1). The Moore Early is a large, well-flavored grape, which ripens early and uniformly and has excellent shipping qualities. Recent plantings have been confined almost entirely to this variety.

Good crop rotations are not followed to as great an extent as in many other sections of the State, owing to the difficulty of arranging



satisfactory rotations rather than to a lack of understanding of their value. On farms where wheat and timothy are the principal crops, wheat is grown for 1, 2 or 3 years, followed by timothy for 2 years. Some farmers sow oats instead of wheat for one year. Recently cowpeas have been planted on land previously used for wheat, and other areas of wheat land have been used for millet, sorghum or corn.

On the bottom lands and on those areas of the upland on which clover can be grown, the rotation most commonly followed has consisted of corn for 1 or 2 years, followed either by wheat and clover or by oats succeeded by wheat and clover. Often, however, it is impossible to get a stand of clover.

Newly cleared forest land is preferred for strawberries, and many fields are abandoned after one or two plantings of this crop. The more successful farmers, however, after growing strawberries for a certain length of time improve the soil by growing clover or cowpeas, or devote the land to pasture for a while, after which it is again put in strawberries.

Commercial fertilizers are employed quite extensively in Newton County, and their use is constantly increasing. Level land with a heavy subsoil is almost invariably fertilized. When wheat is to be followed by timothy, raw bone meal is often applied at the rate of about 100 pounds to the acre. If timothy is not to follow wheat, finely ground steamed bone is applied in preference to raw bone meal at the same rate. Some farmers use a 2-8-2<sup>1</sup> or a 1-8-2 mixture in applications of 75 to 125 pounds to the acre. Fertilizers analyzing 2-8-2 or 3-10-2 are used to some extent on corn, being applied at the rate of 75 to 100 pounds an acre at planting time by means of a fertilizer attachment on the corn planter. Some strawberry growers use 200 to 300 pounds to the acre of a 3-10-2 or 2-10-2 mixture, but many growers do not use any commercial fertilizer. On tomatoes some farmers use 200 to 400 pounds of a 3-8-5 mixture per acre; most tomato growers, however, prefer a good grade of manure for this crop. The use of cowpeas and soy beans for building up the soil is apparently becoming more general.

In 1910, 61.5 per cent of the farms in Newton County were operated by owners. Whether operated by owners or by tenants, the greater part of the farm work throughout the year is done by the farmer and his family. With the great diversity of crops grown the schedule is so arranged that as soon as one crop is out of the way the labor may be used for another. Most farmers keep one or more hired hands through a part or all of the year. When much attention is given to strawberries, sweet potatoes, tomatoes, and other crops of this kind, much day labor is employed, the customary rate of pay being \$1.25 to

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<sup>1</sup> Percentages, respectively, of nitrogen, phosphoric acid, and potash.

\$1.50 a day. When a man with family is hired for the season, he is often furnished a house and garden and paid about \$25 to \$30 a month. Strawberries, raspberries, blackberries, and dewberries are picked by the basket, the price paid being 1½ cents a quart. Much of the work is done by women and children; whole families often work in the strawberry fields. The daily earnings range from a fraction of a dollar for children to as much as \$2 or more for efficient adult pickers. Grapes and tomatoes are also picked by the basket.

According to the census of 1910, 76.5 per cent of Newton County is in farms. There are 3,215 farms in the county of an average size of 94.7 acres, of which 68.3 acres are improved. In the sections of the county devoted largely to specialized crops there are many 10, 20, and 40 acre farms.

Land prices in Newton County vary greatly, for several reasons. First, there is a rather wide range in the actual productive value from practically nonagricultural land to very desirable farming land. The extensive publicity given large crop returns made in small, intensively cultivated fields has tended to inflate prices. High valuations have been still further increased in parts of the county by speculative values of areas classed as mineral land. Statements made below as to land valuations are based upon cash sales and apply to land not improved by orchards, vineyards or plantings of small fruits. The most productive land in the county, including the bottom-land and the red upland soils, sells at about \$60 to \$90 an acre. Much of this land, however, is not for sale. The prairie land ranges in selling value from about \$30 or \$40 an acre to as much as \$70 an acre. The better located areas of gravelly and hilly land range in price from \$50 to \$75 an acre, but many rough and gravelly areas, especially those situated too far from the railroad to be profitably used for fruit growing, can be bought at prices ranging from \$20 to \$40 an acre.

A large proportion of the farms of Newton County have well-built houses and barns, and many have silos. Where neither a spring nor running water is available as a source of water supply, deep wells are often equipped with windmills or gasoline engines which store the water in tanks. Manure spreaders, spraying machines in the fruit districts, and other modern implements are in general use. The farms in general are well fenced with woven wire. Some bois d'arc hedge, however, is used and in places there are stretches of stone fence, built of chert fragments picked from the adjacent fields.

The best improvements are encountered on those farms in the larger valleys where the principal part of the farm is in the bottom and on those in the uplands in the eastern and northeastern parts of the county. The buildings of nearly all the valley farms are situated on terraces or alluvial fans at the mouths of small streams. This location gives good drainage and allows easy access to the uplands.

## SOILS.

The upland soils of Newton County are residual in origin, consisting of material formed through the weathering of the underlying rocks. The soils which occupy the first bottoms and the terraces, or second bottoms, are alluvial in origin, consisting of material washed from the uplands and deposited over the present and past flood plains by overflow waters.

The soils possess some characteristics which are not attributable solely to the rocks from which they are derived. Dark-colored organic matter has accumulated in places, giving the soils a darker color. In other places the soil is light colored, on account of imperfect drainage. The forested types in most places have light-colored surface soils, whereas soils derived apparently from the same source, situated in the prairie areas, are darker colored. Some of the alluvial soils are very dark colored because of the large accumulation of organic matter that has taken place under wet conditions; other light-colored soils apparently owe their light shade to the intermittent wet and dry conditions, and still other types, where the drainage has been good, are brown in color.

Newton County lies near the western margin of the Ozark region. The oldest rocks outcropping in the county are of Mississippian age. They consist of gray to bluish, rather coarse grained, fossiliferous limestone, alternating with the beds of which there are in places thinner beds of chert. There are also in places in the limestone chert nodules and lenses.

Exposure of the rock beds to weathering and erosion has resulted in the removal of the calcium carbonate, leaving the slopes covered with fragments of the more resistant chert and other impure or less soluble constituents of the limestone. These chert fragments are embedded in gray to yellowish-gray silt loam near the surface and in red plastic clay at a greater depth. At a depth usually not less than 3 or 4 feet from the surface a mass of chert fragments is in most places encountered. Below this a red, plastic clay, containing a few small chert fragments, extends to the next continuous chert layer, the layers of chert and of clay in many places being of almost equal thickness. In many places these alternating clay and chert layers extend to a depth of 10 to 30 feet before limestone beds are reached.

