SOIL SURVEY OF ALLEN COUNTY, KANSAS.

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LOCATION AND BOUNDARIES OF THE AREA.

Allen County lies in the third tier of counties from the southern and second from the eastern boundary of the State, and is just 24 miles north of the Parsons area, which was surveyed during the season of 1903. The present survey covers the entire county, or an area of 322,560 acres, or 504 square miles. Much the same soils, soil conditions, and agricultural practices were found in Allen County as in the Parsons area, and the status of the agricultural class is equally satisfactory in the two areas.

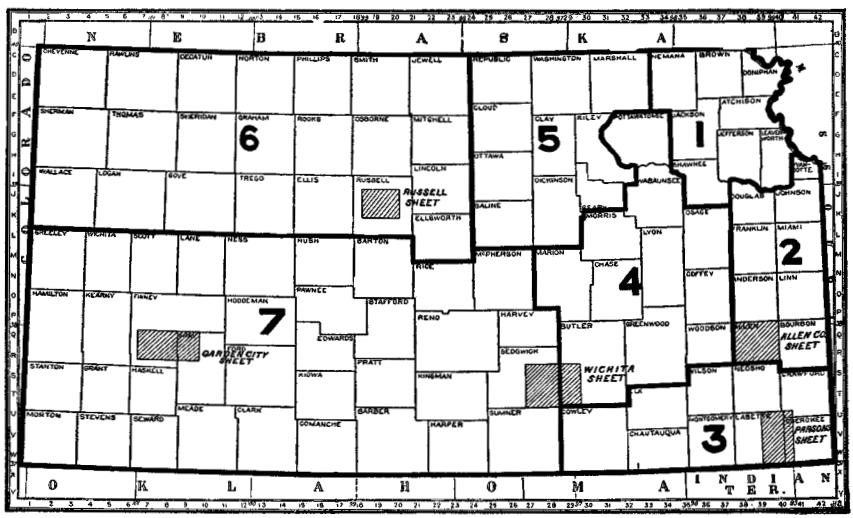

FIG. 37.—Sketch map showing location of the Allen County area, Kansas.

The Neosho River flows through the western part of the county for nearly its entire length from north to south. The county seat is Iola, situated on this river, and at the intersection of the Atchison, Topeka and Santa Fe, the Missouri Pacific, and the Missouri, Kansas and Texas railroads. Humboldt, Moran, and Laharpe are the other important towns.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The first homestead claims were selected in the Neosho Valley in 1855, and during the same year a county organization was effected and the boundaries of Allen County fixed almost as they are at present. A new town, known as "Cafochique," which was soon afterwards abandoned, was made the county seat. From this time until the civil war immigration was quite rapid, the older States, especially Indiana and Illinois, contributing large numbers of settlers.

In 1860 a very serious drought caused an almost total failure of crops, and it is reported that out of the 3,000 persons then residing in the county a great majority moved away, never to return. In 1866, and again in 1874, swarms of grasshoppers appeared, consuming almost every particle of green vegetation, especially in the valleys, and these years also were periods of great discouragement.

In the spring of 1870 the Missouri, Kansas and Texas Railroad was built as far as Humboldt, and in the fall of that year the Leavenworth, Lawrence and Galveston Railroad, now a division of the Atchison, Topeka and Santa Fe, was completed across the county. Both roads received grants of public land, most of which was in the eastern part of the county. The railway companies soon disposed of this land, the greater part passing into the hands of nonresidents. In the early seventies the assertion was quite generally made that these companies had not complied with the terms of the original grants, and that consequently their titles were defective. Squatters claiming rights under the homestead laws proceeded to occupy almost every quarter-section not actually held by resident owners. Much trouble arose, for many transfers had been made prior to and during the time the ownership was unsettled. These land cases and indictments for numerous crimes resulting therefrom were in the Allen County courts for more than twenty years. Pending the settlement of these disputes, about 57,000 acres of land remained unimproved, and agricultural development in general was greatly retarded.

Allen County has at no time been a part of the great range district, most of its lands having been occupied by farmers before the cattle industry of the West assumed great proportions. Corn has always been the principal crop, but wheat and oats have been more or less important at different times. Until recently the growing of wheat had been almost discontinued, owing to the belief on the part of the farmers that it fostered chinch bugs, but the acreage in this crop is now being rapidly increased. Clover, timothy, and a few other tame grasses have been cultivated for about twenty years, but to no great extent until recent years. Broom corn at one time was quite important, but is at present confined principally to the southeastern

part of the county, in the Swedish settlements near Elsmore and Savonburg. In this same section, about fifteen years ago, the castor bean was extensively cultivated, but this industry has now been entirely abandoned.

CLIMATE.

The climatic conditions of Allen County are characterized by somewhat open winters and a long growing season, the early part of which is often wet and the latter part dry, each often being so extreme as to reduce greatly the crop production of the county.

The following table, compiled from the records of the Weather Bureau station at Moran, shows the normal monthly and annual temperature and precipitation:

Normal monthly and annual temperature and precipitation.

Month.	Moran.		Month.	Moran.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	°F.	*Inches.*		°F.	*Inches.*
January	32.8	1.33	August	78.7	4.51
February	30.2	1.75	September	69.6	4.54
March	43.0	2.59	October	60.7	2.03
April	55.8	3.11	November	45.4	1.41
May	66.6	4.67	December	33.0	2.24
June	74.0	4.92	Year	55.7	36.82
July	78.6	3.72			

PHYSIOGRAPHY AND GEOLOGY.

