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Soil Survey
of
Lyon County, Iowa

By

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United States Department of Agriculture

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CONTENTS

SOIL SURVEY OF LYON COUNTY, IOWA

By A. M. O'NEAL, in Charge, and D. S. GRAY, Iowa Agricultural Experiment Station, and H. M. SMITH and R. E. DEVEREUX, U. S. Department of Agriculture

COUNTY SURVEYED

Lyon County is in the extreme northwest corner of Iowa. Minnesota and South Dakota border it on the north and Big Sioux River separates it from South Dakota on the west. The county is nearly rectangular in shape. It measures 16.5 miles from north to south, and its greatest distance from east to west is 38 miles. It includes 576 square miles or 368,640 acres.

The surface relief of the county, in general, is that of an undulating or rolling plain which has been dissected and modified by a complete drainage system. In the western part of the county Big Sioux River has carved a valley, the level of the floor lying about 200 or 225 feet below the general level of the uplands. Bordering this flood plain on the east is a precipitous, rough, gullied escarpment, which extends back along the smaller creeks and drainage ways from 3 to 4 miles before merging with the rolling divides. Rock and Little Rock Rivers have not cut such deep channels, and the bordering hills rise from 60 to 110 feet above the level of the flood plains with smooth gentle slopes and are in few places furrowed or gullied. The divide between Big Sioux River and Rock River is prevailingly gently rolling or rolling but, as the slopes are smooth and long and the hill crests rounded, the general landscape presents an undulating appearance. East of Rock River the relief, in general, is undulating or gently rolling with here and there level or very gently undulating areas. The most conspicuous level areas are southeast of George, in Dale Township, and in the north-central part of Liberal Township.

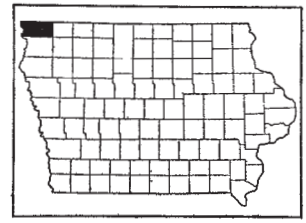

FIGURE 1.—Sketch map showing location of Lyon County, Iowa

The flood plains along the rivers and creeks are well developed. Along the smaller creeks the first bottoms are narrow, with terraces occurring here and there in the bends, but the rivers are bordered by moderately wide terraces and narrow first bottoms.

The elevation of the upland plain ranges from 1,375 to 1,470 feet above sea level. The lowest point in the county, 1,230 feet, is in the bottoms of Big Sioux River south of Beloit. The prevailing slope, which is slight, is toward the south.

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Drainage of the county is through Big Sioux and Rock Rivers, which unite in Sioux County, and flow into Missouri River. The main tributaries of Big Sioux River, which are comparatively short, have cut deep V-shaped gorges, whereas Rock River and its principal tributaries, Little Rock River and Mud Creek, which are longer, have cut less deeply into the underlying materials, and have a more sluggish flow. Most of the streams have developed a complete lateral drainage system and, except for the few flats where artificial drainage is necessary, the farms of the county are well drained.

Lyon County, which was first called Buncombe County, was organized in 1852, and in 1862 the name was changed to Lyon. The first settlers came in from States to the south and east, and early settlement was slow. By 1880 the population had increased to 1,968. During the next three census periods the increase was much more rapid, the 1920 census reporting a total of 15,431 persons in the county, an average of 26.5 to the square mile. The entire population is classed as rural.

Most of the farm population is native born. The eastern half of the county is settled largely by Germans, the central and north-central parts by Hollanders, and the western part by Scandinavians. In the vicinities of Larchwood, Alvord, and Rock Rapids the people are chiefly of Irish descent.

Rock Rapids, with a population of 2,172 in 1920, is the principal town and county seat. It is situated on Rock River about 2 miles northeast of the center of the county. George, in the southeast part, is the next town in size. Inwood, Doon, Little Rock, Larchwood, Alvord, and Lester are the larger railroad towns. Beloit, Granite, Edna, and Klondike are smaller towns.

A few manufacturing plants are located in the county, but farming is the principal industry. Creameries are located at Rock Rapids, George, and Inwood.

Railroad transportation facilities are good. Lines of the Illinois Central; Chicago, Rock Island & Pacific; Great Northern; Chicago, Milwaukee, St. Paul & Pacific; and Chicago, St. Paul, Minneapolis & Omaha systems cut through the county, affording moderately easy access to all outside points. Chicago, Sioux Falls, and Sioux City are the principal markets.

Lyon County is crossed by roads on practically every section line. Most of them are dirt roads which are kept in good condition, except immediately after rains, by frequent draggings. Three graveled highways traverse the county. Iowa Highway No. 9 cuts across the area in an east and west direction, passing through Little Rock, Rock Rapids, and Larchwood; United States Highway No. 75, a north and south artery, runs through Doon and Rock Rapids; and United States Highway No. 18 serves the southwest quarter, passing through Doon and Inwood.

CLIMATE

The climate of Lyon County is healthful and, except for occasional extremes in temperature and precipitation, is favorable for the production of corn and other staple crops adapted to this section of the country. Even during abnormal years there is never a total loss of crops.

The mean annual precipitation is well distributed throughout the year, the greater part occurring during the growing season from May to September. June is usually the wettest month. The precipitation during the winter is generally in the form of snow.

The winters are long and the summers short, with sudden and wide variations in temperature. The hot spells, however, are of short duration.

At Rock Rapids the average date of the last killing frost is May 14, and that of the first is September 29. The Inwood station reports May 9 and October 3, respectively. The frost-free season varies from 138 days in the central part of the county to 149 days in the western part. The latest killing frost recorded is on May 28 at Inwood and June 12 at Rock Rapids and the earliest, September 15 and September 7, respectively.

Tables 1 and 2, compiled from records of the Weather Bureau stations at Rock Rapids and Inwood, set forth the more important climatic data in the central and western parts of the county, respectively.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Rock Rapids*

[Elevation, 1,358 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1905)
	° F.	*° F.*	*° F.*	*Inches*	*Inches*	*Inches*
December	19.7	58	−30	0.63	0.10	(1)
January	13.5	54	−40	.69	1.00	.70
February	17.9	50	−35	.68	.10	.60
Winter	17.0	58	−40	2.00	1.20	1.30
March	31 5	78	−10	1.32	.00	2.15
April	46.3	81	14	2.80	.86	1.10
May	58.0	92	28	3.55	1.50	5.35
Spring	45.3	92	−10	7.67	2.36	8.60
June	67.9	98	35	4.62	1.90	9.17
July	72.6	101	38	3.37	1.55	2.63
August	69.7	98	34	2.35	1.48	6.00
Summer	70.1	101	34	10.34	4.93	17.80
September	61.7	96	23	2.59	2.79	2.73
October	48.9	84	7	1.79	.20	2.50
November	33.2	70	−7	1.19	.05	3.70
Fall	47.9	96	−7	5.57	3.04	8.93
Year	45.1	101	−40	25.58	11.53	36.63

[1] Trace.