Deep drillings at Granby and at other places in the county indicate that the Mississippian limestone is 260 to 380 feet in thickness.<sup>1</sup> That part of it which outcrops over this region is known variously as the Burlington, Keokuk, Chouteau, or Boone formation and by some authorities as the Cherokee, these names being given to the

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<sup>1</sup> Geology of the Granby Area, Vol. IV, 2d series, Missouri Bureau of Mines.



different layers or beds which together make up the formation. The upper part of this formation carries a higher percentage of chert than does the lower part and gives rise to soils that are more cherty in character. Outcrops of the limestone and embedded chert are rarely seen on the gentle slopes, but in many places where the larger streams have recently cut into the adjacent slopes such outcrops are encountered. Along the improved highway between Neosho and Joplin there are some good exposures of alternating limestone and chert beds. These beds constitute the principal soil-giving formation of Newton County, especially in the broken and more rocky areas. From the upper and more cherty beds have been derived the soils of the Baxter series, and from the lower, less cherty beds those of the Hagerstown series.

The Baxter series characteristically has light-brown to grayish-brown surface soils and dull-red to red subsoils. It differs from the Clarksville chiefly in that the subsoil is red instead of yellow and in that the surface soil averages more brownish. The subsoil clay is moderately friable to slightly stiff. The most important types are cherty, at least in the subsoil. Nearly everywhere chert is abundant in the lower subsoil or in the substratum. The material is derived from pure limestone associated with cherty limestone or from cherty limestone. The surface is generally rolling to hilly and the drainage is good. These soils are most extensively developed in the limestone region of the Ozarks, but they occur also in the limestone region east of the Ozarks. In Newton County the Baxter stony loam and gravelly loam are mapped.

The Hagerstown series is characterized by the brown color of the surface soils and the light-brown to reddish-brown color of the subsoils. Fragments of limestone and limestone exposures are of common occurrence in areas of these soils. The Hagerstown series is most typically developed in the limestone valleys of the Appalachian Mountain region, but outlying areas occur elsewhere. The soils have an undulating to gently rolling topography and are well suited to cultivation. In Newton County the Hagerstown silt loam, with a rolling phase, is encountered.

The younger rocks, representing the later deposits of this region, which have been almost entirely decomposed and partially removed, are of Pennsylvanian age. The shales, which make up a large part of the Pennsylvanian formation, have upon exposure broken down or decayed so completely that shale outcrops are rarely encountered, except where exposed by stream erosion or artificial means. The more resistant associated sandstone is encountered along valley slopes and to some extent over the higher uplands. These rocks are most abundant in the east-central part of the county, but outcrops also occur south of Diamond, near Spurgeon, and elsewhere.

In no place does soil derived entirely from sandstone occupy an area sufficiently large to warrant recognition as a separate soil type, but in many places this sandstone material has some influence on the associated soils. In places the Hagerstown soil contains some sandy material, derived from these sandstone formations. The shales have probably contributed to the level, upland prairie soils, of which the Gerald silt loam is the principal type. In this region, however, it is not possible to determine just what rocks have given rise to some of the soils, especially those of the prairies, or to decide what proportion of the material is derived from shale and limestone, respectively.

Those soils of the county derived in varying proportions from shale, sandstone, and limestone belong in the Great Plains soil region and are included in the Eldon, Lebanon, Cherokee, and Gerald series.

The Eldon series is characterized by the dark-brown to nearly black color and the mellow structure of the surface soils; by the gray or grayish-yellow to yellowish-brown color and the friable or crumbly structure of the upper subsoil; by the gray and red color, moderately plastic to crumbly structure, and silty clay texture of the intermediate subsoil; and by the mottled gray and yellow and rather plastic structure of the lower subsoil. Usually a compact layer consisting largely of angular chert fragments mixed with some reddish clay is encountered at 18 to 30 inches from the surface. This stratum usually comes nearer to the surface (often within a few inches) with ascent of slope and lies deeper (often as deep as 4 feet) with descent of slope. The soil material is derived largely from limestone. The Eldon soils are prairie types, the topography being gently rolling with rounded ridges and gentle slopes. The series is closely related to the Lebanon series, but the color of the surface material is much darker. Drainage is well established. In Newton County the Eldon silt loam is encountered.

The surface soils of the Lebanon series are of gray to brownish-gray color and usually have a high content of silt. In local areas where surface drainage is poor the soils are nearly black and the subsoils are mottled brown, yellow, red, and gray. Typically, the upper subsoil is a yellowish silty clay loam, grading into a deeper subsoil of plastic, tough, impervious clay of a yellowish-brown to chocolate-brown color, this in turn passing into a more friable layer of somewhat lighter textured material, mottled yellow, gray, and drab. Usually within the 3-foot section there is encountered a so-called hardpan layer of reddish and gray chert fragments, often firmly cemented. Where erosion has been active, chert fragments from an underlying chert formation are scattered over the surface and disseminated throughout the soil. The topography of the Lebanon series is typically flat to undulating, the series being developed over

the plainlike, smoother, higher divides in the Ozark region. The soil material is derived from a surficial chert-free, clayey layer covering this high, smooth country and consisting probably of outwash material distributed by surface wash or streams. In Newton County the Lebanon silt loam, with a timbered phase, is mapped.

The Cherokee series is characterized by the ashen-gray color and floury structure of the predominantly silty surface soils; by the almost white color and moderately compact structure of the subsurface layer; and by the tough, waxy, plastic, impervious character of the heavy clay subsoil, the color of which is prevailing dark drab or very dark brown mottled with red in the upper part, and mottled dark drab, yellowish brown, and sometimes grayish in the lower part. The material is residual from shale, with possibly some influence from fine-grained sandstone in local areas. The surface is characteristically flat, and both surface drainage and underdrainage are poor. The Cherokee series is closely associated with the Oswego and Gerald series, the Oswego representing the black and the Gerald series the brown members of the group. The silt loam is the only member of the Cherokee series identified in Newton County.

The surface soils of the Gerald series are characteristically gray or grayish brown to light brown, and silty in texture. The subsoil consists of a light-brown or yellowish-brown silty clay loam which passes into a deeper subsoil of dingy brown or snuff-colored, plastic, heavy clay, frequently mottled with gray. The topography ranges from flat to strongly rolling, but the land is not badly dissected or broken. Surface drainage is good over the predominantly rolling country, but underdrainage is poor on account of the imperviousness of the heavy clay subsoil. The Gerald soils are typically developed through a broad section of the northern Ozark Plateau region. In Newton County only the Gerald silt loam is recognized.

