

SOIL SURVEY OF HOWELL COUNTY, MISSOURI.

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LOCATION AND BOUNDARIES OF THE AREA.

The Ozark Uplift involves almost the whole of Missouri south of the Missouri River and a considerable portion of northwestern Arkansas. Over this vast area there are features of topography and characteristics of soil common to every part. In Missouri one series of rocks, the Cambro-Silurian, occupies the greater part of forty-two counties,

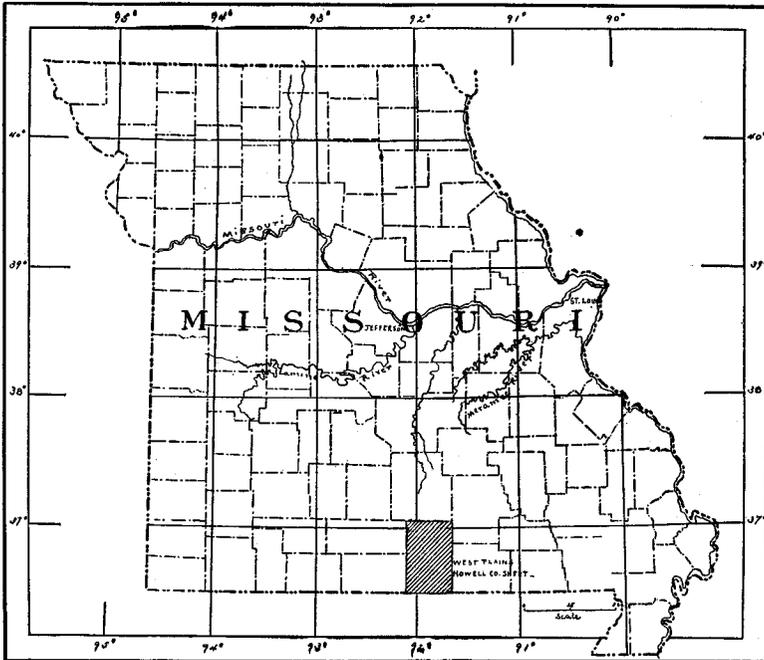


FIG. 16.—Sketch map showing area surveyed in Missouri.

and these by processes of weathering and erosion may be relied upon to give similar results in physiography and soil conditions. The area surveyed occupies a position nearly central in this extensive plateau, for such it is, and a little to the southeast of the point of highest elevation. Because of the relation which the soils of the area surveyed bear to the adjoining territory, the present survey has a double value; it shows the exact soil conditions of Howell County, and is also an index to the soil conditions of much of the surrounding region. (See fig. 16.)

Howell County, containing 919 square miles, or 588,160 acres, is situated in the south-central part of Missouri, and borders Arkansas on the south. It is crossed in the northern part by parallel 37° north latitude and in the western part by meridian 92° west from Greenwich. The area is rectangular, with a length north and south of 38 miles and a width east and west of 24 miles. Texas County borders the area on the north, Shannon and Oregon counties on the east, and Douglas and Ozark counties on the west.

The largest town and chief center of trade is Westplains, a city of about 3,000 inhabitants, situated near the center of the county. Willowsprings is second in size and importance. Other villages, so called, are little more than crossroads post-offices.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

As late as 1850 the Indian was almost the sole inhabitant of this country, though a few homestead tracts had been occupied by white settlers. The country was then an expanse of rolling territory without forest, but with groves of scattered oaks, mainly white, post, red, and black oak. Everywhere the prairie grass—the big blue-stem—grew in rank profusion and of a height at maturity to conceal a horse and his rider. Each season the grass sprouted anew, matured, and fell down, to be burned to make way for the next season's growth. Each season innumerable sprouts of oak sprang up, but the annual fires destroyed these, leaving only stunted roots that grew to be immense "bench grubs."

In certain belts, notably one extending from Burnham and Willowsprings westward to the county line, and, less extensively developed, in the eastern quarter of the north half of the county, existed valuable yellow-pine forests. The growth was not thick, but the trees were of large size and good quality. The grass in the pine forests was less well established and less rank, but still afforded some covering for the soil.

With the advent of the farmer and ranchman, each spring found the country grazed by hundreds of cattle and other live stock that cropped the grass close, leaving but a small part of the growth to mature. The oak sprouts were present as before, but when the fire was started and the dead stems burned there was not sufficient heat developed from the reduced amount of rubbish to kill all of them. Gradually, year by year, the sprouts got a better hold on the land, until finally millions of oak saplings—mainly black-jack—occupied the place of the prairie grass. These saplings made their advent during the decade from 1870 to 1880, when the country became a flourishing commonwealth, and now constitute well-developed forests. At the present time probably more than 60 per cent of the county is timbered.

The greater part of the area was opened to settlement by the homestead act, under the terms of which much of the land was taken up and is still held. In the northwestern part of the area are several thousand acres that were granted to the present State University of Missouri when it was organized as a land-grant college. This land passed into the hands of a private company, which, after removing all the valuable timber, sold out the greater part of the tract to farmers or to mining companies.