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation at Inwood*

[Elevation, 1,474 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1912)	Total amount for the wettest year (1909)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	19.4	60	−39	0.66	0.39	1.65	5.8
January	14.0	58	−46	.65	.37	.85	6.2
February	17.8	64	−37	.87	.04	1.99	7.1
Winter	17.1	64	−46	2.18	.80	4.49	19.1
March	32.7	87	−23	1.20	1.00	.57	5.9
April	46.7	99	10	2.53	1.99	2.77	2.7
May	57.7	95	18	4.20	2.76	4.92	.3
Spring	45.7	99	−23	7.93	5.75	8.26	8.9
June	67.7	103	35	5.31	1.13	8.53	.0
July	72.6	106	40	3.37	3.22	4.37	.0
August	70.5	101	36	2.59	1.63	2.70	.0
Summer	70.3	106	35	11.27	5.98	15.60	.0
September	63.1	103	22	2.79	1.37	4.38	.0
October	49.8	94	−2	1.91	1.31	1.27	1.8
November	33.0	77	−8	1.12	.04	3.08	2.8
Fall	48.6	103	−8	5.82	2.72	8.73	4.6
Year	45.4	106	−46	27.20	15.25	37.08	32.6

AGRICULTURE

The early pioneers, who settled in the few forested areas near the larger streams, devoted most of their time to trapping and hunting. Agricultural practices were limited to a few small areas, on which wheat, corn, and vegetables were grown to supply the home demand. With the later influx of settlers from the East, larger tracts of the virgin prairie were put in cultivation but very little surplus grain was produced until the railroads were built. Flax was grown extensively on new ground, but legumes were unknown. In 1879 wheat was the principal grain crop. Corn followed with approximately half the acreage devoted to wheat, and oats ranked third. During the next two 10-year periods the acreage in these crops retained the same relative importance, but after this wheat yields began to decline and corn became the most important crop. In 1919, the acreage devoted to corn was 122,989, to oats 103,922, and to wheat 4,282. The growing of legumes has received more attention from 1909 on, and an increasing acreage has been sown to sweetclover and alfalfa, crops grown both for forage and seed.

The present agricultural practices are centered around the production of corn, which is the principal cash crop. Oats, barley, wheat, and rye are other important small-grain crops, and legumes, timothy, and wild grasses are grown, the first two for forage and seed and the last for hay. The raising and feeding of hogs and cattle are important, and dairying is practiced to some extent.

Corn yields average about 40 bushels to the acre. On the more highly improved farms, where a high state of fertility is maintained by the use of systematic rotations, much better yields are obtained. Corn is a sure crop and complete failures have never been known. The favorite varieties are Wimple Yellow Dent, Silver King, Golden Jewel, Reid Reliance, and Murdock. Approximately half the total production is used on the farms of the area as feed for work animals, beef cattle, and hogs, and the rest is shipped to outside markets.

Oats are grown on all farms. The favorite varieties are Green Russian, Iowar, Albion (Iowa 103), Early Champion, and Iogren. About 60 per cent of the crop is used on the farms for feed; the rest, mainly from the western part of the county, is shipped to outside markets.

Hay is the third crop in importance, and according to the 1926 Iowa Yearbook of Agriculture the 16,051 acres in tame hay in 1925 produced 18,446 tons. The legumes (alfalfa, sweetclover, and red clover) occupy the largest acreage and are the most important tame-hay crops. In 1925 alfalfa was grown on 8,647 acres, and approximately 95 per cent of the crop was cut for hay, the remaining 5 per cent being used exclusively for pasture. The yield of hay ranged from 2½ to 3 tons to the acre. Sweetclover is coming into prominence both for forage and for seed. The yellow and white biennial varieties are grown. Red clover, although still important as a hay and forage crop, is being replaced by alfalfa and sweetclover. Occasionally timothy is sown with the clover. A considerable acreage of bluegrass and other wild grasses is cut annually for hay, yields ranging from 1½ to 2 tons to the acre. Some millet, Sudan grass, and oats are also cut for hay. All of the hay is consumed on the farms where grown as feed for work animals, hogs, and cattle, and in poor seasons a considerable tonnage is shipped in from outside markets.

The acreage devoted to barley is increasing. In 1925 it was grown on 5,116 acres and produced a total of 194,408 bushels or 38 bushels to the acre. It is used largely as feed for chickens and hogs. Most of the crop is consumed on the farms of the county. In 1927 a considerable tonnage was shipped to outside markets.

Rye occasionally takes the place of oats and barley in the general rotation and is grown both for forage and for feed. During 1927 a small amount of flax was grown, producing from 15 to 24 bushels to the acre. Rape is frequently sown with oats and corn, and during the years of the survey, 1926 and 1927, a large total acreage was in this crop. It is used exclusively for hog pasture. Buckwheat occasionally serves as a catch crop, and some sorghum is produced for forage and for sirup.

Gardens are maintained on most farms, and potatoes, cabbage, tomatoes, and all kinds of truck crops adapted to this region are grown for home consumption. The few apple orchards in the county seldom receive any care, and the fruit is faulty. Cherry trees thrive, but they are not numerous.

The raising and feeding of hogs is the most important livestock industry. From 12 to 15 brood sows, grades of Poland China, Duroc-Jersey, Spotted Poland China, Chester White, and Hamp-

shire are kept on most farms. These are bred to purebred sires and from 60 to 75 pigs are farrowed. Purebred herds are maintained for breeding purposes and for sale. Some farmers ship in animals each year as feeders, the number depending on the size and quality of the corn crop. Most of the hogs are shipped or trucked directly to market, some are handled through cooperative marketing associations, and a small number are sold to buyers. The principal outside markets are Sioux Falls, S. Dak., Sioux City, Iowa, and Chicago.