The alluvial soils of Newton County include those of the terraces or second bottoms, and those of the first bottoms or present flood plains of the streams. The terrace soils are classed in the Riverton and Robertsville series.

The Riverton series is characterized by brown surface soils and light-brown to reddish-brown upper subsoils, as well as by the very gravelly character of the lower subsoil. These soils occur on relatively old terraces. The material has been derived by wash from limestone soils of the Ozark region, with more or less influence from sandstone and shale soils. In Newton County the Riverton silt loam type is mapped.

The Robertsville series has gray to grayish-brown surface soils, prevailing of silty texture. The subsoils typically consist of a gray to white, compact layer of silt loam to silty clay loam, overlying a lower subsoil stratum of compact, impervious, plastic clay of a

gray to brownish color, with some faint mottling of reddish brown. Black oxide of iron concretions are common throughout the soil section, being most abundant in the more poorly drained situations. The soil-forming material has been washed principally from limestone, sandstone, and shale soils. The Robertsville silt loam type is encountered in Newton County.

The soils of the first bottoms are classed with the Huntington and Dunning series.

The surface soils of the Huntington series are light brown to brown, and the subsoils yellow to light brown. Frequently there is little change in the color or the character of the material from the surface downward. The Huntington soils are developed in the first bottoms of streams in the Limestone Valleys and Uplands and Appalachian Mountain regions, and consist of material derived by wash from limestone, sandstone, and shale soils. They represent the best drained soils of the first bottoms of the regions in which they occur. In Newton County the Huntington gravelly loam and silt loam types are mapped, the former with a colluvial phase.

The Dunning series includes surface soils of a dark-gray to black color and high organic-matter content. The subsoils are mottled yellow, drab, and bluish. These soils consist of material washed principally from limestone, sandstone, and shale soils. They are closely associated with the Huntington soils in occurrence and in origin of the material, differing from them chiefly in color and organic-matter content. The silt loam is the only type of the Dunning series mapped in Newton County.

In subsequent pages of this report the various soil types encountered are described in detail and their relation to agriculture discussed. The distribution of the soils is shown on the map accompanying this report. The table following states the actual and proportionate extent of each soil type mapped:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Baxter gravelly loam.....	136,256	34.3	Baxter stony loam.....	21,248	5.3
Lebanon silt loam.....	15,744	19.3	Huntington silt loam.....	17,536	4.4
Timbered phase.....	60,800		Dunning silt loam.....	5,376	1.4
Gerald silt loam.....	43,456	10.9	Riverton silt loam.....	4,096	1.0
Huntington gravelly loam....	3,456	9.7	Cherokee silt loam.....	1,344	.3
Colluvial phase.....	35,200		Robertsville silt loam (inclusion symbol).....	576	.1
Eldon silt loam.....	28,992	7.3			
Hagerstown silt loam.....	10,944	6.0	Total.....	398,080	
Rolling phase.....	13,056				



## BAXTER STONY LOAM.

The Baxter stony loam differs from the Baxter gravelly loam in occupying steeper slopes and in having a prevailing higher content of large chert fragments.

Within the Baxter stony loam there are included many areas of the gravelly loam type, which on account of their small size could not be separated. Likewise the Baxter gravelly loam includes patches of the stony loam.

The Baxter stony loam occurs chiefly in narrow strips immediately adjacent to the valleys of Lost, Buffalo, Fivemile, Indian, and Shoal Creeks. The land is practically all forested, the growth being largely blackjack oak and red oak. This land is practically nonagricultural, on account of the high content of rock, and, in many places, the roughness of the topography. It includes nearly all the limestone bluffs and ledges.

## BAXTER GRAVELLY LOAM.

The surface material of the Baxter gravelly loam is a gray to light ashen gray silt loam, in which is embedded 25 to 50 per cent of chert fragments ranging in diameter from less than one-fourth inch to 4 inches or more. At a depth of 8 to 10 inches this material grades into a pale-yellow silt loam, slightly heavier in texture, in which there is about the same content of similar gravel particles. At depths ranging from about 10 to 24 inches a mass of angular chert fragments is usually encountered with some admixture of reddish clay and grayish, soft, partly decomposed chert material. Below this layer of chert there are chert beds alternating with beds of red clay. These beds of chert and clay as revealed in many places in road cuts and mine-shaft excavations are seen to extend to depths of 10 to 30 feet and probably more.

Some of the chert fragments are hard and flinty, showing smooth surfaces and sharp angles, and are commonly spoken of as "white flint"; others, known as "red flint," are red to reddish brown, somewhat porous, easily broken, and often somewhat rounded by weathering.

The Baxter gravelly loam is the most extensive and most widely distributed soil in the county. The type occurs in belts extending from the alluvial soils along the large streams, or from the adjacent narrow strips of rough and stony land, to the almost level uplands. Narrow belts of the type extend along the valleys of all the smaller streams which have worked back into the uplands. In many places it extends entirely across the ridges, which separate two drainage courses and in some instances, particularly in the southeastern part of the county, it forms a sort of escarpment at the margin of the uplands. Narrow strips of the type are encountered along the



border of stream terraces. In general the Baxter gravelly loam is developed wherever chert beds have been exposed by erosion and sufficient time has elapsed for the weathering of the material.

In topography the type varies from gently rolling areas to areas too steep for satisfactory cultivation. The greater part of the type, however, can be cultivated. Drainage is thorough and in places excessive. The chert fragments on the surface serve as a mulch and help to conserve soil moisture. They also serve a useful purpose in protecting the soil against erosion. Where the chert fragments, however, are too abundant, and especially where the mass of subsoil chert is near the surface, the soil tends to be droughty and is unsuited for tree fruits or deep-rooting crops.

On account of its large total area and its extensive use for specialized crops, the Baxter gravelly loam is one of the most important types of the county. A larger proportion of it is uncultivated than of any other type except the Baxter stony loam, but the type covers the greater part of the most intensively cultivated area. Less than one-half the land is under cultivation.

In its virgin state the type is forested with blackjack oak, post oak, red oak, black oak, white oak, and black hickory, and in the southeastern part of the county with chinquapin. The trees are named in about the order of their relative abundance. The forest growth furnishes a fair measure of the character of the soil. Where the growth consists mainly of blackjack oak with some red oak and black oak, the soil is better for most crops than where the growth is exclusively post oak. Where red oak predominates, with scattered black oak and blackjack oak trees, the soil is still more desirable. Areas forested with white oak and chestnut oak or with these oaks and scattered red oak are in general confined to partly colluvial slopes near the streams and to developments of the type closely associated with Hagerstown silt loam and include the most desirable part of the type; these areas are of only small extent.