The geology of Allen County is also similar to that of the Parsons area. In each the formations consist of alternating beds of shale and limestone belonging to the Carboniferous system. The stratigraphic formations of this area, however, are later deposits forming the basal members of the Upper Coal Measures. These strata are conformable one with another and have a slight dip to the north and west, thus successively exposing five formations, as recognized by the State geologists. Each of these outcrops reveals itself in the characteristics of the soil formed thereon and by peculiarities of the surface.

In the southeast corner of the county the very rolling land along Marmaton Creek is the result of the erosion of the bed of this stream through limestones of the Erie formation. The large, light-colored chert fragments so abundant in this locality are associated with this particular rock. The upper stratum of this limestone and the included chert is exposed along the banks of Big Creek.

The Thayer shales which overlie the Erie formation have furnished

the surface materials for a narrow area extending in a northeast and southwest direction from the Little Osage River to the vicinity of Leanna. The sandstone strata occurring in this formation have given rise to the sandy soils found on the flanks of the ridges or forming the tops of the more prominent elevations. The greater part of these shales, however, are less arenaceous, and weather into soils of finer texture.

The Iola limestone is the next higher member in the geologic column, and is much in evidence at Humboldt and on the adjacent uplands east of the Neosho River. It is a hard, crystalline rock, having few seams or fractures, and, considering its thickness and nearly horizontal position, has affected but a limited extent of surface.

The Lane shales lie above the Iola horizon, and have a wide exposure through the central part of the area, contributing liberally to the formation of the Oswego silt loam of this section.

The uppermost member of the geologic column, the Garnett limestones, outcrops near Carlyle. The different strata of this formation have formed the limestone lands lying between Deer Creek and the northern boundary of the county. They also appear west of the Neosho River.

This brief reference to the geology of the area is, in a measure, descriptive of its physiography. There are no topographic features of exceptional prominence, nor any considerable extent of surface deficient in drainage. The Neosho River flows in an east and southeast direction through the western part of the county. Bear, Elm, and Coal creeks are tributaries from the east, the latter two having their sources within the county. The valley of the Neosho varies from 1 to 3 miles in width, but in most of its broader expansions there are well-defined terraces or "second bottoms" between the flood plain proper and the lower slopes of the bordering uplands. Within the limestone areas the small streams have narrow valleys, or flow through mere channels bordered by rough, stony land. But the wide exposures of the soft shales have weathered to a surface characterized by broad depressions separating gentle undulations that succeed each other until interrupted by the more rugged limestone topography. Sometimes the relief becomes more pronounced by the rise of a gravelly knoll or the presence of a sandy ridge. In the western part of the county some thin limestone layers, remnants of the Garnett system, have protected the shales beneath, thus forming flat-topped elevations varying from a few acres to a square mile or more in extent.

In general, the major part of this area may be described as a gently rolling upland, rising from 40 to 100 feet above the valleys of the larger streams. The extreme elevation, about 1,100 feet above sea level, is attained near Moran. Aside from a few stony bluffs, the

profile and contour lines have easy curves and the surface features are favorable to agriculture.

SOILS.

Eleven types of soil, including the Rock outcrop and Rough stony land, were recognized and mapped in the survey of Allen County. The following table shows the actual and relative extent of each:

Area of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Oswego silt loam	177,600	55.8	Sharkey clay	2,739	0.8
Sedgwick clay loam	75,239	22.4	Yazoo clay	2,560	.8
Yazoo loam	20,531	6.4	Yazoo sandy loam	909	.3
Oswego fine sandy loam	15,565	4.9	Rock outcrop	870	.3
Rough stony land	12,211	3.8	Total	322,560	
Neosho silt loam	9,171	2.9			
Sedgwick gravelly loam	5,165	1.6			

OSWEGO SILT LOAM.[a]

The Oswego silt loam, commonly known as "white, ashy land," covers the greater part of the upland portion of the area. The soil varies in depth from 7 to 18 inches, with an average of about 12 inches. It is best described as a gray to dark-gray, more or less ashy silt loam, containing small and varying amounts of very fine sand, which is scarcely discernible with the ordinary means of observation. With thorough preparation it is reduced to a loose, friable, dusty condition, but becomes compact and massive when left thus for some time undisturbed. When in this state there is a slight tendency to crack, and on the whole a disposition to dry out rapidly. When wet the color of the soil becomes darker and approaches almost a black in the depressions, where also there is occasionally a tendency to a slightly more clayey texture. Except in these small areas there is a general deficiency of organic matter.

Underlying the soil from 12 to 36 inches is found a dark-drab to yellow silty clay subsoil, compact, stiff, and impervious, and popularly known as "hardpan." In the depressions the color of this material becomes much darker, and there is a slightly higher clay content. The subsoil of the Oswego silt loam, from its nature and extent, may result in a marked decrease in the production of crops in the area during a wet season. Special reference is made to this problem in a subsequent part of this report. Where closely associa-

[a] The Oswego silt loam is the same soil as the Oswego loam of the Parsons area, Kansas. The Oswego silt loam of the latter area will be correlated with some other type.

ted with the Sedgwick clay loam or the Oswego fine sandy loam this hardpan condition is often lessened or wholly removed by the formation of a looser and more friable structure, which promotes a better subdrainage. The material also becomes loose and granular upon exposure to the atmosphere, and where it can be mixed with the surface soil the mechanical condition of the latter will be greatly improved and the yield of crops increased. At present the plowing on this type of soil is generally too shallow for the best results.