Some land in the county is still open to homesteaders, but it is of the most undesirable character.

As has been intimated, the grazing of cattle at first formed the chief industry of the farmers of Howell County, but with the decrease in the extent and depreciation in quality of the public range, grain farming assumed first place in the local agriculture, both in acreage and value of product. In this line of agriculture there has been no noticeable change since its advent, the same crops—corn, wheat, oats, rye, and timothy—being grown now as formerly.

About 1882 an agricultural interest new to the region—fruit growing—was introduced into Howell County. This industry has since spread to other parts of southern Missouri, which has become famous for the quality of its fruits. Col. J. C. Evans, whose attention was first called to the possibilities of the soils of the region for fruit growing, while passing through the country with his regiment during the civil war, planted the first commercial orchard of peaches and apples at Olden, near the center of the county. His experiment was a success, and furnished the basis for the orchards that now reach from Springfield to the border of the State, following in general the line of the St. Louis and San Francisco Railroad. The original Olden orchard still exists, and additions have been made until it now contains some 1,300 or 1,400 acres, and although others of even larger extent have been established in the region, this one continues to be the largest in Howell County. New orchards are being set out each year.

About the same time as the Olden experiment (1883) Mr. Philip Brand established a large vineyard near the present town of Brandsville. This venture also proved a success, and new vines have been added to the vineyard from time to time until it now covers 65 acres. Experiment has shown that wine grapes are most profitably grown, and they now occupy the whole area. Other smaller vineyards have been established on the strength of the success of this first one.

CLIMATE.

While the temperature records show considerable range throughout the year, the summers are usually not excessively hot nor the winters extremely cold. But little snow falls, and this seldom remains long on the ground. The winter season is best described as a succession of

alternating periods of moderately cold and comparatively mild weather. The rainfall is well distributed through the year, but periods of drought are not infrequent, though usually not of sufficient length or severity to do general injury to the crops.

The following table gives the normal temperature and precipitation by months and for the year. These records are from the Weather Bureau station at Olden:

Normal monthly and annual temperature and precipitation.

Month.	Temperature.	Precipitation.	Month.	Temperature.	Precipitation.
	° F.	Inches.		° F.	Inches.
January	35.4	2.44	August	76.4	2.72
February	38.8	3.21	September	70.2	3.12
March	45.9	5.31	October	59.6	2.40
April	57.6	4.53	November	46.1	2.88
May	65.7	4.39	December	36.9	2.34
June	73.9	3.45	Year	56.5	40.67
July	76.7	3.88			

In the late fall and early spring there are occasional unseasonable warm spells, which force the fruit buds unduly and render them liable to damage by freezing. From the somewhat fragmentary records of the station at Olden it is seen that killing frost may come as late in the spring as April 23 and as early in the fall as September 18. The average dates of occurrence are April 13 and October 21. This gives an average growing season for tender vegetation of one hundred and sixty-one days.

The success with fruit in this area shows that the climatic conditions are in the main highly favorable to the industry.

PHYSIOGRAPHY AND GEOLOGY.

The area forms a part of the large elevated region known as the Ozark Plateau. The originally level surface of this plateau, subjected to weathering and erosion since early geological time, has been carved and chiseled into a vast system of water courses, some with deep, narrow gorges, and others more shallow and with broad bottoms. The part of the plateau situated within Howell County has an elevation above sea level of from 900 to 1,300 feet, with a general slope to the south and east. Through the central part of this area extends a broad divide whose general trend is northwest and southeast. This divide enters the county near Sterling, passes about 4 miles west of Westplains, and leaves the county near Brandsville. With the exception of a small knob or two the greatest elevation of the ridge is in the vicinity of Burnham, and a considerable elevation is retained

throughout the distance from that place to Olden, the difference being less than 100 feet.

The surface of this plateau is rolling and hilly. Nowhere in the country do there occur very extensive level areas. Along the main divide the country has a gentle swell which in a few places gives way to comparatively level stretches, such as occur a few miles southeast of Westplains. On the minor divides there are also level areas, conspicuous by contrast, in the vicinity of Moody and Peace Valley. Off the divides along the borders of the county the country is very rough and rugged. In general the southern half of the county is more level than the northern half. Two prominent peculiarities of the topography, common to all parts of the plateau, are the rounded knobs that rise above the surrounding country as dome-shaped hills, and the bowl-shaped depressions of variable extent and depth known as sink holes. Typical of the former is Kings Mountain, lying east of Wil-lowspring. This eminence is the highest point in the county, attaining an elevation of 1,440 feet. Sometimes these knobs occur in chains along the crests of narrow divides, as seen in the vicinity of Silver Springs. Their existence is traceable to two causes—the obdurate character of the cherty materials of which they are composed and the arrangement of the local drainage systems, which are not necessarily the result of structural differences in the country. The sinks are formed by the falling in of the roofs of superficial caverns in the limestone and are frequently occupied by ponds of water.