Strawberries are the most important crop grown on the Baxter gravelly loam, and this type is the principal strawberry soil in the county. It has the reputation of producing large yields of sound, clean, well-flavored fruit.

Tomatoes are grown on this type extensively, often in connection with strawberries. In many cases after the strawberry vines have produced their last crop they are plowed under and the land immediately put in tomatoes. The north and east slopes are preferred for tomatoes, as well as for strawberries. The same farm equipment and labor may be used in growing tomatoes as in strawberry culture; the cost is much less. Tomatoes are set out about June 1 and begin to bear about August 15. The average yield is 4 to 5 tons per acre, although much larger yields are often obtained.

The Baxter gravelly loam is used rather extensively for grapes, nearly all the earlier plantings made in the county being on this type. It is also used for apples and peaches, and recent plantings made of both these fruits have been on the Baxter gravelly loam to a greater extent than on any other soil. Raspberries and blackberries are other important fruit crops on this type.

The leading varieties of fall and winter apples grown are the Grimes Golden, Jonathan, Ben Davis, Winesap, Stayman Winesap, Arkansas, Winter Banana, Gano, and Missouri Pippin. The quality of the fruit, where the trees are properly pruned and sprayed, is excellent. Rather large quantities of apples are sold on the local markets and part of the crop is shipped.

In addition to these special products, all the common crops are grown on the Baxter gravelly loam, including corn, wheat, clover, and cowpeas. On the better areas of the type wheat gives fair yields of a good quality of grain, the average yield probably being between 10 and 15 bushels an acre. Clover does well. The soil in its virgin state is not very well adapted to corn, though fair to good yields may be obtained after clover or where the land is given liberal applications of stable manure.

Considerable areas are not suited to cultivated crops on account of shallowness of the soil and high percentage of gravel. On many of the better farms the gravel fragments have been removed and placed in large piles, thrown in ravines or used for fencing. The cost of removing the surface gravel and that which comes to the surface in the course of the first few years of cultivation is conservatively estimated by a number of farmers at about \$10 an acre, this estimate applying to land which has an average content of gravel.

Commercial fertilizers are used on this type in a small way for wheat and strawberries, but stable manure and green manure from cowpeas and clover is used to a much greater extent for keeping up the organic matter and nitrogen supply.

Land of the Baxter gravelly loam, unimproved by orchards or vineyards, ranges in price from \$20 or \$40 an acre for the rougher and more undesirable areas to \$75 or more an acre for the best located and more productive land.

Suggestions made by a successful fruit grower in Newton County for the improvement of farm practice, which are believed to be particularly applicable to this type, include: The growing of summer apples in sufficient quantity for shipment in carload lots to both northern and southern markets, to be handled in the same way as strawberries; the growing of black raspberries to be shipped in carload lots instead of being sold in local markets on consignment; the growing of more peaches, and the utilization of surplus straw-

berries, raspberries, and blackberries in making preserves and jams and of grapes in making grape juice.

The results of fertilization experiments on the limestone upland soils of Christian County, in southwest Missouri, are believed to be in a general way applicable to the Baxter and Hagerstown soils of Newton County. In these experiments the best results with corn, wheat, clover, and cowpeas were obtained from the use of phosphates, followed by potash and lime. The pasturing of live stock and the application of animal and green manures have been found beneficial.<sup>1</sup>

Much of this type now used for pasture land could with proper seeding be made to yield much larger returns. Japan clover or lespezea grows luxuriantly over the greater part of the type and furnishes much of the pasturage. The Missouri Agricultural Experiment Station has carried on extensive experiments with grasses in the Ozark uplands, which indicate that orchard grass, supplemented by various mixtures of bluegrass, redtop, and red, white, and alsike clover, is most suitable for the drier, more gravelly lands. For the better soils used for pasture bluegrass may be supplemented by one or more of the following: Orchard grass, timothy, redtop, red clover, white clover, and alsike clover.<sup>2</sup>

#### HAGERSTOWN SILT LOAM.

The typical Hagerstown silt loam consists of a brown to chocolate-brown silt loam, grading at about 6 to 10 inches into a yellowish-brown silt loam to silty clay loam, which in turn grades into a reddish-brown to dull-red, friable but rather compact clay. On the slopes chert fragments are common.

A few rather small areas, as in the vicinity of Newtonia and Stark City, consist of a reddish-brown silt loam passing through reddish silty clay loam into red clay. Such areas really represent the Crawford silt loam (a prairie soil), but on account of their small size they were not mapped separately. There are also included in several places areas in which the soil has been influenced by material from sandstone. These areas if large enough and sufficiently distinct would be classed with the Boone soils. Areas of this kind occur a short distance north of Newtonia, in an upland belt south of Shoal Creek, extending from a point south of Ritchey eastward to the county line, near Spurgeon, south of Diamond, and in several other places.

The largest areas of the Hagerstown silt loam occur around Newtonia and Stark City and west of Fairview. The topography is almost level to gently undulating. Drainage is good.

This type is generally recognized as the most productive upland soil of the county, and it is practically all under cultivation, some areas having been cultivated since the county was first settled in 1830. It

<sup>1</sup> See Bull. 129, Mo. Agr. Exp. Sta., Columbia, Mo.

<sup>2</sup> Id. Bull. 108.

has been used chiefly for the common farm crops, but recently a considerable area of the type near Stark City has been devoted to growing nursery stock, for which use it is said to be well adapted. It is also used for strawberries, and results with this crop have been satisfactory. It is a good soil for clover, and alfalfa has been found well suited to similar soils in other counties.

A reliable farmer who has used this soil for many years reports 15 bushels per acre as a fair average yield of wheat, without the use of fertilizer. Corn yields average about 35 bushels an acre, although about twice this yield is sometimes obtained.

Selling prices of land of the Hagerstown silt loam range from about \$65 to \$85 an acre.

A considerable proportion of the type has been farmed under inefficient methods and needs to be improved. The soil is benefited by the application of animal and green manures and the growing of the legumes, such as clover and cowpeas.

*Hagerstown silt loam, rolling phase.*—The rolling phase differs from the typical Hagerstown silt loam in having a slightly more pronounced yellowish or light-brown color at the surface, in having a lighter red to reddish-brown subsoil with slight mottlings of yellow in places, and in containing throughout both surface soil and subsoil small chert fragments, rarely encountered in sufficient abundance to affect the crop value.

The phase occurs principally in narrow strips along the lower slopes bordering the larger streams. In places the strips of this soil extend from the higher lying gravelly areas on the slopes to the margin of the alluvial bottom-land soils; in general, however, the phase approaches the stream flood plain as a high bench or terrace. Where the terrace proper and the adjacent slope are of sufficient width they have been separated on the map, but in many places the terraces are so narrow that the soil has been included with the rolling phase of the Hagerstown silt loam.