The raising and feeding of cattle is a source of considerable revenue. The dual-purpose animal is most popular, and from 12 to 15 head are kept on a farm. The calves are sold locally, and the milk is separated on the farms and the cream disposed of at near-by creameries and cream stations. Most of the farmers who make a practice of feeding a large number of cattle ship in feeders from outside markets in addition to animals raised in the county. Many of the larger herds include 200 or more cattle. In fattening cattle it is common practice to turn the animals into the cornfields to forage on the stover, after which they are finished on corn and silage. Dairying, with a few exceptions, is carried on as a side line. Most farmers keep about three dairy cows. Grades of Holstein, Guernsey, Brown Swiss, and Jersey are the most popular.

Chickens and eggs are produced on practically every farm, and considerable revenue is derived from the sale of these products. According to the 1920 United States census the value of poultry and eggs in 1919 was $502,233. The produce houses handle most of this business direct, and a few farmers exchange chickens and eggs at the country stores for household necessities.

Cropping practices and rotations are about the same on all the smooth upland soils of the county. Clarion loam, steep phase, owing to its rough or strongly rolling relief is not well adapted to farm crops and is usually left in its native state and utilized for pasture. Sioux loam is considered less valuable than other soils for corn on account of its droughtiness. The first-bottom soils, Lamoure silt loam, silty clay loam, and loam and Wabash loam and silt loam, on account of poor drainage, are valuable mainly for pasture, and a considerable area has been left in its native sod.

Soil management is much the same in Lyon County as in other counties in this part of Iowa. Approximately 75 per cent of the land is plowed in the fall, usually from 4 to 6 inches deep, and the fields are double disked and harrowed in the spring before planting time. Barnyard manure is saved on all farms and most of it is scattered over the stubble or grassland before plowing. Only occasionally are green-manure crops turned under. The topsoils are usually acid and where alfalfa or sweetclover are to be grown small applications of ground limestone have proved very beneficial. Commercial fertilizers are used mainly on an experimental basis. Definite crop rotations are in use on the better type of farms. On most farms corn is grown from 2 to 4 years, oats or barley 1 year, and clover 1 year. Clover is being replaced by alfalfa and sweetclover. Alfalfa is usually left on the land from three to five years. On many farms corn is grown continuously from 2 to 10 years or rotated only with oats.

Seed corn is usually carefully selected with regard to its germinating and early-maturing qualities. Corn is planted from May 1 to

May 20, receives three or four cultivations, and is laid by between July 4 and July 15. Practically all the corn is planted in checkrows, but in a few fields it is drilled in. The greater part of the crop is husked in the field by hand or with machines, a little is cut with binders and stacked in the field until feeding time, a small acreage is hogged down, and some is cut for silage.

Oats, barley, and wheat are grown on all farms in the general rotation. Oats and barley are generally broadcast and wheat is drilled in. These crops are harvested with a binder and threshed from the shock. Clover and clover and timothy are still grown to some extent both for hay and for pasture, but these crops are fast being replaced by alfalfa and sweetclover. Clover and timothy are usually sown with oats and pastured lightly the first year. The second year the first crop is cut for hay, and the second crop is pastured or turned under as green manure.

Alfalfa is usually planted in the spring with oats or barley, which serve as a nurse crop. Equally good results have been obtained from July and August seedings. The ground is seldom limed, but occasionally the seed is inoculated. Little difficulty is experienced from winterkilling. Alfalfa is grown on the same land from four to six years. It receives no cultivation other than a light disking in the spring. It is utilized almost exclusively for hay and three cuttings are usually obtained. Sweetclover is always planted in the spring and is grown chiefly for forage.

The farm dwellings, on the whole, are substantial and well kept. Many of them are strictly modern. The barns are large and afford ample room for the work animals and for storage. Silos are found on a few farms. All the farms are fenced, mainly with hog-tight woven-wire and barbed-wire fencing. The work horses are of the heavy draft type, and a few mules are used. The farm machinery, in general, consists of gang plows, disk harrows, spike-tooth harrows, riding and walking cultivators, drills, binders, mowing machines, hayrakes, hay loaders, manure spreaders, and corn pickers. The threshers are community owned. Gas engines are used for various purposes on many farms. Some windmills are utilized for pumping water.

Farm labor for the last three years has been sufficient. Except during the harvest season much of the work is carried on by the owners or tenants. The 1920 census reports a total expenditure of $780.24 a farm for labor during 1919. Monthly wages range from $50 to $60, with board, for single men and from $55 to $65 for married men. Married men are usually furnished a house, a garden, and other perquisites in addition to wages. Day laborers receive $2.50 and board. During the years of the survey (1926 and 1927) corn pickers were paid from 7 to 10 cents a bushel depending on the condition of the crop.

The Iowa Yearbook of Agriculture for 1926 reports the total number of farms in Lyon County as 1,769 and the average size as 204 acres. The majority of the rented farms are leased for cash. The average price paid was about $8 an acre in 1927. The grain-rent system is also in use, the landlord receiving two-fifths of the grain and from $6 to $8 an acre for pasture and hay land. When cattle and hogs are to be fed, the landlord and renter share equally the expenses and the profits.

SOILS

Lyon County is located within the prairie region of the United States where the soils have been formed under the influence of a luxuriant grass vegetation. With the decay of grass roots from year to year, the residue in the form of finely divided carbonaceous material became thoroughly mixed with the mineral constituents, and soils with dark grayish-brown or almost black surface layers have resulted. The intensity of the dark color and the depth to which it has penetrated the upper layers depends largely on the moisture conditions under which the soils have been formed. On creek and river bottoms, and in flat or depressed areas on the upland, the black soil may be from 15 to 20 inches in thickness, but on the well-drained slopes it may be 10 inches thick or less. Drainage, therefore, can be considered directly responsible for the thickness and blackness of the surface soils, and on the basis of these and other characteristics produced by drainage conditions, the soils of Lyon County can be separated broadly into two major groups. The soils of the first group, which occur on the high well-drained terraces and undulating or rolling uplands, have had good surface and subsoil drainage for a long period of time, and the water table has been at sufficient depth below the surface to allow free action of the soil-forming forces. Oxidation, leaching, and many other forces have persisted with little interruption and a characteristic regional profile has developed.

This normal profile, which may be considered the mature profile of soils of this group, is well illustrated by the profile of the Marshall soils, especially the silt loam. Variations of the profile described are rare except differences in the thickness of the surface horizon owing to sheet erosion and the accumulation of new alluvial material along the outer edges of the terraces. The profiles of the Waukesha soils are also typical of the well-weathered soils.