The Oswego silt loam is found in almost all parts of the area and often extends in unbroken bodies for several miles. It occupies slopes, depressions, and elevations. Leaving the areas of the Sedgwick clay loam in the north-central and northwestern parts of the county, it occupies first the more abrupt slopes and narrow depressions, then extends into a broad and expansive depression to the northeast of Iola, and assumes the form of a broad and slightly irregular upland to the north of Laharpe and Moran. In the vicinity of Gas it begins to occupy the elevations and slopes, the Sedgwick clay loam occupying the depressions; thence south and southeastward the types alternate in this respect.

Except where the type occurs on very gentle slopes or in slight depressions the topography is such as to give apparently good surface drainage, but in times of extreme and continued rainfall crops suffer greatly from the lack of subdrainage, the impervious subsoil holding an excess of moisture too near the surface.

The weathering of the different beds of shale found in the county has given rise to this soil. Owing to the thickness of these beds in some places the type occupies elevations varying from 40 to 50 feet within comparatively short distances, while in others a slight difference will effect a change in soil type, so that elevation and general topography are no guide to its occurrence.

Owing to its silty texture and tendency to pack, the Oswego silt loam is naturally adapted to the growing of wheat. Broom corn yields well, and likewise corn, where the land has not been carelessly farmed for long periods. By applying manures and thus increasing the organic matter, and by improving the mechanical condition of the subsoil as suggested, the Oswego silt loam will prove equal if not superior to any of the other upland types for general agricultural purposes. With small applications of fertilizer, wheat yields about 18 bushels; corn, about 20 bushels on an average, without fertilizers; and oats, 25 bushels per acre. Broom corn averages about one-fourth of a ton per acre; native hay, 1 ton; and clover and timothy, from 1 to 1¾ tons. Much of the type is at present in a low state of productiveness, but by skillful management and proper cultivation its crop yields can be greatly increased.

The following table shows the results of mechanical analyses of both soil and subsoil of the Oswego silt loam:

Mechanical analyses of Oswego silt loam.

No.	Locality.	Description.	Fine 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 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11857	¼ mile E. of Elsmore.	Silty loam, 0 to 14 inches.	0.2	1.1	0.9	2.1	7.8	76.9	10.7
11855	3½ miles NE. of Iola.	Silty loam, 0 to 10 inches.	.1	.8	.7	1.7	8.5	75.7	12.6
11853	4½ miles S. of Iola.	Silty loam, 0 to 10 inches.	.1	.7	.8	1.2	10.9	71.1	14.6
11854	Subsoil of 11853	Silty clay, 10 to 36 inches.	.0	.6	.5	1.9	8.0	67.8	20.8
11856	Subsoil of 11855	Silty clay, 10 to 36 inches.	.1	.5	.4	2.0	5.5	67.6	23.3
11858	Subsoil of 11857	Silty clay, 14 to 36 inches.	.0	.4	.3	2.5	6.2	62.0	28.4

SEDGWICK CLAY LOAM.

The Sedgwick clay loam is the second in importance of the upland types. From its prevailing reddish tinge it is known locally as "red land." The upper 10 inches consists of reddish-brown to black silty loam to clay loam, rather granular, but loose and friable, and containing a relatively high percentage of silt. Underlying this is a red to reddish-brown, and occasionally black, silty clay to clay subsoil, generally somewhat open and granular, but becoming compact and stiff near the bottom of the soil profile. This in turn rests on limestone at depths ranging from 25 to 60 inches.

Being naturally a strong soil, and having a subsoil somewhat more open, this type is preferable to the Oswego silt loam during wet years, and is thought by many to stand drought equally well. Owing to its nearness to rock, however, and its peculiar texture, it has a decided tendency to dry out and to become deficient in moisture during continued periods of dry weather. This feature makes it necessary to practice frequent cultivation, which should be shallow, the surface being kept as level as possible. When this is begun early and the soil is kept in good tilth till late in the growing season, corn suffers but little from drought and often yields as much as 50 bushels per acre.

The largest area occurs in the northern part, but the type is encountered in almost all parts of the county. Being the product of the weathering of different layers of limestone, it occupies alternately the tops and slopes of elevations, ridges, and depressions, depending on the position the formation from which it is derived occupies with

reference to the beds of shale between. Where found on the elevations it has good natural drainage, but drainage is very deficient in the depressions, where the type is often used for pasture only.

The Sedgwick clay loam is naturally best adapted to corn, but all the general farm crops of the area do well. Wheat possibly does not yield as well as on the Oswego silt loam, being somewhat more subject to the effects of freezing and thawing. It is the general opinion that alfalfa dies out in about three years, but an instance was observed where by two years of deep plowing and manuring a stand was secured that had yielded about a ton per cutting and had been cut four or five times each year for twelve years. It is reasonable to suppose that by thoroughly preparing and manuring the soil better success could be had in growing this valuable crop. There must, however, be good surface drainage and sufficient depth of soil. Clover and timothy together do well, producing from 1 to 2 tons per acre. Corn will average about 22 bushels, oats 25, wheat about 16, and flax from 6 to 10 bushels per acre.