The principal areas of this phase lie along Shoal, Indian, Jones, and Buffalo Creeks. Small areas lie along the tributaries of these streams and in patches throughout the eastern and central parts of the county. The topography is undulating to sloping, none of the land being too steep for cultivation. Drainage is good.

The rolling phase has a slightly lower crop value than the typical Hagerstown silt loam.

#### ELDON SILT LOAM.

The typical Eldon silt loam consists of a dark ashen gray to black silt loam, underlain at about 8 to 10 inches by yellowish-brown to light-brown silt loam to silty clay loam. At about 14 to 20 inches this passes into moderately friable to somewhat plastic clay, mottled



yellowish and reddish, with gray or drab mottlings frequently coming in below. Chert fragments are scattered to some extent over the surface and distributed through the surface soil and subsoil, most of them being small and angular. At a depth ranging from 8 to 24 inches a mass of chert fragments is reached. In some places chert is so abundant that the soil is a gravelly loam; soil of this character often occurs in small patches on the steeper slopes. As a rule, however, the soil is not gravelly enough to interfere seriously with cultivation.

Small areas of the Eldon silt loam are distributed throughout the county. Many areas, especially those of smaller extent, are not very typical, resembling the closely associated Lebanon silt loam. The type occurs in numerous narrow strips on fairly steep slopes along the courses and around the heads of the small prairie streams. The largest areas are encountered around Diamond and in the north-eastern part of the county. The topography of the type is undulating to sloping.

The type does not hold a very important place in the agriculture of the county. Where the layers of gravel lie at a depth of 18 inches or more the soil is fairly productive. Considerable areas of soil of this character in the vicinity of Diamond give yields of wheat, corn, and other crops about as large as those obtained on the Lebanon silt loam. Where the surface soil has a large content of gravel and the heavy chert lies within 10 or 12 inches of the surface the soil naturally has a low agricultural value. Considerable areas of soil of this character in the north-central part of the county have never been under cultivation, the native prairie grasses being used for pasture or cut for hay.

Land values on the Eldon silt loam are probably somewhat lower than on the Lebanon silt loam.

The Eldon silt loam is improved in productiveness by the same farm practices that are beneficial with the Lebanon silt loam.

#### LEBANON SILT LOAM.

The Lebanon silt loam consists of an ashy-brown to moderately dark brown silt loam, underlain at about 8 to 10 inches by yellowish-brown silt loam to silty clay loam, which grades at about 12 to 18 inches into mottled reddish and yellowish clay of a moderately friable to slightly plastic structure. Frequently the subsoil is mottled reddish brown and gray or yellowish gray in the upper part. In the lower subsoil the reddish mottling is usually less conspicuous, being replaced by yellowish gray or drab. A mass of chert fragments, embedded in reddish clay, is generally reached at a depth of about 12 or 15 inches, and occasionally even nearer the surface. Over a part of the area covered by this type, however, the chert lies at a depth of 2 feet or more and in some places it is not reached within the 3-foot

section. The type in such places resembles the Gerald silt loam with the "clay pan" wanting. In many places, especially on slopes, chert fragments are encountered in the surface soil and upper subsoil, but usually not in sufficient abundance seriously to hinder cultivation or to affect the crop value.

The Lebanon silt loam does not occur in large areas, but numerous small developments of the type occur throughout that part of the county occupied extensively by the Gerald silt loam. The typical Lebanon silt loam occupies an intermediate position between its timbered phase and the Gerald silt loam. It is a prairie soil, with surface almost level to undulating. The type is in most places fairly well drained.

The most important intensively cultivated crop grown on the Lebanon silt loam is grapes. The largest and most successful vineyards in the county are on this type and its timbered phase. (See Pl. II, fig. 1.) The Lebanon silt loam is used to a considerable extent for other small fruits, as well as for peaches, apples, and sweet potatoes. A considerable area is used for wheat, and corn is grown to some extent. These grains give fairly satisfactory yields. Clover does well where the soil is deep and well drained.

Land values for this type range from about \$40 to \$70 an acre for unimproved land, and much higher for that which has been planted to grapes or other fruits.

Much of the land of this type would be made more suitable for growing clover by the application of lime. The greatest need of the type, however, seems to be an increase in organic matter and nitrogen. These elements can best be supplied by making applications of manure, by plowing under leguminous crops or by pasturing the land. Suggestions made by the Missouri Agricultural Experiment Station for the improvement of a similar soil in Jasper County could be availed of by farmers on the Lebanon silt loam to advantage.<sup>1</sup>

*Lebanon silt loam, timbered phase.*—The surface soil of the timbered phase of the Lebanon silt loam is a light ashen gray to brownish-gray silt loam, the virgin soil being slightly darker at the surface than soil that has been under cultivation. At a depth of 6 to 8 inches this layer passes into a pale yellowish gray to light-yellow silt loam which becomes heavier with increasing depth, grading at 12 to 16 inches into a reddish, yellow, and grayish, somewhat mottled, moderately friable to somewhat plastic clay, in which the red color is predominant. At depths ranging from about 12 to 24 inches this clay layer is underlain either by a mass of angular chert fragments embedded in reddish or yellowish clay or by a thin layer of compact chert below which is red clay.

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<sup>1</sup> See Bull. 119, Mo. Agr. Expt. Sta., Columbia, Mo.

Much of the phase where the drainage is more nearly perfect has a subsoil of dull-red, rather compact clay, which passes into a more friable clay, having some yellow or grayish mottlings, before the chert stratum is reached. In places the subsoil is dull red, with little or no mottling. Occasionally the gravel mass is reached near the surface and throughout much of the areas of the phase small gravel particles, often somewhat rounded by weathering, are scattered over the surface and through the surface soil and upper subsoil, but these do not usually occur in sufficient abundance to affect the arableness of the land or to modify the crop value. The phase includes many small areas of Baxter gravelly loam which are too small to be shown separately on the soil map.

The Lebanon silt loam, timbered phase, is in some measure an intermediate soil between the Gerald silt loam and the typical Lebanon silt loam on the higher, prairie side and the Baxter gravelly loam on the lower, forested side. Where the type lies adjacent to the Gerald silt loam, and also in flat, poorly drained areas, the surface soil is a light ashen gray silt loam, underlain rather abruptly by a reddish-brown to dark-gray, heavy, plastic clay. The forest growth here is almost exclusively post oak of uniform size. These narrow strips are really a timbered phase of the Gerald silt loam, too small in extent to be separated. Where the timbered phase occurs adjacent to the typical Lebanon silt loam it has a slightly browner color and the forest growth consists largely of blackjack oak and red oak. In the southeastern part of the county the phase could be separated from the Hagerstown silt loam only with difficulty, the differentiation being based on the slightly lighter, more yellowish color of the surface soil and the slightly more plastic, and in places faintly mottled, subsoil, in the case of this phase. Regardless of these variations, the main body of this phase resembles the Baxter soils more closely than those of any other series, having a similar gray surface soil, a yellowish-gray subsurface layer, and a dull-red deep subsoil. The gravel is less abundant and the particles are usually smaller than in the Baxter gravelly loam, but practically all the phase rests upon compact chert within the 3-foot section.