Thorough drainage is attained in every part of the county through a complete system of ramifying streams and draws. These divide and subdivide until they end in ravines or gullies in the highest hills. The largest streams are Eleven Point, Gunters, Warm Fork, and Wyatt creeks in the eastern half of the county, two tributaries of South Fork in the southern part, and a half dozen tributaries of Spring River in the western part of the county. With the exception of the lower course of two or three of these streams, they are all dry during the greater part of the year, serving only to carry away the excess of water during freshets. A few springs are found along the courses of all the streams.

As already pointed out, the walls of these streams may be either precipitous or very gently sloping. In the interior of the county they are most commonly very low and with a gradual slope, while practically every stream leaves the county in a deep gorge. In this latter position they are often lined by tortuous rock walls, but without any of that castlelike and columnar carving seen in regions of less age. In fact that feature is entirely absent from the county. The process of weathering has progressed beyond such forms, and their former presence is indicated only by piles of chert—the most resistant part of the

original strata of stone composing the plateau. The steeper slopes are frequently covered by these chert fragments.

The topography of the area exercises a marked influence upon its agricultural development, hindering it in some ways and helping it in others. The rough surface is an obstacle to cultivation and the use of modern implements in general farming, but to the fruit grower such a surface is of benefit, in that it insures air drainage and reduces the danger of frosts and heavy freezes.

The rocks from which the soils of the region have been derived are of sedimentary origin and belong to the Cambro-Silurian series. These rocks consist of alternating strata of limestone and sandstone, of which exposures 100 feet in thickness have been noted. The geology of the county has never been studied in detail, so that very little information is available on the subject. The limestone is of a light color, somewhat magnesian, and usually quite cherty. Intercalated with the limestone thin strata of sandstone sometimes occur, and irregular masses of fine-grained and kaolinitic rocks are found. The limestone rocks are the most common, occurring in every part of the area and at the highest elevations. From their breaking down come the cherty boulders which lie strewn about over the surface or form knoblike masses, frequently of considerable height.

The sandstone varies from a medium to a very fine grained texture. It comes to the surface mainly in the bottoms of the deeper stream channels in the western part of the county. It is of a siliceous character, and masses of quartzite are frequently included. Much of the sandstone is composed of exceedingly fine sand.

SOILS.

The soils of the area are derived almost entirely from the breaking down of the limestone and associated rocks by the agencies of general weathering and erosion, the sandstone contributing in an almost negligible proportion. The materials resulting from the decomposition of these limestone rocks are all quite clayey in texture and are stained strongly with oxide of iron, especially where not subject to much leaching by rain water. More or less sand and silt is mingled with the clay, the former frequently occurring in pockets. The depth of this residual mass is variable and ranges from nothing, over the crests of a few hills, to more than 50 feet in places where the soil has accumulated. Through the soil mass the more resistant cherty part of the rock is scattered in proportion as it occurred in the original rock, though generally most abundant on the surface.

Because derived from a common rock acted upon by the same conditions, in every part of the county the soils are comparatively uniform over large areas and show a well-marked relationship to one

another. But three types were found in the area, as given in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.
Clarksville stony loam	499,264	84.89
Clarksville loam	48,512	8.25
Clarksville silt loam	40,384	6.86
Total	588,160

CLARKSVILLE STONY LOAM.

The Clarksville stony loam is a loam of grayish or yellowish color, with a depth of 7 inches, resting on a heavier yellow loam extending to a depth of from 15 to 25 inches, where it gives way to a stiff red or reddish clay that is continuous downward for several feet. The upper 15 to 25 inches of soil is noticeably silty, and particularly so in the surface few inches.

From the surface downward there is a gradual increase in the clay content, until the material becomes distinctly a clay. The clay varies from a dark reddish brown to a yellowish red, there being no regularity in the distribution of the different shades of color.

The soil of this type contains from 10 to 65 per cent of chert and sandstone fragments, the chert largely predominating. The proportion of the two rocks differs in different parts of the area. In the subsoil the quantity of rock is less than in the soil, the proportion varying from 5 to 30 per cent. The fragments are most plentiful on the surface, frequently forming a continuous carpet. Under cultivation the fragments and boulders, generally not of large size, become mixed with the soil or, as sometimes happens, they are picked off and form a much less conspicuous feature of the type. As indicated by the percentages already given, there is a wide variation in the quantity of rock present in different areas of the soil. There are considerable areas, lying chiefly along the larger streams, that are so rough and rocky as to be impracticable of cultivation. These areas have been indicated on the map by rock symbol. (See Pl. XXXIII.)

The presence of sandstone in the area has supplied the small proportion of sand disseminated through the soil and subsoil, but particularly the soil, of this type. The sand content is not high enough to influence the crop value of the soil except in a few isolated places, and its general occurrence will be considered further on in this report.

The Clarksville stony loam is by far the most extensive type in the area. It occurs in every part of the county and occupies almost 85 per cent of the whole area. It may be considered as a continuous

body of soil with the other types cutting through it at irregular intervals or occurring in limited areas in its midst.