The following table shows the results of mechanical analyses of typical samples of the soil and subsoil of this type:

Mechanical analyses of Sedgwick clay loam.

No.	Locality.	Description.	Fine 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 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11861	5 miles N. of Iola	Silty loam, 0 to 10 inches.	0.0	0.4	0.4	2.9	8.9	69.4	17.8
11863	8¼ miles NW. of Elsmore.	Silty loam, 0 to 12 inches.	.1	.5	.5	1.7	8.9	63.4	24.8
11865	1 mile N. of Bayard	Clay loam, 0 to 12 inches.	.1	.3	.3	1.8	5.4	64.5	27.6
11862	Subsoil of 11861	Silty clay, 10 to 36 inches.	2.6	2.9	.9	1.6	3.8	64.5	23.3
11866	Subsoil of 11865	Silty clay, 12 to 36 inches.	.1	.5	1.1	11.9	5.3	50.6	30.6
11864	Subsoil of 11863	Silty clay, 12 to 36 inches.	.6	.6	.4	2.2	6.2	53.3	36.7

NEOSHO SILT LOAM.

The soil of the Neosho silt loam is a light-colored, somewhat ashy silt loam to a depth of 8 inches, in which small and varying amounts of fine and very fine sand are incorporated. This sand content would be expected to benefit the soil materially by improving its mechanical condition, yet owing to its silty texture and the depletion of organic matter by long cultivation, it has a decided tendency to run together in a dense mass, which renders fall and summer plowing

to any reasonable depth very difficult, unless done when the soil is wet. When dry for some time the soil has a tendency to crack, the cracks often having a depth of from 6 inches to 1 foot, which permits a rapid escape of the moisture in the soil and subsoil. Thorough cultivation of the soil reduces it to the consistency of dust, which in turn forms a compact mass again if not cultivated continually. On the whole, there is a marked deficiency of organic matter, which should be supplied by turning under coarse stable manure and green manures. These should be plowed in deeply, turning the soil to a depth of at least 8 or 10 inches.

From 8 to 25 inches the subsoil is a dark, very compact, and impervious silty clay, with little power to retain moisture, and becoming dry and difficult to bore soon after rains. Below this, to a depth of 36 inches, there is almost always found a mottled yellow and grayish-white sandy material, which is loose and powdery when dry, and cuts off the water supply from below, although sometimes the subsoil is composed entirely of the compact clay always occurring immediately below the surface soil.

The occurrence of the Neosho silt loam is confined to terraces, lying from 5 to 15 feet above the level of the river bottom proper, and is locally known as "second bottom." It doubtless marks a flood plain of the river before it had cut down to its present level, and in the case of the area along Deer Creek it probably marks a former level of that stream. The elevation of the type is sufficient to insure it against danger from floods, and to afford a fair means of surface drainage. The surface presents a flat or gently rolling topography, however, which does not hasten the surplus water to the small streams or ditches. This, together with the impervious character of the subsoil, is often responsible for damage to crops. Deep plowing or subsoiling would doubtless do much to improve the drainage conditions in such cases.

Although generally greatly influenced by the adjoining uplands, the Neosho silt loam is largely of alluvial origin. It has lost most of the characteristics of a typical alluvial soil by subsequent weathering, and has no resemblance to the soils of the first bottom.

The type is probably best adapted to wheat, but corn and oats do well when the season is not extremely wet or dry. Twenty-five bushels of wheat per acre can often be grown, and as much as 50 bushels of corn and 30 bushels of oats; but owing to the effect either of excessive moisture or drought the general average is much lower.

The following table shows the results of mechanical analyses of the soil and subsoil of the Neosho silt loam:

Mechanical analyses of Neosho silt loam.

No.	Locality.	Description.	Fine 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 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11846	5 miles SW. of Iola	Silty loam, 0 to 8 inches	0.2	1.0	2.1	5.5	18.0	59.3	13.6
11844	1½ miles NW. of Humboldt.	Silty loam, 0 to 6 inches	.2	1.5	2.8	4.5	7.0	67.5	16.5
11845	Subsoil of 11844	Impervious silty loam, 6 to 25 inches.	.3	2.4	6.3	9.7	13.6	55.9	11.5
11847	Subsoil of 11846	Impervious silty loam, 8 to 24 inches.	.0	.6	1.7	5.0	11.6	63.2	17.5

SHARKEY CLAY.

The Sharkey clay covers a comparatively small proportion of the Neosho bottoms, and is consequently not a great factor in the agriculture of the area. The soil consists of a black clay, 0 to 10 inches deep, stiff, waxy, and tenacious. When dry it becomes very hard, cracks to some depth, and is very difficult to plow, while if plowed when too wet it bakes to such an extent that any further preparation for seeding it almost impossible. It is best to choose the intermediate condition, if possible, and plow in the fall or early winter instead of in the spring. When this is done the soil becomes more loamy, is easier to cultivate, and maintains a much higher moisture content during the growing season.