The Marshall and Clarion soils, which cover approximately 90 per cent of the total area of the county, have the characteristics of this group. The profile shows a comparatively thin soil, since the time period during which weathering has been in progress has not been sufficient to weather the soils to a great depth. This is shown by the slight depth to carbonates. In the Marshall soil the surface soil in virgin areas, to an average depth of 16 inches, includes three distinct layers. The upper layer, which is 2 or 3 inches thick, is dark grayish-brown imperfectly granular silt loam filled with a mass of grass roots, many of which cling to the granules. The second layer, which is approximately 9 inches thick, is very dark grayish-brown imperfectly granular silt loam; and the third, which lies between depths of 12 and 16 inches, is slightly darker and more distinctly granular than either of the layers above. The granules are small and soft in all layers, are coated with a very thin film of dark material, and when crushed appear somewhat lighter. The fourth layer of the soil, which averages 6 inches in thickness, is a transition zone. The color, which grades downward from very dark grayish brown to brown, is not uniform but is streaked vertically with dark colors caused by organic matter brought down from above through old root channels, worm casts, and animal burrows. In the upper part of this layer the soil mass is imperfectly granular, but granulation disappears entirely with depth. Crushed and cut surfaces appear

slightly browner than the undisturbed soil. The fifth layer lies between depths of 22 and 36 inches and consists of brown structureless silt loam that breaks up into soft irregular clods. The basic color is yellowish brown but, as in the layer above, many streaks and splotches of darker material occur in places. Clods when cut or crushed are yellowish brown. The sixth layer, which in most places is from 12 to 18 inches thick, consists of yellowish-brown heavy silt loam. As in the layer above there is a slight concentration of clay. The soil mass apparently has no definite structure but where cut surfaces are exposed and weathered there is a slight columnar arrangement. Beneath this layer is yellowish-brown highly calcareous silt loam mottled and specked with gray and iron-colored stains. The soil mass has a very smooth, even feel and no definite structural arrangement of the particles is present. Below a depth of 5 feet an eighth layer of variable thickness occurs. It is predominantly yellowish-brown even-textured silt loam splotched and specked with gray and iron-colored stains. The material has a very soft feel and very little plasticity. The soil mass does not show a strong lime reaction and fewer concretions are in this than in the layer above.

The Clarion soils show a similar profile development to the Marshall soils except that the lime zone occurs nearer the surface, usually between depths of 30 and 36 inches. The Dickinson and Sioux soils, which have sandy and gravelly subsoils, show different degrees of weathering. The Dickinson have been thoroughly leached of carbonates to a depth ranging from 4 to 5 feet, whereas the Sioux contain varying amounts of lime-bearing materials within a depth of 3 feet.

The second group includes soils that have been developed under conditions of excessive moisture, and for that reason have not developed normal profiles. Throughout the lower terraces and narrow swales of the uplands where the water table has been near the surface the subsoil horizons show little or no effect of oxidation. Owing to their prevailingly wet condition and frequent inundation, the first-bottom soils show an even less distinct profile development.

The Bremer soils have developed on the lower, more level terraces where the heavy impervious subsoils have restricted drainage. The Wabash and Lamoure soils represent the newest materials of the county. They occur on the flood plains or first bottoms of streams. The Wabash soils contain no carbonates, whereas the Lamoure soils contain lime in all or some part of the soil to a depth of 3 feet.

The soil groups described have been separated on the basis of the distinguishing characteristics of the soil horizons without any consideration of the material from which the soils were derived. But in the classification of the soils into series, attention has been given to the influence of the parent materials.

Lyon County was covered at one time by a mantle of loess. Erosion has modified and altered this original covering in places, exposing the underlying drift sheet. Thus, it is evident that the parent materials of the upland soils consist of loess and glacial drift. Loess covers the entire county except a small area in the northeastern corner and narrow strips along stream valleys. It ranges in thickness from a mere film in the eastern part of the county to 60 or more feet near the western border. It is supposed to be of wind-blown

origin and consists of fine-grained siliceous silt. The material is porous, and leaching has removed the carbonates, in most places, to a depth ranging from 3 to 5 feet below the surface. Large quantities of organic matter have been incorporated with the surface materials, and the subsoils are little heavier than the surface soils. The soils of this origin are grouped in the Marshall series.

The upper part of the drift material, which is well oxidized, consists of yellowish-brown fine sandy clay loam or gritty sandy clay, and the lower part is splotched with iron stains and streaked with whitish calcareous material. Many glacial bowlders and gravel occur throughout the soil. The subsoils are heavier than those of the Marshall soils, and leaching has not removed the carbonates to such great depths. Glacial drift soils in which lime occurs within a depth of 3 feet have been classed in the Clarion series, and soils having the more thoroughly leached sandy subsoils are classed in the Dickinson series.

The alluvial soils are derived from materials that have been washed from drift and loess areas farther upstream. The higher terraces are well drained and the soil-forming forces have not been retarded. The resultant soils are Waukesha silt loam and Sioux loam. Soils on the more poorly drained terraces and first bottoms have immature profiles, and some of the more recently formed low terrace soils have profiles still in the formative stage. The more poorly drained alluvial soils include the Bremer soils of the terraces and the Wabash and Lamoure soils of the first bottoms.

The soils of Lyon County have been classified and separated into a number of series on the basis of characteristics resulting from the composition of the parent material, topography, drainage, and other agencies. The series are divided into soil types on the basis of the texture of the topsoils.

The soils of the Marshall series are characterized by dark-colored surface soils and yellowish-brown subsoils. The subsoils are usually slightly heavier than the topsoils and frequently contain some lime concretions, the soil mass in many places showing effervescence when treated with dilute hydrochloric acid. Areas of these soils range from gently rolling or undulating to strongly rolling. Drainage is well established. Soils of this series are derived mainly from the Missouri loess.

The Clarion soils have very dark grayish-brown surface layers which are almost black when wet. The subsoils are yellowish brown, grading within a depth of 3 feet into grayish or grayish-yellow calcareous material. Soils of this series are of glacial origin and are extensively developed over the Wisconsin drift area of Iowa. The areas range from gently rolling to rolling and hilly, and drainage is good.

The surface soils of the Dickinson soils are characteristically dark grayish brown, and they overlie yellowish or yellowish-brown sandy subsoils. Neither soil nor subsoil is calcareous. The relief in most areas is billowy, ridgy, or gently rolling, and drainage is excessive.