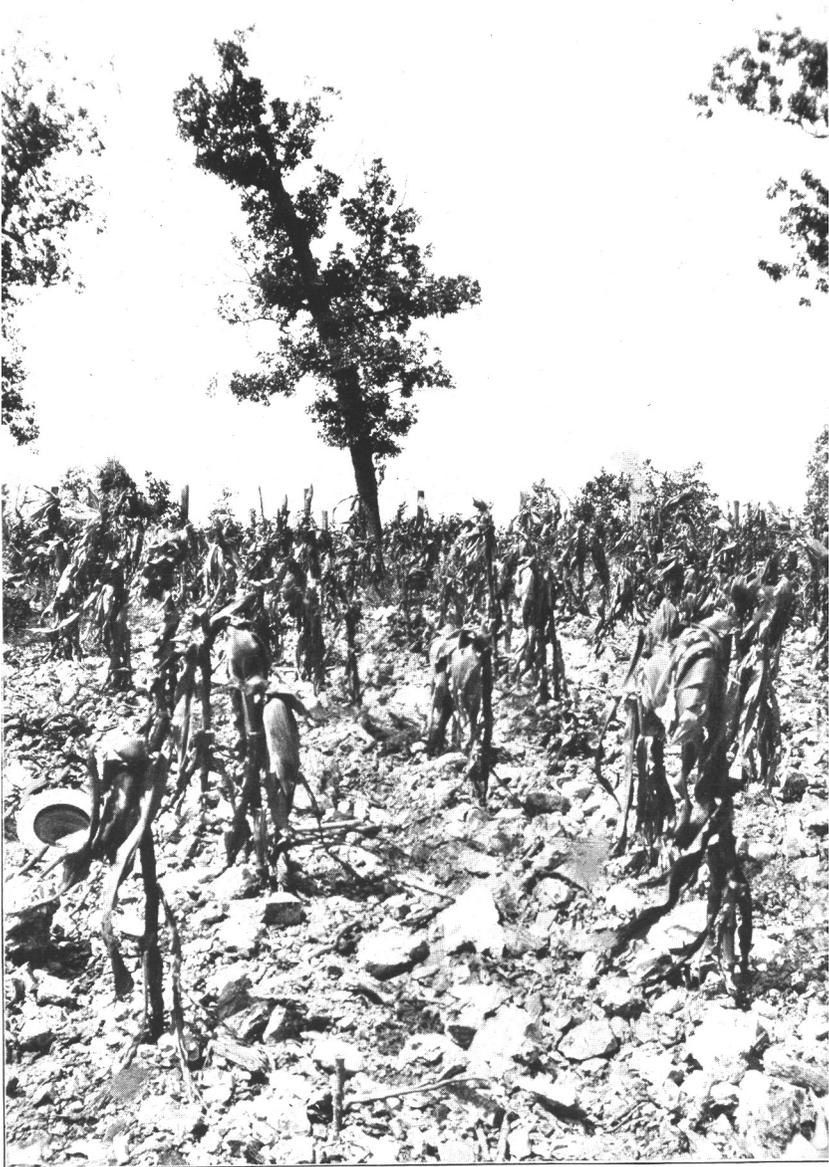
The surface of this soil type has nearly all the characteristics of the topography of the county in general. It is rolling and hilly, with occasional comparatively level stretches. The type covers all the divides where the most level areas are found, as well as areas along the streams, where it is most rough, and includes all the slopes suitable for cultivation to ordinary crops.

The forests, which cover a large part of this soil, consist of black, white, red, and post oak, hickory, and yellow pine. While the "black-jack" or black oak is found in all parts of the county, it is most abundant on the divides where the red clay comes nearest the surface. Indeed, the size and abundance of this oak may usually be taken as an indication of the near approach of the red clay to the surface. As a rule, also, those areas are the most fertile parts of the type. The other species form more open forests and occur most abundantly nearer the borders of the county, where the topography is most broken. In this part of the county some forests occur on the other upland soil types. No soil differences to account for the distribution of the pine forests were apparent.

Parts of the most level uplands that have a considerable growth of white oak are termed "white-oak flats," and similar names are applied to other areas having a predominance of other species of trees.

The complete system of stream courses and the general rolling character of the country insure thorough surface drainage. Any excess of surface water is rapidly carried away. The movement of water through the soil is not particularly rapid, because of the heavy underlying clay, but the surface 2 feet takes up water readily, so that a heavy and rather prolonged rain is necessary to start the surface flow of water. By properly compacting and puddling the soil may be made to retain water for indefinite periods, and this feature is made use of in constructing ponds to collect water for stock.