The timbered phase of the Lebanon silt loam is as widely distributed as the Baxter gravelly loam, but it covers a much smaller total area. It occurs in strips, usually about one-fourth to three-fourths mile in width, bordering nearly all the areas of the Baxter soil, and extending along the crests of many of the ridges. Although the phase usually occurs on the divides, small areas are encountered on slopes below areas of the Baxter gravelly loam.

Over the greater part of the area covered by the timbered phase of the Lebanon silt loam the drainage is good, but on the crests of

some of the ridges and adjacent to the Gerald silt loam there occur flat, poorly drained areas.

This land was originally forested, post oak occupying the poorly drained areas, with blackjack oak, black oak, and red oak becoming more abundant with approach to the Baxter gravelly loam. In the southeastern part of the county there is a larger percentage of red oak, with some hickory and walnut, in addition to some white oak, chestnut oak, and chinquapin.

The better areas of this phase, having good drainage and a fairly friable subsoil, are used extensively for berries, peaches, apples, and grapes, and returns seem to be about as good as on the Baxter gravelly loam. Sweet potatoes are grown quite extensively. Corn, wheat, clover, alfalfa, and soy beans are other crops grown on this soil.

One grower who has grown sweet potatoes on land of this phase for several years reports yields as ranging from 100 to over 200 bushels per acre. On this farm all the crop is marketed in the fall, beginning about August 1. The soil is improved by the use of barnyard manure and the growing of clover and cowpeas. Nansemond, Yellow Jersey, Golden Queen, and Moody are among the principal varieties grown.

Clover does well on the better areas of this phase. The type has been used for alfalfa as yet only in an experimental way. Near June several acres were sown to alfalfa in the spring of 1915 and the crop made an excellent growth, yielding four cuttings which averaged over 1 ton each. Plate II, figure 2, shows this field of alfalfa ready for the second cutting. The soil is a good grade of Lebanon silt loam, timbered phase. No other fields of alfalfa were seen on this type. A small field of sweet clover which had made an excellent growth was noticed on this phase in the course of the soil survey. Plate III, figure 1, shows a heavy growth of sweet clover on this soil. Cowpeas and soy beans do well and usually make a large yield of seed. Wheat gives fair yields, but corn yields are low, apparently ranging between 15 and 25 bushels an acre.

#### CHEROKEE SILT LOAM.

The Cherokee silt loam in Newton County consists of a gray to light-gray silt loam which grades at a depth of 3 to 5 inches into a very light gray or almost white silt loam. This has a fluffy, flourlike structure when dry, but is rather sticky and plastic when wet. At any depth between 15 inches and 2 feet this silt-loam layer is underlain abruptly by a stiff, tenacious clay, mottled gray and drab.

Only a few small areas of this type are encountered, these occurring in the eastern and northeastern parts of the county. They occupy circular or elongated depressions, with or without drainage outlets. A number of small patches of this type have necessarily been included



on the map with the surrounding soils, principally the Gerald silt loam.

The Cherokee silt loam has a low agricultural value, but is used to some extent for small grains and timothy.

#### GERALD SILT LOAM.

The Gerald silt loam consists of an ashen-brown to rather dark brown silt loam, passing at an average depth of about 8 inches into a yellowish-brown silt loam which grades into a silty clay loam. This in turn is underlain rather abruptly at a depth varying from about 15 to 24 inches by a mottled, tough, plastic clay which virtually constitutes a clay hardpan. The predominating colors of the heavy clay are mottled bright red to dark red or reddish brown, and drab or yellow or brown in the upper part, and mottled yellowish and drab or gray below. In places the red mottling continues downward, and again areas are encountered where the clay is brown or dark rusty brown throughout. The structure is more friable in the lower part of the 3-foot section because of a higher content of silt in some places, and of friable material, apparently ferruginous oxides, in other places. In some areas, however, the heavy clay extends to a depth of 3 feet, or to the underlying chert stratum. Where the surface of the type is very flat and drainage is poor, the subsurface material has a somewhat lighter gray color than is typical, and the subsoil, which is extremely heavy, is dark drab to almost black in color.

The subsoil of this type is distinctly heavier and tougher than that of the Eldon and Lebanon soils, although in the mapping it was not everywhere easy to determine sharp boundaries between the Gerald and these two types.

Areas of the Gerald silt loam are widely distributed throughout the county, the type occupying the more level upland between the main drainage courses. It is developed to some extent on all the prairies. The most extensive occurrence of the Gerald silt loam is in the north-eastern and north-central parts of the county. Another large body is found near Fairview in the southeastern part of the county, and a smaller area lies between Stark City and Aroma. Other developments of the type occur northwest of Racine, north of McElhany, along the Seneca road southwest of Neosho, and in other places.

The topography of the Gerald silt loam is level to very gently undulating. There seems to be a rather direct relation between the topography and the character of the subsoil, the heavier subsoil accompanying the level topography. The drainage of much of the type is imperfect.

Until 20 or 25 years ago this type was considered practically worthless, except for prairie hay and for pasturage. Gradually, however, it was realized that with the use of commercial fertilizers wheat and

timothy could be grown on it quite successfully. The principal crops grown, and almost the only money crops, are wheat, timothy hay, and prairie hay. The type is not a good soil for corn, although it is used to some extent for this crop and occasionally gives fair yields. Oats do well, but this crop is grown only to a small extent. Other crops grown are cowpeas, sorghum, milo, kafir, and millet. The type is used to a considerable extent as pasture land.

One successful farmer on a good grade of Gerald silt loam has found raw bone meal to be very beneficial on wheat, especially where timothy follows wheat. Before using the bone meal he found it difficult to grow timothy successfully. Part of the wheat crop is thrashed from the shock, but the bulk of it is stacked, and the advantage of stacking seems to be fully appreciated.<sup>1</sup>

Timothy on this type, under favorable seasonal conditions, yields 1½ to almost 2 tons of hay to the acre. Much of the production is baled without stacking and is hauled to market or stored. A small proportion of the crop is cut for seed.

Several years ago apples were planted rather extensively on this type, but the soil was found poorly suited to this fruit and the orchards have nearly all been abandoned.