The Waukesha soils have very dark grayish-brown surface soils and yellowish-brown subsoils. The subsoils are usually friable and slightly heavier than the surface soils. These soils occur on terraces

above the reach of overflows. Areas are level or undulating, and drainage is good.

The soils of the Bremer series have dark-brown or black surface soils underlain by dark-gray or drab compact, tough, impervious clay subsoils which are mottled with brown and rust brown. The lighter-textured members are fairly well drained, but subsoil drainage of the heavier-textured soils is inadequate. Soils of this series are developed on terraces, and the surface is usually level or gently sloping toward the streams.

The surface soils of the Sioux soils, which occur on terraces, are very dark grayish brown or almost black when wet. The subsoils are usually light yellowish brown or light brown, grading at a depth ranging from 18 to 22 inches into stratified beds of sand and gravel that contain considerable calcareous material. The surface is level. Drainage is excessive, and during dry seasons crops have a tendency to fire.

The surface soils of the Wabash soils, which have a high content of organic matter, are very dark grayish brown or black when wet. The subsoils range in color from dark grayish brown to black and are heavier than the surface soils. Neither soil nor subsoil is calcareous. Soils of this series are developed on the first bottoms of streams and are subject to frequent inundations. The land is level or gently sloping, and drainage ranges from good to poor.

The soils of the Lamoure series are characterized by very dark grayish-brown or black surface soils which are high in organic matter. The subsoils range in color from gray and drab to mottled rust brown and yellow and are much heavier than the surface soils. Soils of this series differ from the Wabash soils in their lime content, one or more of the layers of the Lamoure soils showing effervescence when treated with acid. The land is level, and drainage ranges from good to poor.

Detailed profile descriptions of the various soil types, together with discussions of methods of handling the soils, adaptation to crops, agricultural value, and recommendations for improvement are contained in the following pages of this report. The distribution of the soils is shown on the accompanying soil map, and their acreage and proportionate extent are given in Table 3.

TABLE 3.—*Acreage and proportionate extent of soils mapped in Lyon County, Iowa*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Marshall silt loam	245,184	72.4	Bremer loam	192	0.1
Level phase	16,832		Judson silt loam	2,752	.7
Shallow phase	4,608		Lamoure silt loam	19,392	5.3
Clarion silt loam	17,344	4.7	Lamoure loam	1,920	.5
Clarion loam	8,448	4.4	Lamoure silty clay loam	2,688	.7
Steep phase	7,744		Wabash silt loam	10,368	2.8
Dickinson fine sandy loam	2,752	.7	Wabash loam	2,368	.7
Waukesha silt loam	18,496	5.0			
Sioux loam	4,928	1.3	Total	368,640	
Bremer silt loam	2,624	.7			

MARSHALL SILT LOAM

The surface soil of Marshall silt loam to an average depth of 8 inches is very dark grayish-brown finely granular mellow silt loam. In the few virgin areas of this soil the upper 2 inches is dark grayish-brown very finely granular or dustlike silt loam filled with a mass of grass roots. The lower part of the layer is slightly firmer and darker than the upper part. Below the surface soil and extending to a depth of 16 inches is a transitional layer, the upper part of which does not differ greatly from the surface soil in color, but is more granular and the granules are larger. The color changes downward from that of the surface soil to dark grayish brown. The dark color in the lower part of this layer is not uniform through the soil mass but occurs only as a coating on the granules. The material when powdered is therefore lighter in color than the freshly broken surface. The next lower layer, which continues to a depth ranging from 32 to 48 inches, is dark grayish yellow with dark-brown spots and streaks caused by materials brought down from the layer above. The texture becomes heavier with depth, passing into silty clay loam. The material has no definite structure but breaks up into soft clods. Below this layer is grayish-yellow or yellow silty clay loam, in which lime occurs distributed in finely divided form throughout the soil material and in white streaks and concretions. The content of lime seems to increase gradually downward to a depth of 5 or more feet. Lime determinations of samples, taken at four points on the smooth or gently rolling upland in different parts of the county, showed no indication of lime-carbonate accumulation in any layer. The maximum depth to the unleached lime carbonate of the parent rock in these samples ranged from 30 to 49 inches, the average being 42 inches.

Marshall silt loam is uniform in color and texture throughout Lyon County with a few exceptions. On hilltops, crests of ridges, and steeper slopes the surface soil is thinner and lighter in color, whereas at the bases of gentle slopes and in flat, poorly defined swales the topsoil in most places is 2 or 3 inches thicker and is darker than in typical areas.

Marshall silt loam is the most extensive soil in the county. It occurs as large continuous bodies covering entire divides, broken only by the comparatively narrow ribbons of alluvial and glaciated soil which border drainage ways. In the eastern part of the county, in the vicinity of Little Rock, the bodies are less continuous, and along the western border, where areas of Clarion loam, steep phase, extend back along the drainage channels, the strips are narrow.

Surface drainage of Marshall silt loam is generally good, but throughout the more rolling areas it is excessive in places. Little damage results from erosion, however, owing to the porosity of the surface soil and subsoil.

The Marshall are considered the most valuable soils in the county for the production of the staple crops, and practically all the land is under cultivation. Marshall silt loam is well adapted to forestry, but practically the only tree growth on it consists of a few straggling willows along old fence rows and trees that have been set out for windbreaks and shade. The soil is used principally for the production of corn. Oats, wheat, alfalfa, and hay are also grown. Crop

yields are about as follows: Corn, 40 bushels to the acre; oats, from 30 to 35 bushels; tame hay, from 1½ to 2 tons; and alfalfa and sweetclover, from 2 to 3 tons.

Marshall silt loam is easily handled. Owing to the porosity of the soil and the good surface and internal drainage, it can be handled under rather wide moisture conditions without injury to growing crops. The seed bed can be easily pulverized and maintained in good tilth. Crops on this soil seldom suffer from drought.

Marshall silt loam is a productive soil, and crop yields are generally satisfactory. The organic content of the soil, however, is less than it should be, and applications of barnyard manure or green-manure crops turned under would prove of benefit. The phosphorus content of the soil is moderately high, but the use of this element on similar soils in adjoining counties has demonstrated that crop yields can be economically increased by applications of superphosphate (acid phosphate). The subsoils are calcareous, but as some of the surface soils are slightly acid, dressings of ground limestone, where legumes are to be grown, are beneficial.

Marshall silt loam is the highest-priced farm land in the county, the price depending on location of the areas and improvements.