The subsoil, from 10 to 36 inches, is a stiff, waxy, and impervious clay, somewhat lighter in color than the soil, and slightly mottled with yellow, the mottling becoming more prominent with depth, or as the organic matter decreases from above, and often grading into a uniform drab color at a depth of 30 inches.

Occupying as it does the lowest areas in the river bottom, and being in the part of the bottom most distant from the river, the drainage of the type is naturally very poor. In addition to this, much water is usually received from the adjoining upland slopes. Floods of any consequence overflow most of the type, and much water remains after their subsidence, unless sloughs or artificial ditches afford means for its escape. Some parts of the type, occurring on slightly higher levels, constitute the strongest farming lands of the area. Drainage would materially benefit the type as a whole, but owing to the great

uncertainty of crops on account of floods there is little disposition on the part of the owners to expend much money for this improvement.

The Sharkey clay is an alluvial deposit, and is formed principally from the finer particles deposited where the current during the time of overflow is very slow or entirely checked.

Where sufficiently drained this soil is excellently adapted to wheat, large yields of which have been produced. Were it not for the danger of loss by floods, it would undoubtedly be the best wheat soil of the area. Although not typically an ideal corn soil, the farmers often realize from 40 to 50 bushels per acre, and sometimes when the season is favorable this yield is exceeded. The soil remains too wet and warms up too late for the best results with oats.

The following table shows the results of mechanical analyses of typical samples of the Sharkey clay:

Mechanical analyses of Sharkey clay.

No.	Locality.	Description.	Fine 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 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11867	5 miles S. of Humboldt.	Clay, 0 to 8 inches	0.0	0.2	0.4	2.7	2.7	54.3	39.6
11869	3 miles NW. of Iola	Black clay, 0 to 8 inches	.1	.4	.6	2.6	2.1	54.1	40.0
11870	Subsoil of 11869	Gray clay, 8 to 36 inches	.0	.4	.5	2.2	2.4	56.5	38.0
11868	Subsoil of 11867	Clay, 8 to 36 inches	.1	.4	.9	5.8	4.4	47.8	40.5

SEDGWICK GRAVELLY LOAM.

The Sedgwick gravelly loam, which is of rather limited extent in the area, is not well suited to general farming. The surface soil, to a depth of 8 inches, consists of a very dark to black loam, containing from 10 to 50 per cent of rounded and worn chert fragments of a reddish tinge. The subsoil, from 8 to 36 inches, is a very stiff, tenacious red clay, in which small quantities of the same gravel usually occur. The gravel content of both soil and subsoil varies greatly. In many instances it is impossible to bore more than 5 or 6 inches, while again there is not enough gravel to interfere with cultivation.

This type is almost wholly confined to the northwestern part of the county, and is somewhat patchy in its occurrence. It is found on knobs and ridges, which rise from 5 to 30 feet above the general level, presenting thus a rolling topography and affording an excellent surface drainage. The gravel in the soil also permits ready subdrain-

age. This is a very desirable feature in a wet year, but in many seasons crops suffer greatly from drought and often fail absolutely.

The gravel seems to be deposited above the other formations, and is mixed with the soils derived therefrom. It has greatly protected the surface from erosion. In almost all instances the soil is composed largely of material derived from limestone, together with some slight admixture of the products of disintegrated and decomposed chert. The occurrence of this gravel formation is somewhat peculiar, and geologists offer no very satisfactory theory for its deposition. The surrounding soil type is generally the Sedgwick clay loam, but it is occasionally the Oswego silt loam, and in such instances the interstitial soil becomes more silty, though the type is otherwise the same.

The Sedgwick gravelly loam as a whole is best adapted to pasture, but where the proportion of stone is not excessive corn is successfully grown, especially in wet seasons, when as many as 50 bushels per acre have been produced, though the average is about 20 bushels or lower. Grapes, peaches, and a few other fruits would probably do well on the greater part of this soil. Flax has yielded from 6 to 8 bushels. Wheat and oats have been grown but little.

The following table shows the results of mechanical analyses of the fine earth of this soil:

Mechanical analyses of Sedgwick gravelly loam.

No.	Locality.	Description.	Fine 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 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11842	5½ miles NW. of Iola.	Silty loam, 0 to 12 inches.	1.6	1.2	0.7	1.2	5.2	61.5	28.2
11843	Subsoil of 11842	Clay, 12 to 30 inches.	2.5	1.5	1.1	4.2	7.1	53.2	30.2

YAZOO LOAM.

The Yazoo loam is the most extensive of the bottom soils. Being an alluvial deposit, it varies somewhat in texture, being composed chiefly of silt, fine sand, and clay, in different proportions, although the first largely predominates. Near the streams quantities of fine sand and silt are usually greater, while farther back, and occasionally in strips marking old river channels, the soil contains more clay and becomes perceptibly heavier. A typical profile consists of a loose, friable loam or silt loam to an average depth of 10 inches, dark to dark brown in color, and containing a small amount of fine sand. Below this to a depth of 36 inches is found a dark-gray to dark

yellowish-gray silt and fine sandy loam, permeable and easily penetrated by all deep-rooted crops. This is a very productive soil, and its texture is such as to need no special treatment other than good cultivation. During the last few years the most serious drawback to crop production on the type has been the floods, with which it seems impossible to deal successfully. These, however, are said to be the exception rather than the rule.