The selling price of land of the Gerald silt loam ranges from \$30 to \$60 an acre. In parts of the county the land has a speculative value on account of lead and zinc deposits.

The Gerald silt loam is not a clover or alfalfa soil, but where well drained and improved by means of the application of animal manure or the growing of cowpeas, and sweetened to some extent by the use of lime, alsike clover can be grown and red clover can be made fairly satisfactory. The Missouri Agricultural Experiment Station has found that tile drainage on similar soil pays a fair rate of interest on the expenditure. Better surface drainage by means of open ditches would also prove beneficial.

Results of experiments recently carried on at Lamar, in Barton County, on a soil quite similar to the Gerald silt loam, should prove helpful to farmers on this type.<sup>2</sup>

#### RIVERTON SILT LOAM.

The surface soil of the Riverton silt loam consists of a light-brown to brown silt loam, which passes at 8 to 12 inches into a yellowish-brown, friable silty clay loam. The subsoil, beginning at 12 to 18 inches, is a yellowish-red, reddish-brown or dull-red, friable clay, which becomes brighter red and more compact below. Some sub-

<sup>1</sup> Wheat stacking is the subject of a bulletin recently issued by the Missouri State Board of Agriculture.

<sup>2</sup> See Bull. 130, Mo. Agri. Expt. Sta., Columbia, Mo.; also Bull., "Soil Acidity and Liming," State Board of Agri., Columbia, Mo.; also Bull. 6, U. S. Dept. of Agriculture, "The Agricultural Utilization of Acid Lands by Means of Acid-Tolerant Crops."

angular and rounded gravel particles are present in the lower subsoil and in the substratum.

The type occupies stream terraces, most of which lie high above the present valley floor. The transition from the terrace to the first bottoms is often abrupt and well defined, in places consisting of a chert-covered slope. On the upland side, however, the terrace usually merges gradually into the adjacent slope, which is occupied by either the Baxter gravelly loam or the rolling phase of the Hagerstown silt loam.

The principal areas of the Riverton silt loam occur along Shoal Creek, but smaller areas are developed in the valleys of all the larger streams of the county.

The topography is level to gently sloping. Drainage over the type is good. Practically all the land is under cultivation, being used for corn, wheat, clover, alfalfa, and other common field crops. The yields are about the same as those obtained on the Huntington silt loam.

#### ROBERTSVILLE SILT LOAM.

The Robertsville silt loam is shown by means of the inclusion symbol in areas otherwise mapped as the Riverton silt loam. The soil consists of a brownish-gray, light-gray or almost white silt loam, underlain at 5 to 8 inches by ashy-gray or yellowish-gray silt loam. This passes at 12 to 18 inches into a mottled red or reddish-brown and drab, plastic clay, in which yellowish and gray become more prominent below. Small black concretions are present, especially in the subsoil.

The Robertsville silt loam, especially in those areas where the surface soil is very light gray, is, as a rule, of low productiveness, particularly in dry seasons.

#### HUNTINGTON GRAVELLY LOAM.

The Huntington gravelly loam differs from the Huntington silt loam only in having distributed through both surface soil and subsoil sufficient sharp and waterworn gravel to make the soil somewhat less productive.

Areas of this type occur principally in the first bottoms of the larger streams. The bodies mapped include small areas in which the soil is not very gravelly. The crop adaptation is similar to that of the Huntington silt loam.

*Huntington gravelly loam, colluvial phase.*—The colluvial phase of the Huntington gravelly loam differs from the typical soil in several ways. The soil of the typical Huntington gravelly loam has been transported by stream waters for some distance, has been more or less assorted before deposition, and lies, or at least has at sometime

lain, subject to overflow. The colluvial phase occurs in narrow strips along the small streams and on the lower part of the adjacent slopes. Much of the soil material has not been carried by streams but has been merely moved down the slope by gravity, with the aid of run-off and percolating water, the colluvial movement being furthered by cultivation of the soil, trampling by stock, and wind action. Only narrow strips of the phase along the streams are subject to overflow.

The soil of the Huntington gravelly loam, colluvial phase, is rather variable, depending upon the types from which the material has been derived. In general, the soil is well supplied with organic matter. Nearly all the land of this phase is more or less gravelly. The predominant soil consists of a brown to grayish-brown, mellow silt loam, underlain at about 12 to 15 inches by a lighter brown, heavy silt loam which passes into silty clay loam. There is in nearly all areas of this phase a gradation from true alluvium in the lower part of the valley to a more or less purely colluvial soil on the adjacent slopes.

Where the small valleys extend well up into the almost level uplands they are in many places broad and shallow. Here there are included spots where a subsoil of tenacious clay or one of dark-gray color is developed. Such areas resemble the Osage silt loam, but they have been included with this phase owing to their small extent.

Strips of this phase, varying in width from a few feet to 40 or 60 rods and in length from one-half mile to 3 or 4 miles, are encountered along the small streams in almost all parts of the county. The surface is level to gently sloping in the lower part of the small valleys, the slopes becoming steeper with ascent. The drainage over most of the phase is good.

The greater part of this soil is under cultivation. Even those strips only a few rods wide are cleared and cultivated, frequently surrounded by uncultivated land. Much of the phase is used for corn, but it is also devoted to strawberries, sweet potatoes, and garden truck of all kinds. Some of the most intensively cultivated farms of the county are on this soil.

#### HUNTINGTON SILT LOAM.

The Huntington silt loam consists of a brown, mellow silt loam grading at about 12 to 15 inches into a yellowish-brown to slightly reddish brown, friable to somewhat compact silty clay loam. In places gravel is present in the surface soil and subsoil. The type as mapped includes many small areas of Huntington gravelly loam which owing to their small extent were not separated. The more important gravelly areas are indicated on the map by means of the gravel symbol.



The Huntington silt loam is a first-bottom, alluvial soil, the material consisting largely of wash from the Baxter soils but to some extent of wash from all the other upland soils of the county. Strips of the type, varying in width from a few rods to one-half mile or more, extend along the principal streams of the county, the largest development being in the valley of Shoal Creek.

The surface is level or practically so. The type is typically subject to overflow, although as mapped it includes some strips of soil which lie above ordinary floods. These have been included with the Huntington silt loam rather than with the corresponding terrace soils. In places the type lies slightly higher than the adjacent darker colored bottom soils. Drainage over the greater part of the type is good, but in some places the flat surface and elsewhere seepage from the adjacent slopes have resulted in certain areas being poorly drained.