The immense strata of limestone, with the associated kaolinic rocks found throughout the county, are the source of the soil, which has been derived through processes of weathering and erosion. The soluble constituents of the rocks have been carried away by running water, and the insoluble or slightly soluble residue left behind, forming the soils as they are to-day. In the process of weathering the most resistant parts of the rocks, mainly chert, were unaffected and remain intact in the residual mass. These cherty particles are found scattered through the residual clays, sometimes only as small fragments, in other places forming sheets of varying extent and thickness. These sheets may be broken into numerous fragments, although remaining approximately in place. The fact of common observation that the rock fragments are most abundant on the surface is to be attributed to constant washing and erosion, which carries away from the surface the fine



THE CLARKSVILLE STONY LOAM, HOWELL COUNTY AREA, MISSOURI.

Showing the very stony character of the soil, which is poorly adapted to general farm crops, but well adapted to apples and peaches.



VIEW OF APPLE AND PEACH ORCHARDS ON THE CLARKSVILLE STONY LOAM, HOWELL COUNTY AREA, MISSOURI.

earth, leaving behind the stony material too heavy to be deported. This accumulates year by year until it covers the surface. This theory makes plain why the stones are more abundant on the slopes than on certain flat uplands. Of course it must be remembered, too, that the quantity of the material originally in the rock is an influencing factor.

The presence of the rock fragments is said to improve the yields of crops, and they are held to be generally beneficial except where numerous enough to cause inconvenience in cultivation. During heavy rains they retard washing. They prevent the baking of the surface as the soil dries, and during droughts serve as a mulch, preventing the escape of moisture.

The general red color of the subsoil and the yellowish color of the soil are due to the influence of oxides of iron which have been concentrated in the soil during the processes of weathering and erosion. To such an extent has this process of concentration taken place that in many places iron ore of high quality has been formed. This ore appears sometimes as fragments on the surface, while at considerable depths large masses of the ore have been exposed.

The general absence of the darker red color in the surface foot or two, particularly in the most hilly parts of the area, is due to the leaching of the rains, which has carried away much of the iron and changed the form of the oxide in the part remaining.

The crops produced on this soil are chiefly the grains and grasses, which are most important in extent and probably in total value, and fruit, which has gained for the region a prominent place in the fruit areas of the United States. (See Pl. XXXIV.)

The average yields of the grains and of hay are moderate, in correspondence with the moderate fertility of the soil. They also are influenced to a large extent by the annual rainfall and its distribution. The average yield per acre of wheat ranges from 8 to 10 bushels, that of corn from 15 to 30 bushels, and of the chief hay grass—timothy—from 1 to 1½ tons. The yield of rye is about that of wheat, and of oats from 12 to 30 bushels per acre. Of the leguminous plants clover and cowpeas are grown, but the droughts do considerable damage to these crops, and the total production is small. About 1 ton per acre is regarded as an average yield. Cowpeas make but a moderate growth, standing only from 1 to 2 feet above the surface of the ground at maturity.

Cotton is grown to a limited extent in the extreme southern part of the county, but the yield of lint is small, ranging from 150 to 300 pounds per acre.

Tobacco finds a place on many farms on this type of soil, but only in small patches, and the product is not of commercial importance. It is a heavy type of tobacco, used for smoking and chewing, and is consumed entirely at home. The growth of the plants indicates that the production of a heavy export and smoking tobacco might be developed into a profitable industry.

The fruits most extensively grown in the area are the peach and the apple, and the orchards are almost entirely limited to the Clarksville stony loam. The fruit is uniformly of large size and superior quality, while the color is especially attractive. If there is any difference in the adaptation of fruit to this soil the peach succeeds better than the apple, but the difference is not great. The other fruits grown are the pear, plum, strawberry, blackberry, and raspberry. These small fruits do not succeed as well on the upland soil as on the soil of the bottom lands, to be described later.

Grapes of all kinds thrive on every part of this type, and are generally considered to be the best adapted to the soil of any of the fruits grown.

Considering the type as a whole, the tree fruits and grapes are better adapted to it than any other class of crops. The soil is not suitable for crops making a heavy draft on its fertility each season, and if the grains are to be grown successfully care must be taken to maintain and increase the supply of available plant food. The soil is deficient in organic matter, and every effort should be made to increase the amount of this material. Even fruit would be benefited by practices that will add organic matter to the soil. The leguminous plants should be more often included in the rotation of crops, and either plowed under in entirety or the hay fed to stock and returned to the fields in the form of manure. The clovers, cowpeas, vetch, and like crops are some of the best soil renovators, and by using these the farmer will materially increase the returns from all the other crops. It also seems that in connection with leguminous crops commercial phosphates and potash fertilizers can be used advantageously on this soil type.

The description of this type would not be complete without particular mention of certain variations occurring here and there in the area. The occurrence of more sandy areas of the soil has been mentioned. In a general way the type is more sandy toward the borders of the county than in the interior. Particularly is this true in the northern part of the county, from near Willowsprings eastward to Mountainview; in the eastern part of the county, south of Gunters Valley; and at various points in the southern part of the county. In these localities the sandstone boulders are more abundant on the surface than in other parts of the type, and the sand is seen as small bars in washed places and in the roads. Examination of an ordinary section of the soil reveals very little sand except in a few small areas. West and a little to the south of Brandsville, centering in the northern part of section 22 of that township, occurs an area of about 2 square miles that is distinctly sandy. The surface 8 inches is a heavy sandy loam of a whitish color. The yellowish upper subsoil is also sandy. Other similar areas of smaller size are found in the vicinity of Moody. The timber growth on these sandy areas is the same as on other parts of

the type. Crop yields are also the same, except that shallow-rooted grain crops are more readily affected by drought than where the soil is heavier.