The Yazoo loam occupies the greater part of the broad Neosho bottom, being found almost invariably near the river and consequently on the highest portions, from which it slopes very slightly back toward the uplands, more or less continuously, and in many instances coming directly into contact with the upland soils. It likewise occurs in narrower strips along some of the creeks and smaller streams, and here presents somewhat wider variations from the true river type. Along the smaller tributaries floods are less injurious, since they subside more quickly. For all ordinary rainfall the drainage of the type as a whole is fairly good, but in many places artificial drainage is necessary on account of the level or slightly depressed surface of such areas.

This type of soil is naturally well adapted to corn, and, aside from the liability to damage by floods, is the best soil for this crop in the area. Very large yields have been produced, but it is doubtful whether for a long series of years the average will prove much above that of the upland types. With the same exception, it is equally as well adapted to alfalfa, but only on the highest areas along the creeks can this crop expect to escape drowning out. Wheat, oats, and all the other crops of the area do exceptionally well in favorable seasons.

The following table shows the results of mechanical analyses of both soil and subsoil of this type:

Mechanical analyses of Yazoo loam.

No.	Locality.	Description.	Fine 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 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11871	3 miles SW. of Iola	Silty loam, 0 to 14 inches	0.0	0.1	0.1	2.0	11.2	69.8	16.2
11873	2½ miles SW. of Humboldt.	Silty loam, 0 to 6 inches	.0	.2	.2	1.7	5.9	71.5	20.2
11872	Subsoil of 11871	Silty loam, 14 to 36 inches	.0	.0	.1	1.7	8.2	74.0	15.8
11874	Subsoil of 11873	Silty clay loam, 6 to 36 inches	.0	.0	.1	1.5	3.8	68.4	25.6

OSWEGO FINE SANDY LOAM.

The Oswego fine sandy loam, locally known as "sandstone soil," covers a comparatively small area in Allen County, but is very well suited to general agricultural purposes. The soil to a depth of 12 inches is a yellowish to reddish-brown fine sandy loam, or loam the sand content of which, varying from 30 to 45 per cent, is of the fine and very fine grades, and of a peculiarly sparkling appearance. From 12 to 36 inches is found a yellow fine sandy loam, or loam usually somewhat heavier and more compact than the soil, and often containing fragments of partially decomposed sandstone and arenaceous shale at from 25 to 36 inches below the surface. Where these rock fragments occur a red mottled or spotted color is common, and their presence likewise gives rise to a looser, more open structure in the lower portion of the soil profile. Under cultivation this soil retains a loose, friable condition with less attention than any of the other residual types, and it can also be plowed when in a relatively wet condition without much danger of puddling. It warms up and dries off early in the spring, permitting cultivation earlier than in the case of the other soils.

It is distinctly an upland type and occurs in rather broken and disconnected areas, which are confined principally to the southeastern and eastern portions of the area, occupying rounded knobs and elongated ridges, together with their slopes and the depressions between. Owing to the comparative thinness of the layers of sandstone and arenaceous shale from which it is derived, a depression of any great width or depth will usually show another type of soil. Because of its rolling topography and porous subsoil, crops suffer very little in times of excessive rainfall. On the other hand, with thorough and frequent surface cultivation it does not lack moisture in times of drought.

All the general farm crops of the area are successfully grown, but the type is best adapted to corn, broom corn, potatoes, truck, and small fruits, and on the more sandy phases to sweet potatoes. The average yields of the principal crops grown are about as follows: Corn, 22 bushels; broom corn, one-third of a ton; wheat, 16 bushels, and oats, 25 bushels per acre.

The following table shows the results of mechanical analyses of typical samples of this soil:

Mechanical analyses of Oswego fine sandy loam.

No.	Locality	Description.	Fine 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 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11849	8½ miles SE. of Humboldt.	Silty sandy loam, 0 to 12 inches.	0.4	1.0	0.4	4.8	25.5	55.9	12.0
11851	2 miles W. of Elsmore.	Fine sandy loam, 0 to 12 inches.	.1	.3	.6	10.9	36.6	37.9	13.2
11852	Subsoil of 11851	Fine sandy loam, 12 to 36 inches.	.3	.7	.9	13.4	32.0	34.5	18.1
11850	Subsoil of 11849	Loam, 12 to 36 inches	.8	1.8	.6	3.3	15.2	52.1	26.1

YAZOO CLAY.

Intermediate between the Yazoo loam and Sharkey clay of the bottoms is found the Yazoo clay. It is a somewhat heavier type of soil than the Yazoo loam and more loamy than the Sharkey clay. The upper 6 inches is a dark clay loam, which sun-cracks when dry, but is loose and friable when reasonably moist and well cultivated, with a tendency to be sticky when wet. The subsoil, from 8 to 36 inches, contains less organic matter than the surface soil and is a dark-gray and drab mottled clay or silty clay, which becomes a dark drab at lower depths.

The type as a whole covers a comparatively small territory, and aside from the danger of damage from floods is a very valuable and productive soil. Some attempts have been made at diking, which so far have proven inadequate. A few areas are located quite favorably for this, but would require a bank from 5 to 12 feet high for absolute safety.