Marshall silt loam, level phase.—The level phase of Marshall silt loam has essentially the same profile characteristics as typical Marshall silt loam, except that the surface layer is thicker and the carbonates occur at greater depths. The topsoil ranges in thickness from 16 to 20 inches, averaging 18 inches. In most places lime is detected at a depth ranging from 45 to 50 inches, but in several places no indication of carbonates was observed at a depth of more than 5 feet. In a few areas, in which internal drainage is poor, a small number of rust-brown mottles and iron stains occur below a depth of 24 inches. The most conspicuous of such areas are in section 36, Wheeler Township, and section 2, Liberal Township.

Areas of level Marshall silt loam occur mainly throughout the eastern third of the county, the more extensive bodies being in Dale and Liberal Townships. Very small isolated areas are in other parts of the uplands.

The land ranges from gently undulating to level, and the surface is very smooth. Few drainage ways penetrate the larger bodies, but internal drainage, except in a few local areas, is sufficient for crop needs.

All the land of this phase is improved and either under cultivation or in pasture. Cropping systems are the same as those employed on typical Marshall silt loam and in many places the two soils are farmed together. Land values are practically identical.

Marshall silt loam, shallow phase.—Marshall silt loam, shallow phase, differs from typical Marshall silt loam in that the dark-colored surface soil is not so deep, and lime is nearer the surface, in most areas occurring at a depth of 18 or 20 inches. The surface is rougher and more broken, and many of the slopes are badly eroded. Crop yields are less than on the typical soil, depending on the degree to which erosion has progressed.

Marshall silt loam, shallow phase, occurs only in the western part of the county as narrow ribbonlike bodies bordering the breaks to the bottoms of Big Sioux River. It occupies a position between the

rolling uplands and the rougher, more broken bodies of Clarion loam, steep phase.

Soil of the shallow phase should be covered with some crop during the winter in order to prevent erosion. The steeper slopes should be left with their native vegetation and used for pasture.

CLARION SILT LOAM

The surface layer of Clarion silt loam consists of very dark grayish-brown silt loam 8 or 10 inches deep and contains a small amount of fine sand. Below this layer and extending to a depth of about 14 inches is a transitional layer in which the material of the surface layer grades downward into slightly compact dark grayish-brown heavy silt loam. Both the above layers, when broken, fall apart into small irregular particles or granules. In virgin areas the upper 2 or 3 inches of the surface soil is very dark grayish-brown and is filled with a mass of grass roots, many of them clinging tenaciously to the small granules. The surface soil is underlain by a 12-inch layer, which ranges from yellowish-brown to brown heavy friable silt loam splotched with dark streaks here and there where the organic materials from above have filtered down through cracks, root channels, and worm burrows. Broken and crushed clods appear much yellower than the unbroken soil. Below this layer is a fourth distinct layer, which extends to a depth of 35 inches with little change. Where undisturbed the material in this layer is slightly darker than in the layer above. Faint iron stains and some gravel occur in the lower part of the layer. The material has no definite structure and breaks into irregular-shaped clods. Faint traces of carbonates occur at a depth of 33 or more inches, effervescence being more pronounced with depth. Underlying this layer and extending to variable depths is brownish-yellow or dark-yellow sandy clay splotched and streaked with dark worm casts, rust-brown spots, and whitish calcareous material. The whole layer is filled with rock fragments of the parent till, and the soil mass is highly calcareous.

Owing largely to the thickness and influence of the superimposed loess, minor variations occur throughout areas of this soil which is otherwise very uniform throughout the county. In many places the surface soil, subsurface soil, and subsoil very closely resemble Marshall silt loam, differing from that soil in that the lower part of the weathered soil contains some small pebbles and fragments of underlying drift. Consequently the boundaries between Clarion silt loam and Marshall silt loam are somewhat arbitrarily drawn in some places. On the steeper slopes, where sheet erosion has been most active, the calcareous layer is nearer the surface. Bordering the bottoms of Little Rock River, in the vicinity of Little Rock, areas were included in mapping in which the friable loam or sandy clay subsoils were free of bowlders and fragments of till other than a content of sharp fine sand. Some small bodies of Clarion loam are included with this soil.

Clarion silt loam is developed throughout all parts of the county and occurs as narrow ribbonlike bodies along the lower slopes to streams. The larger and more continuous areas are in Elgin and Grant Townships. The surface ranges from undulating to gently

rolling. Surface and subsoil drainage are good, and the subsoils are retentive of moisture.

This is an important agricultural soil and practically all of it is under cultivation or in pasture. The only tree growth consists of windbreaks that have been set out to the north and west of farm dwellings.

Corn is the most important crop and occupies the largest acreage. Yields average around 40 bushels to the acre. Oats yield from 35 to 65 bushels to the acre, and alfalfa 2½ to 3 tons from three cuttings a season. Livestock farming is not so important as on Marshall silt loam. Clarion silt loam is handled in practically the same manner as Marshall silt loam. It is a strong agricultural soil and is highly prized for the production of the staple crops.

Selling prices of this land are about the same as for Marshall silt loam.

Although Clarion silt loam is naturally a strong agricultural soil moderately well supplied with the necessary plant-food elements, continuous cropping of corn and small grains without regard to the use of clovers and manure crops has impaired yields. Improved cultural methods are therefore necessary and where practiced will eventually return the soil to its original productiveness. In other counties of Iowa—Winnebago, for instance—where experiments have been carried on with this soil, applications of manure increased the yield of corn approximately 7 bushels to the acre, and manure, lime, and superphosphate gave a total increase of 11.7 bushels. Superphosphate, therefore, seems to be the principal requirement of this soil, together with organic matter and lime. Fall plowing and deeper plowing are recommended for best results, as a deep well-cultivated seed bed will conserve more moisture for use during seasons of low rainfall and in dry spells.

CLARION LOAM

The surface soil of Clarion loam to an average depth of 12 inches consists of very dark grayish-brown or dark grayish-brown fine granular loam containing some coarse sand and fine gravel. The subsoil is yellowish-brown silty clay loam containing various amounts of coarse gravel in the upper part and pale yellowish-brown slightly sandy silty clay mottled with gray and rust brown below a depth of 28 or 30 inches. A few lime concretions occur within a depth of 2 feet, but the number increases with depth. The content of coarse sand and subangular rock fragments, mostly granite, of the glacial till also increases in the lower part of the subsoil.