Another variation of importance is seen in many small areas, ranging from a few rods up to an acre or more in extent, scattered throughout the type, where the soil conditions are such that all crops make but a small growth. These spots may be noticed in the forest, in the field, or in the orchard. Forest trees are absent or stunted; fruit trees grow slowly, are stunted in appearance, and are short lived. The particular soil conditions responsible for such a condition of the vegetation are not uniform. Most commonly the cause is in the subsoil, the soil being of the typical material, but the subsoil consisting of an impervious, almost impenetrable mixture of a whitish clay and fine black or brownish pebbles or gravel. These give rise to the term "buckshot land," applied to such soil. Again, some of these places are due to the presence of a most tenacious light-colored clay. At other points the occurrence of thin layers of rock at a depth of 18 or 20 inches below the surface may account for the inferior character of the vegetation. In the vicinity of Sterling are found small areas of a very white and pure clay, which also occurs mixed with the red clay in contiguous areas.

These areas are the result of the gradual process of erosion to which the country has been subject and represent ancient pools—possibly sinks—in which the peculiar materials have accumulated.

The following table gives mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Clarksville stony loam.

[Fine earth.]

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
7622	4 miles SE. of Cure-all.	Grayish clayey silt to yellowish silty clay, 0 to 22 inches.	0.70	0.70	0.80	2.96	12.00	3.70	61.88	17.72
7624	1 mile NW. of Brandsville.	Grayish-yellow to red silty sandy loam, 0 to 18 inches.	.57	1.42	2.14	4.72	15.92	5.06	52.10	18.04
7625	Subsoil of 7624.....	Red stiff clay, 18 to 36 inches.	.18	1.02	1.24	2.68	10.48	3.02	43.00	38.26
7623	Subsoil of 7622.....	Red stiff clay, 22 to 36 inches.	.32	1.00	1.86	1.30	5.56	7.14	43.22	39.20
7629	¼ of a mile N. of Pomoná.	Red silty clay, 18 to 36 inches.	.31	.60	.84	1.06	3.40	1.84	38.58	53.20

CLARKSVILLE SILT LOAM.

The Clarksville silt loam is a loam of grayish or yellowish color with a depth of 7 inches. The subsoil is usually a yellow loam of heavier texture, varying in depth from 15 to 25 inches. Beneath this is found a stiff red or reddish clay, which usually extends several feet before the basal rock is reached. The upper soil is quite silty, and especially the immediate surface. This soil differs from the Clarksville stony loam chiefly in the absence of rock fragments.

The drainage is generally good, and because of the absence of rock this type is more easily cultivated than any other in the area. The crops grown are about the same as those on the Clarksville stony loam, and the yields are generally about the same, although the yield of wheat is probably somewhat larger.

The following analyses show the texture of the soil and subsoil of this type:

Mechanical analyses of Clarksville silt loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
				P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
7626	7 miles SW. of Westplains.	Yellow silty loam to stiff red clay, 0 to 24 inches.	0.60	0.66	2.04	4.46	9.74	2.88	59.16	20.66
7627	Subsoil of 7626.....	Stiff red clay, 24 to 36 inches.	.28	.34	1.22	4.34	10.06	3.34	55.76	24.94

CLARKSVILLE LOAM.

The Clarksville loam is a rich yellowish or brown silty loam, 10 inches in depth, resting on a heavier yellow loam which reaches to a depth of 36 inches or more. The subsoil is usually quite silty.

The type is found distributed throughout the area in narrow ribbons along the streams, where they have any considerable width of valley. It constitutes the "bottom land" type of the area. The largest areas occur in the valleys of Hutton, Eleven Point, Gunters, and Howell creeks and their major tributaries. Extensive areas of this type occur around Westplains and in the Pottersville Valley. Besides its occurrence along streams there are a few very small areas found in connection with sink holes in the uplands, chiefly in the region between Whitechurch and Pomona.

In contrast with the upland soils the Clarksville loam contains few rock fragments of any kind. Near the heads of the valleys there sometimes occurs considerable gravel, and the soil covering is often thin. In the larger valleys the gravel is frequently present as narrow irregular lenses or strata. The original forests included a larger variety of species than the upland forests, adding to the list already given the elm and sycamore. At present the timber is practically all removed and the type is entirely under cultivation.

These low lands are subject to occasional overflow during periods of freshet, though in the larger valleys a general flooding is comparatively rare. The soil is generally well drained, and those areas containing bands of gravel near the surface may even become very dry after a short period of drought. Normally, however, the soil takes up and retains a large quantity of moisture, and the crops are able to withstand prolonged drought without suffering much injury.