For general farming the Huntington silt loam is the most important type of the county. It is practically all under cultivation, and is used to some extent for almost all the common crops of the county. The most important crop is corn, with wheat second. Corn yields range from 25 or 30 bushels to as much as 70 bushels per acre. Wheat yields range from 12 to over 25 bushels an acre, with an average yield of about 19 bushels. Farmers report that the yield of grain on this soil is not in proportion to the straw, and that the application of fertilizers does not increase yields as much as on the prairie soils. The type is used to a considerable extent for clover and to some extent for alfalfa. Results indicate that the Huntington silt loam is well suited to alfalfa. Although this legume may be grown without the application of lime, an acreage application of 1 to 2 tons of finely ground limestone has been found beneficial. Under favorable seasonal conditions alfalfa each season yields 4 cuttings of one-half ton to over one ton each. (See Pl. III, fig. 2.)

Farms a considerable proportion of which include soil of this type are among the highest priced in the county.

#### DUNNING SILT LOAM.

The Dunning silt loam consists of a dark-gray or very dark brown to black silt loam, overlying at depths ranging from 8 to 14 inches a very dark brown to black, somewhat plastic silty clay loam. This passes into brownish-drab, plastic clay, showing some faint rusty-brown mottlings. There are included, especially in the more poorly drained areas, patches of Dunning silty clay loam and clay, in which the soil on drying compacts and cracks, in addition to small areas of gray Holly silt loam and some patches of gravelly soil. As in the case of the Huntington silt loam, there are included with this type



broad, nearly level or gently sloping areas which lie above normal overflow but are not distinct terraces.

The Dunning silt loam consists of alluvium derived entirely or in large part from the Baxter soils. The principal areas of the type occur in the valley of Shoal Creek, but small areas are encountered along the other larger streams.

The Dunning silt loam is used extensively for corn and, to a less extent than is the Huntington silt loam, for wheat, oats, timothy, clover, and other crops. On account of its poorer drainage and more strongly acid condition it is not so well suited to alfalfa as is the Huntington soil, but with proper attention given to drainage and liming it would apparently be fairly well suited to this legume. Yields of corn are about the same as on the Huntington silt loam.

#### SUMMARY.

Newton County lies near the southwest corner of the State. It has an area of 622 square miles, or 398,080 acres. Approximately one-third of the county consists of almost level to gently rolling uplands, a considerable proportion is embraced in stream flood plains and terraces, and the remainder includes gently rolling to rough, hilly land.

The elevation of the uplands ranges from about 1,100 feet above sea level in the western part of the county to 1,300 feet above in the eastern part. The valleys of the larger streams lie about 200 feet lower than the adjacent uplands.

Perennial clear-water streams fed by large springs traverse nearly all parts of the county.

The population is cosmopolitan, the early settlers coming from the Eastern and Northern States, as well as from the South. Later settlers have been attracted from almost all parts of the United States.

The climate of Newton County is more equable than that of central and northern Missouri and is well suited to the types of farming and fruit growing carried on. The rainfall, if conserved by deep breaking and surface cultivation, is sufficient for all the crops grown.

The census reports show a steady increase in the acreage of corn during the last 30 years, a considerable fluctuation in the acreage of wheat, and little change in the acreage of oats. Farm crops which have recently come into importance are kafir, milo, feterita, shallu, cowpeas, alfalfa, and soy beans.

Of small fruits the most important is strawberries, which constitute one of the most important money crops of the county. Next in importance are grapes, followed by raspberries and blackberries.

Apples and peaches of excellent quality are grown rather extensively. The number of bearing apple trees probably remains about stationary, but the production of peaches is increasing.

Tomatoes, sweet potatoes, Irish potatoes, and various other truck crops occupy places of importance in the agriculture.

Poultry raising receives much attention, and poultry products are the source of an important part of the farm income. Dairying is also carried on to quite an extent. Other kinds of live stock, although not raised in very large numbers, are of good grade.

The agriculture of the county may be divided into three rather broad classes, based primarily on topography and soil adaptation. On the prairie uplands grain and hay farming is the predominant type of agriculture; on the stony, hilly lands fruit growing prevails, and in the larger valleys corn growing is carried on in combination with dairying and stock raising. These types of farming, however, are not confined to these respective sections of the county. The hilly lands, particularly, might be called a region of diversified farming.

Farm equipment throughout the county is good and efficient methods of farming are followed, especially in the production of crops requiring intensive cultivation.

Land prices have a wide range, some land being held at less than \$20 an acre and some at over \$100 an acre. Actual cash prices for land in fruit or suitable for general farming range from about \$35 to \$65 an acre.

In origin the upland soils of Newton County are residual. The material has come principally from limestone and chert beds of the Mississippian formation. Shale and sandstone beds of a later formation have influenced the upland soils, especially on the flat prairies. The upland soils are classed in the Baxter, Hagerstown, Eldon, Lebanon, Cherokee, and Gerald series.

The Baxter stony loam occurs in narrow strips along the valleys of some of the streams. It is practically all forested and the land is mainly nonagricultural.

The Baxter gravelly loam is the most extensive type encountered and the principal small-fruit, orchard, and diversified-farming soil of the county.

The Hagerstown silt loam is a brownish soil, developed in the eastern part of the county. A rolling phase of this type occurs in small bodies in other parts. These soils are very desirable for farming and are practically all under cultivation.

The Eldon silt loam is a drab-gray to black soil, containing sharp chert fragments. The type is used for small grain and grass, and to some extent for corn.

The Lebanon silt loam is a brown-colored soil used for grapes, small fruits, tree fruits, and general-farming crops. The timbered phase of this type is lighter brown to gray in color and has much the same crop adaptation as the Baxter gravelly loam.

The Cherokee silt loam is a grayish-colored soil, of small extent. It is low in productiveness, but is used to some extent for small grain and timothy.

The Gerald silt loam has a brown surface soil, with a lighter colored subsurface layer and a heavy clay subsoil. This type is widely distributed throughout the county. It is used largely for small grain and grass.

The alluvial soils of Newton County include the soils of the terraces, or second bottoms, and those of the first bottoms, or present flood plains, of the streams. The terrace soils are included in the Riverton and Robertsville series, and those of the first bottoms in the Huntington and Dunning series.

The Riverton silt loam is a well-drained, productive soil, developed in the valleys of all the larger streams of the county. The type is practically all under cultivation.

The Robertsville silt loam is a light-colored soil, only fairly productive. The type is very inextensive in this county.

The Huntington gravelly loam and its colluvial phase are widely distributed soils. The typical gravelly loam is slightly less productive than the Huntington silt loam. The colluvial phase is practically all under cultivation, and is used for corn, strawberries, and truck crops.

The Huntington silt loam is a brown-colored soil developed along the principal streams. It is the most important general-farming soil in the county.

The Dunning silt loam is a dark-colored soil. The type is poorly drained in places, but it is extensively used for corn, and to some extent for small grain and hay.



[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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