Clarion loam is moderately uniform throughout the county, the most conspicuous variations consisting in the different thicknesses of the various layers. Included in mapping are areas of Clarion silt loam which are too small to show on a small-scale map.

Areas of Clarion loam occur in all parts of the county along the lower slopes to streams. Throughout the eastern half the bodies along Little Rock River and in the vicinity of Doon are moderately wide and continuous, but in the western half they are narrow. As a rule, this soil occupies an intermediate position between Marshall silt loam of the uplands and soils of the first and second bottoms.

Areas of Clarion loam are slightly more rolling than areas of Clarion silt loam, and in some places the surface soil is somewhat eroded. Drainage is sufficient for crop needs. The subsoil is retentive of moisture.

Clarion loam, though a valuable soil, is not so highly prized as Clarion silt loam and Marshall silt loam. The greater part is under cultivation or in pasture, the only tree growth consisting of shelter belts that have been set out to the north and west of dwellings and a few cottonwoods.

Corn is the principal crop and occupies the largest acreage, with oats and hay following in the order named. Clarion loam is handled in essentially the same manner as Clarion silt loam. It can be cultivated, however, under a wider range of moisture conditions, and crops mature slightly earlier. On many farms barnyard manure is scattered over the land before plowing, but limestone and commercial fertilizers are not used.

Methods recommended for the improvement of Clarion silt loam can be equally well applied to this soil. Definite crop rotations, in which legumes are used, deeper plowing, and the more thorough preparation of the seed bed are recommended. As the surface soil is acid, the application of ground limestone would doubtless prove beneficial.

The selling price of Clarion loam is somewhat less than of Clarion silt loam.

Clarion loam, steep phase.—Clarion loam, steep phase, differs from typical Clarion loam in that the topsoil is not so thick, averaging only 6 or 7 inches, and lime is nearer the surface.

Soil of this phase occurs only in the extreme western part of the county along the breaks to the Big Sioux River bottoms. The ribbon-like areas are intermediate between Marshall silt loam, shallow phase, and the terrace and bottom soils.

Areas range from rolling to strongly rolling and broken. The slopes are generally rough and steep. Drainage is good, in many places excessive, and after heavy rains the rapid run-off causes serious erosion.

Owing to its rough, broken relief, Clarion loam, steep phase, has all been left with its natural vegetation and is used for pasture. Most of the slopes are covered with a straggling growth of oak, elm, ash, basswood, and maple.

DICKINSON FINE SANDY LOAM

The surface soil of Dickinson fine sandy loam is dark grayish-brown fine sandy loam or fine sand from 12 to 15 inches deep. It is underlain to a depth of 30 inches by yellowish-brown loamy somewhat gritty fine sand, streaked with tongues of dark organic material, which has percolated downward through cracks and worm burrows. The surface soil appears almost black after rains, and the subsoil is decidedly sticky when wet. Throughout the few remaining virgin areas the upper 2 or 3 inches is filled with grass roots and has a slightly lighter color than the layer below. At a depth of 30 inches the soil mass is loose yellowish-brown fine sand, which grades into calcareous gravelly sand at a depth ranging from 37 to 50 inches.

Dickinson fine sandy loam, as developed in Lyon County, is very uniform in color, texture, and thickness of the several layers. With the exception of two small bodies on the east side of Mud Creek near Alvord, the soil occurs only along the east side of Rock River and the southeast side of Little Rock River. In most places it occupies the lower half of the slope and merges with the higher-lying Clarion silt loam or Marshall silt loam. The surface is gently rolling, and internal drainage is excessive.

Dickinson fine sandy loam is handled in much the same manner and the same crops are grown as on Clarion silt loam and Marshall silt loam, with which soils it is usually farmed. However, it warms up earlier in the spring than those soils. As the soil is droughty, the growing and turning under of green-manure crops is strongly recommended to increase the moisture-holding capacity.

WAUKESHA SILT LOAM

The surface soil of Waukesha silt loam, to an average depth of 12 inches, consists of very dark grayish-brown mellow friable silt loam. Plowed fields appear black when wet. The surface soil is uniform except where dark-colored streaks and tongues of organic matter have been washed down from above through cracks and animal burrows. Where the soil has not been disturbed the upper 2 or 3 inches, which is filled with grass roots, is a finely granular mass having a slightly darker color than the layer below. The subsoil which extends from a depth of 12 to 40 inches is yellowish-brown friable silt loam slightly heavier than the surface soil. Beneath this layer and extending to a depth of about 55 inches is a silty transitional layer which is predominantly pale yellowish brown streaked and feathered with gray. This layer, in turn, grades at a depth of 72 inches into gray silty material splotched with rust brown, black, and yellow. No evidence of carbonates was detected throughout the soil.

Areas of Waukesha silt loam are uniform, with the exception of a few bodies throughout the bottoms of Rock and Little Rock Rivers. The large area southwest of Doon differs from typical Waukesha silt loam in that the subsoil is brown resembling somewhat the subsoils of the Buckner soils. Similar areas are mapped along the east side of Rock River north of Rock Rapids. On account of their small extent some patches of Buckner loam are included with Waukesha silt loam in mapping, in which the surface soil consists of very dark grayish-brown or almost black light-textured loam from 14 to 17 inches thick. It is underlain to a depth of 30 inches by slightly lighter-colored gritty loam containing more clay than the layer above. Beneath this is brown or grayish-brown loam which is sticky when wet. This layer, in turn, is underlain at a depth of 46 inches by a layer having approximately the same color but a gravelly loam texture. At a depth of 48 or 50 inches slight effervescence with acid occurs. These included areas occur on terraces of Big Sioux, Rock, and Little Rock Rivers and Mud Creek. The larger bodies are in the bottoms of Little Rock River between George and Little Rock.

Waukeska silt loam is most extensive in the valley of Big Sioux River on terraces lying from 20 to 45 feet above the normal level of

the stream. Smaller areas occur throughout the bottoms of Rock and Little Rock Rivers and of all the creeks of the county.

Areas of this soil are smooth or gently sloping toward the streams, and drainage is well established and sufficient for all crop needs. Practically all the Waukesha silt loam is under cultivation. Corn occupies the largest acreage and is the most important crop. Crop yields are as follows: Corn, from 30 to 45 bushels to the acre, averaging about 39 bushels; oats, from 25 to 70 bushels; barley, from 12 to 25 bushels; and hay, from 1½ to 3 tons.