This soil is an alluvial deposit, lying in the Neosho bottoms, between the Yazoo loam and the Sharkey clay of the uplands. From year to year thin layers of sediment are still being deposited by the river in its overflows, and large quantities of organic matter are continually added in the same way. Like the other bottom soils, it has a level topography and rather poor surface drainage. Tiling would be very beneficial, but, as with the other bottom types, the most serious drawback for the past few years has been that of overflow.

In adaptation to crops and their yields the type is very much like the Sharkey clay, being best suited to wheat, though capable of producing large yields of corn during favorable seasons.

The following table shows the results of mechanical analyses of typical samples of the Yazoo clay:

Mechanical analyses of Yazoo clay.

No.	Locality.	Description.	Fine 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 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
11875	2 miles NW. of Humboldt.	Clay loam, 0 to 8 inches..	0.1	0.2	0.2	2.1	6.1	58.7	32.4
11876	Subsoil of 11875.....	Gray clay, 8 to 36 inches.	.0	.4	.5	3.0	4.6	48.7	42.4

YAZOO SANDY LOAM.

Only a very small portion of the bottoms of the area can be classed under this type, and because of its limited extent no samples were collected for analysis.

ROUGH STONY LAND.

Adjoining the areas of rock outcrop and in various places associated with the Sedgwick clay loam, occur areas more or less rough and stony, which, although not so barren as to be worthless, can be used for pasture only.

ROCK OUTCROP.

A few areas, amounting in the aggregate to a little more than 1 square mile, are classified as rock outcrop. Such areas are of absolutely no agricultural value.

SPECIAL PROBLEMS.

Of the problems confronting the farmers of the upland areas in Allen County, that of the intractable subsoil of the Oswego silt loam and other important types, locally known as "hardpan," concerns the greatest number and is the most serious and difficult to deal with. Owing to its wide distribution, this stiff, compact, and impervious subsoil, and the consequent unfavorable moisture conditions, reduce materially the crop production in the county. In its prevailing occurrence it approaches very nearly a typical hardpan, while in other instances, though departing somewhat from the characteristic structure of hardpan, it still is close, massive, and sufficiently impervious to interfere seriously with the movement of water, either when the need is for subdrainage or when, owing to drought, there is necessity for capillary movement of the deeper subsoil water to within the root zone of the growing crops.

The season of 1904, being very wet until the middle of July, afforded an excellent opportunity to study the conditions consequent upon an excess of moisture. Despite the fact that the fields were generally rolling and apparently had an excellent natural drainage, the effects were very marked, not only in the depressions, but on the ridges and slopes as well. Corn took on a yellow and scalded appearance, made a stunted growth, tasseled early, and gave very light yields. In short, it was "water killed," regardless of its location, whether on the higher elevations or slopes, possibly suffering most in the latter position on account of the seepage from higher levels along the impervious subsoil stratum.

It may be stated in general that whatever deepens the soil above and loosens or flocculates the subsoil below will aid in promoting subdrainage, and only to the extent to which this is accomplished can beneficial results be expected. In the progress of the survey some excellent examples of the effects of deep plowing alone were observed. A few fields plowed to a depth of 10 inches suffered but little, while on the same soil and slope in adjoining fields, where the plowing had been much shallower, the crop was almost an entire failure. In past years subsoiling has been found to give good results, but owing to the labor and expense which it requires this practice has been abandoned.

In addition to deep plowing and subsoiling, and to make the results more certain and lasting, tile drainage would probably prove very beneficial, even if the drains were laid at wide intervals and only with a view to cutting off the seepage from the slopes and ridges. Underdrainage would tend also to keep the subsoil more open by promoting better aeration, but owing to the character of the subsoil materials thorough subdrainage would doubtless be very expensive and might not be economical at present. Some thorough and practical experimentation along these lines should be made to determine the efficiency of drains and the cost of laying them under a system designed for the fullest possible amelioration of the impervious condition of this subsoil.

The treatment that will give the best results during excess of moisture will also prove the best in seasons of drought, for the conditions that prevent the downward percolation of water likewise prevent its capillary rise from below.

Unlike the drainage problem in some parts of the country, the matter in Allen County is not one calling for cooperative effort, but can be taken up by the farmers individually.

AGRICULTURAL METHODS.

There are many unimproved farms in Allen County. A disregard of the needs of the soil, injudicious cultivation, and unsystematic

cropping have done much to reduce the productiveness of a large part of the land in the area. The more progressive farmers, however, are beginning to practice better methods, and their action may influence others to adopt a more intelligent system.

The character of the soils of the greater part of the area, or almost the entire upland and second bottom portion, is such that a slight increase of humus or organic matter proves highly beneficial in many ways. In fact, in order to get good results with the soils found here, it is necessary to maintain organic matter in abundance. When it has been reduced by continuous cropping without rotation, as has been the common practice in the area, the main crop being corn, the soils become lighter in color and run together into a compact mass which admits water slowly and permits it to evaporate readily.

A systematic rotation of crops should be at once initiated, in which clover and other legumes should have a regular place; these should be plowed under to a good depth and thoroughly incorporated in the soil in the late summer or fall, before planting to corn the following spring. Such a procedure would tend greatly to overcome one of the very objectionable features found where cultivation has been carried on for several years.