The materials constituting this soil type are derived from the wash of the upland types. The small gullies on every hillside become torrents during heavy rains, and in its movement down the slope the water carries away the soil and the smaller pebbles and stones, which are deposited in the bottoms below. In this way the bottom lands have been built up. The loamy character of the soil is due to the process of vigorous washing, which has removed from the soil much of the clay and a considerable part of the iron oxides as well.

These bottom lands are the best general farming lands in the county. Upon them all the grain crops give good returns. The yield per acre of wheat ranges from 12 to 22 bushels, of corn from 30 to 50 bushels, and of hay from 1 to 2 tons. Other crops grown give equally good returns.

The small fruits also do remarkably well on the valley lands. The blackberry, raspberry, currant, and strawberry are chiefly grown and are of excellent quality. The apple orchards are longer lived and yield more heavily on the bottom soil than on the hill soil, but the quality of the fruit is not as good. Among the truck crops the sweet potato is found to produce very well.

With proper attention given to cultivation and rotation of crops the fertility of this soil may be maintained or even increased, and profitable crops of grain and truck obtained year after year.

The table on the following page gives the mechanical analyses of soil and subsoil of this soil type.

Mechanical analyses of Clarksville loam.

[Fine earth.]

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
7614	¼ mile N. of Pottersville.	Brown silty loam, 0 to 12 inches.	1.80	0.46	0.82	1.58	5.72	5.80	71.36	14.24
7616	1 mile E. of Willow-springs.	Brown silty loam, 0 to 10 inches.	2.18	.12	.30	.48	2.90	4.42	75.02	15.08
7618	1 mile E. of West-plains.	Brown silty loam, 0 to 12 inches.	2.07	.08	.56	.56	2.58	3.76	73.22	18.56
7619	Subsoil of 7618.....	Yellow heavy silty loam, 12 to 36 inches.	.69	.08	.40	.82	2.88	3.50	70.10	21.84
7615	Subsoil of 7614.....	Yellow silty loam, 12 to 34 inches.	.56	.70	1.46	1.84	4.70	5.00	63.36	22.94
7617	Subsoil of 7616.....	Yellow silty loam, 10 to 36 inches.	.50	.12	.18	.16	1.20	3.74	69.42	25.04

AGRICULTURAL METHODS.

The agricultural methods of the area have, in a way, been developed by the peculiar local conditions. The presence of large quantities of stone in the soil renders necessary certain modifications of the methods familiar to farmers in regions where the soils are free from stone. Over much of the area some implements, for instance the disk harrow, are almost useless. Frequently in stony land it is found that a sort of mole plow is more satisfactory than the turning plow, since it keeps the rocks on the surface and prevents the fine earth from being washed away. Farming in southern Missouri is not on an extensive scale. The fields are usually small and the implements in use limited in number and variety. Some of the implements are even primitive. Farm machinery does not find a large use and there is a tendency toward the using of small implements, probably justified to some extent by the irregular surface. In cultivation there is need of running the turning plow deeper and the surface implements more frequently, to deepen the soil and conserve moisture, the lack of which is one of the serious hindrances to grain farming in the upland or, in fact, anywhere in the area.

There is a general lack of systematic rotation of crops, which tends to the deterioration of the soils and the impoverishment of the farmer. Clover and cowpeas are grown in every part of the county to some extent, but their growth should be more general, and in addition every other legume that can be turned to use should be sown. The soils as a whole are markedly deficient in organic matter, which is probably

accounted for in part by the annual fires that swept the country in pre-farming days, destroying the prairie grass and forest leaves. Every application of barnyard manure gives phenomenal returns, and commercial fertilizers—complete mixtures—are also very satisfactory in their results. The use of commercial fertilizers in connection with clover or some other legume and the application of organic matter to the soil in every possible way can not be urged too strongly upon the farmers of the area.

The present system of farming should be modified so that as little bulk of product as possible will be removed from the land. To do this there must be concentration of the output into a form that is more valuable. The chief objection made to stock raising is that the soil will not produce sufficient feed. Certain it is that it will not produce the quantity, acre for acre, that the soils of northern Missouri or the Illinois prairie soils do. But will it not yield forage for half as many cattle per acre; will there not be an annual increase in its productive power under proper management? Continuous grain cropping does not give large returns, either, and each year these grow a little less. It is the conviction of the writer that animal husbandry will ultimately be found to be the most satisfactory form of farming in the area, on the lands that are sown to any of the grain or forage crops.