Considering the beneficial effects of manure in supplying both organic matter and plant food, and the length of time these effects are manifest on these soils, too little attention is given toward increasing the supply, and too much neglect is shown in making a proper use of the manure that is produced. Nearly every farmer keeps a small number of live stock, but there is great need of increasing the number so that certain crops and roughage may better be turned into manure, and more of it produced. If too much of the prairie pasture has been "broken out," it should be replaced by redtop and bluegrass, and, in general, an effort should be made to reduce the acreage of crops under cultivation, and to increase the yields by employing better methods, devoting more land to grass for summer pasturage.

A careful study of the upland and second bottom soils, the ones which seem to require the most careful management, together with the climatic conditions of the area, suggests the following as possibly the best method for successfully growing corn: Plow the soil to a good depth—10 inches if possible—in the fall or late summer and disk as soon as it is advisable to go on the fields in the spring, in order to check evaporation. If heavy rains follow, repeat the process and reduce to perfect tilth before planting. As soon as possible after the plants are up begin level surface cultivation, and keep it up at regular intervals till late in the growing season, the later the better if kept shallow and the surface level. If it is im-

possible to break the soil in the fall or summer, it should still be plowed deep, also thoroughly disked and harrowed before planting, and if necessary, rolled, to be followed by harrowing. Fall plowing and early sowing are to be recommended for oats.

In the production of wheat the soil should be plowed early in the summer, somewhat shallower than for corn, and partly reduced to a condition suitable for seeding. A few days after each succeeding rain, if they are not too numerous, it should be harrowed lightly. In this way a supply of moisture can be stored up which will enable the crop to start on a vigorous growth at once regardless of the dry weather which may set in about the time of sowing. When the soil can not be plowed early, a roller should be used, before drilling, to form a firm seed bed. The judicious use of commercial fertilizer is not to be discouraged, but the farmers should by no means discard barnyard and green manures, which are so essentially needed in soils whose peculiar texture requires a large amount of organic matter to maintain a mechanical condition suitable to crop growth.

AGRICULTURAL CONDITIONS.

Agriculture in somewhat varied forms has been the chief pursuit of the inhabitants of Allen County since its settlement. Of recent years it has been growing more general in its scope, and some material progress has been made. Land has increased in value, adding greatly to the general wealth of the farming classes. While there are many evidences about the average farm that would indicate a not very prosperous condition, the landowning class may be considered as in very good financial circumstances. The modern country home, with adequate barns and other farm buildings, is seen here and there, but these are the exception rather than the general rule, and their number varies somewhat in different parts of the county.

Only about 40 per cent of the farms are operated by the owners. Renting is thus seen to be quite prevalent, and it is probably on the increase. Large oil and gas, smelter, and cement companies have recently bought up adjoining farms in large tracts for the furtherance of their interests, and they rent them out to a rather poor class of tenants, little care being taken to improve their agricultural value. Many individual owners also make a practice of renting their farms. A share of the crop is usually given, which in the case of corn is usually one-third in the shock, and in the case of wheat and other grains one-half. Meadows of native grass are generally rented for cash at $1 an acre. Farming land under the cash-rental system brings from $1 to $1.50 an acre. Aside from the larger tracts, the average farm consists of about 160 acres.

A great hindrance to agricultural operations in the county is the

peculiar labor conditions which exist. The other industries employ such large numbers of men at better wages than the farmer can afford to pay that it has become difficult to hire men to do ordinary farm work. The average price paid a farm hand is $20 a month. During wheat, hay, and broom-corn harvest there is a good demand for hands at $1.50 a day.

Corn, native hay, oats, wheat, millet, and broom corn constitute the chief crops of the area. Corn is grown most extensively, but the acreage in other crops, more especially wheat, is being increased. Broom corn is confined principally to the southeastern portion of the county, where community cooperation of labor is most practicable, this being necessary under present conditions. Kafir corn and sorghum are sown to some extent for forage. Clover, timothy, redtop, and flax are crops of some importance. The acreage of flax is decreasing, as its continued cultivation has rendered many fields unfit for its profitable production. By applying manures and growing other crops for a few years, fair yields may again be had on the same land. As to the value of clover, timothy, and redtop, compared with that of the native grass, there is a difference of opinion among farmers. Many prefer the native grass both for pasture and hay, but those who have given the matter a thorough trial find that by a liberal seeding and thorough preparation of the soil a good stand of either of the others may be easily obtained, and that when this is accomplished they are much to be preferred to meet the general demands of the farm. An acre of native grass yields from 1 to 1½ tons of hay per acre, which is best suited to horses, while a fairly good stand of clover and timothy will yield from 1½ to 2 tons of hay having a greater value for general feeding purposes. Good timothy meadows rent for from $1.50 to $2 an acre, whereas native grass meadows generally rent for $1. The yield of redtop hay is about the same as that of clover and timothy, but its chief value lies in pasture, one acre being equal to two of the native grass for this purpose.

Throughout the county, year after year, corn will average from 18 to 22 bushels per acre; wheat, 12 to 18; millet, 25 to 35 of seed; Kafir corn, 30 to 35 of seed and about 3 tons of roughage; and broom corn, one-fourth to one-third of a ton of straw. The average price of this straw for the last few years has been about $100 a ton.

Two lines of railroad pass through the county from north to south; another from east to west, with a branch line touching the northwest corner; and another crosses the southwestern part of the county. These several railroads afford ten shipping points in the county, and furnish direct connections with Kansas City and St. Louis, the principal markets for the products of the area.

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