In orcharding, too, the methods have been developed somewhat by the soil conditions. The most satisfactory surface work in the orchard is accomplished with the ordinary cultivator. In the young orchards the best fruit growers sow cowpeas and rye to serve as feeders to the young trees and help keep down weeds. The amount of cultivation given the trees is made dependent upon the size of the fruit crop. The orchards are considered to need less frequent cultivation during seasons when there is no crop on the trees than when the limbs hang heavy with fruit. One grower reports that by frequent cultivation during the ripening period he was able to retard the maturing of his crop of peaches nearly two weeks, thus securing larger fruit and avoiding to some extent an overstocked market. While there are in the county several orchards that receive very good care generally and quite thorough cultivation, there are very many in which this is not the case. Many of them are neglected in every respect. As a result it is not unusual to see orchards with half the trees dead or dying and the rest lacking in vigor and giving little, if any, returns. In these the grass and weeds have formed a thick sod. It is obvious that if success is to be attained in any form of fruit growing there must be a reasonable amount of attention bestowed on every operation, from planting the trees to marketing the product. Insect and fungus enemies must be fought and diseased trees destroyed. Fortunately, these pests are not as numerous or destructive as in some other sections of the United States.

AGRICULTURAL CONDITIONS.

The general appearance of the county, the condition of the farms, the size and construction of the farm buildings, the number and kind of implements, and number and quality of the live stock do not indicate a highly prosperous farming class. Another indication of the unfavorable condition of the community is found in the large number of vacant houses and abandoned farms seen throughout the county. It is said that many of these vacancies were occasioned by the exceptionally severe drought of 1901. There is much of the appearance of the pioneer settlement in every part of the area. Around the towns in the central part of the county and in several of the larger valleys there are some prosperous looking farmhouses, but excepting these the buildings are small and antiquated.

According to the Twelfth Census of the United States, of the total of more than 576,000 acres in Howell County, 417,170 acres are classed as included in farms, of which only 153,701 acres are improved. The number of farms in the county is 3,065, of which 3,030 are improved by buildings. The average size of the farms is 136 acres. The average value of the buildings per farm as derived from the same source is \$300. The average value of the machinery on the farms is \$66 and of live stock \$238. The gross receipts from all sources of income except live stock are \$295 per farm, and the expenditures for labor \$32. The farms are mainly operated by the owners, and the above figures indicate that, while the farms are not large, the cultivated portion is very much smaller and the work is nearly all performed by the operator and his family.

The area of 159,000 acres not included in farms is owned largely by mining companies and by individuals for speculative purposes and lies in the virgin forest. Much of this land is suitable for cultivation.

In the fruit industry the conditions average better than in general farming. The owners of several of the largest orchards reside outside the county and operate their orchards through a resident manager.

No figures are at hand showing the acreage or production of the several fruits. In the county there are between 10,000 and 20,000 acres in orchards, by far the greater area of which is devoted to peaches and apples. The growers rely on a full crop of peaches every third year. The yield of apples is more certain year by year. Some growers contend, however, that growing peaches is the more profitable. The rough, rocky slopes of the Clarksville stony loam areas produce peaches of the largest size and finest quality. The apple orchards do best on the lowest part of the slope and give the largest quantity of fruit per tree, but the largest fruit, and the finest in quality, is obtained on the highest parts of the hills.

The Kieffer pear grows well, and plums bear remarkably well, but neither of these fruits is extensively grown. Grapes of all kinds

flourish on the upland soils and are said to be more certain than any of the tree fruits. Table grapes—such as the Concord—are, however, quite subject to the black rot, which seriously interferes with their profitable production. Fortunately a number of varieties of the best wine grapes are more resistant to this fungous disease. A single strong stock will produce from 10 to 20 pounds of fruit. An acre set to Moore's Early is reported to have yielded 6,400 pounds of fruit in a single season.

The roads of the county, which are not laid out on the rectangular system, are generally poor, and the transportation of products to the point of shipment is often extremely difficult. But few county roads traverse the area away from Westplains, and even near that town very little work has been done to permanently improve these main highways. The secondary roads—"country roads" as they are called locally—reach all parts of the area. These roads are in reality private, traversing private property, although not closed by gates or fences.

The Kansas City, Fort Scott and Memphis Railroad is the only line in the county. It passes diagonally from northwest to southeast through the center of the county, touching Willowsprings and Westplains. At Willowsprings the Current River branch leaves the main stem, traversing the county in an easterly direction and connecting with the Iron Mountain line at Williamsville. On the main line there are through-train connections with Kansas City and Memphis, but for points northeast the connections are by a rather roundabout route for shipping. There is need of competitive rates to reduce the cost of freight transportation. Surveys which are being made by the Rock Island Railroad Company for a new road give some hope for improvement in this respect.

The local markets for produce are small, and staples of every kind must largely seek outside markets. The large cities are a considerable distance away. Cattle go direct to the slaughtering pens of Kansas City. The fruit is shipped to many parts of the country, some shipments being billed direct to Boston and other Eastern cities.

The condition of the area with regard to markets and transportation is added argument for concentration of the products into the smallest and most valuable form and the retention of cheap, bulky products and waste material on the land. It does not follow because of the present low average income of the farms that the country is naturally poorly adapted to all forms of agriculture. On the contrary, it is capable of giving very fair returns for the labor and capital bestowed upon it. Live-stock production and fruit growing are the interests best suited to the area. These will prove the most profitable, and with the adoption of more intensive methods the average return per farm will be materially increased.

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