Waukesha silt loam is easily cultivated. It is handled in practically the same manner as Marshall silt loam. The methods suggested for the improvement of Marshall silt loam apply equally as well to Waukesha silt loam. Crop yields can be economically increased by similar applications of superphosphate, but heavier applications of ground limestone must be made as most areas of Waukesha silt loam are more lacking in lime than Marshall silt loam.

SIOUX LOAM

The surface soil of Sioux loam to a depth of 12 or 14 inches is dark grayish-brown gritty loam containing a small amount of fine pebbles. The subsoil is light grayish-brown loamy sand or gravelly loamy sand underlain at a depth ranging from 18 to 24 inches by a laminated bed of whitish sand and pebbles. Small gravel, ranging from one-eighth to 1 inch in diameter, are scattered throughout the soil mass. The upper part of the subsoil is neutral or slightly acid, but below a depth of 24 inches the material shows strong effervescence when treated with dilute acid. Areas lying on the higher benches differ from typical areas in that the subsoils are gritty sandy loams or heavy sandy loams which grade at a depth ranging from 24 to 30 inches into sand and gravel. Included with mapped areas of Sioux loam are a few small areas that show no trace of carbonates within a depth of 3 feet.

Sioux loam occupies a comparatively small total area in Lyon County. It occurs in small, isolated bodies throughout the valleys of Big Sioux, Rock, and Little Rock Rivers. Most areas lie from 15 to 20 feet above the normal level of the streams and from 4 to 10 feet above the first bottoms. The surface is smooth or very gently sloping, and drainage ranges from good to excessive. Crops have a tendency to fire except during periods of excessive rainfall.

The greater part of the soil is improved and under cultivation. It is handled in essentially the same manner as the adjoining Waukesha silt loam, but crop yields are lower. This soil can be greatly improved by growing and turning under green-manure crops. Such practice not only increases the moisture-holding capacity, which prevents to some extent the danger of firing during droughts, but improves the physical condition of the seed bed. Alfalfa and sweetclover can also be successfully grown provided the fields are limed sufficiently to enable the plants to send their roots down to the supply of lime in the lower part of the subsoil. Liberal use of barnyard manure would also prove beneficial.

BREMER SILT LOAM

The surface soil of Bremer silt loam to an average depth of 15 inches is very dark grayish-brown silt loam which grades into heavy

silt loam of about the same color. The content of organic matter is high and plowed fields when wet appear intensely black. At a depth ranging from 24 to 30 inches is dark grayish-brown silty clay loam, the texture of which becomes much heavier with depth. Neither soil nor subsoil is calcareous. A few areas in which the soil profile varies somewhat from typical are included in mapping. Some of these included areas have a loam surface soil.

Bremer silt loam occurs in the valleys of Big Sioux, Rock, and Little Rock Rivers where it lies from 7 to 15 feet above the normal level of the streams and from 2 to 5 feet above the average level of the first bottoms. The larger bodies are 2½ miles north of Rock Rapids and just east of Beloit.

Areas of this soil are level or very gently sloping. Throughout the higher-lying bodies drainage is good, whereas crops on the lower areas show the effect of poor internal drainage, especially during wet seasons.

Practically all the Bremer silt loam is under cultivation to general farm crops. Corn is the most important crop and may be grown for longer periods without rotation than in the uplands. Oats and hay are next in importance.

The greatest need of the soil is drainage, for which purpose either open ditches or tiles are recommended. The soils are acid in reaction and the application of ground limestone would prove beneficial. The use of superphosphates might prove profitable. Barnyard manure should be incorporated in the soil where possible. The use of more definite crop rotations is urged.

BREMER LOAM

Bremer loam in all characteristics, other than the texture of the surface soil, which is mellow friable loam, is identical with Bremer silt loam. It is an inextensive soil in Lyon County, occurring only in the valleys of Rock and Little Rock Rivers, where it occupies the lower benches above the reach of ordinary overflow. The individual areas are small and scattered.

The land is level or very gently sloping, and drainage is not everywhere sufficient for crop needs, owing to the nearness of the water table to the surface and the imperviousness of the subsoil.

Practically all of Bremer loam is in cultivation or in pasture land, the only tree growth consisting of a few willows along old fence rows and ditches. The chief crops, which are corn, oats, hay, and barley, return the following yields: Corn from 35 to 60 bushels to the acre, oats from 25 to 55 bushels, hay from 1½ to 2½ tons, and barley from 15 to 20 bushels. Owing to the high moisture content of the soil, grasses do well, and a small acreage is devoted to pasture.

The needs of this soil are much the same as of Bremer silt loam.

JUDSON SILT LOAM

To a depth of 5 or 6 inches the surface soil of Judson silt loam consists of dark grayish-brown floury silt loam. It is underlain by very dark grayish-brown even-textured silt loam, which grades into a slightly lighter-colored layer of the same texture. There is little change in texture to a depth of 3 or 4 feet other than a slight compaction in the subsoil.

Judson silt loam occurs on the terraces of Big Sioux, Rock, and Little Rock Rivers where it is typically developed along the edge bordering the uplands. It is undoubtedly of colluvial origin, and most areas spread out in fanlike bodies. The larger areas are in the bends of Big Sioux River near Beloit and Granite and on Rock and Little Rock Rivers near Doon.

Areas are level or gently sloping and lie from 2 to 5 feet above the first bottoms and from 10 to 20 feet above normal stream level. Drainage is sufficient for crop needs.

Judson silt loam is recognized as a good soil for the production of the staple crops, and approximately 80 per cent of the land is in cultivation. The remainder is left with its natural growth and utilized for pasture. Crop rotations are not practiced so extensively as on the uplands, corn being grown on the same ground for many years in succession.

LAMOURE SILT LOAM

Lamoure silt loam to a depth of 15 inches is dark grayish-brown mellow silt loam which appears very dark grayish brown or black when wet, owing to the high content of organic matter. The subsoil consists of grayish-brown heavy silt loam or silty clay loam, which passes at a depth of about 30 inches into light grayish-brown calcareous silty clay containing some sand. The surface soil in many places is slightly calcareous, but generally no effervescence occurs above a depth of 15 or 18 inches. Between 20 and 24 inches, however, there is an abundance of carbonates, many of which occur in the form of small concretions.

Lamoure silt loam, as is true of all overflow soils, varies considerably both in color and texture. In mapping, therefore, small bodies of associated soils may be included, or the boundaries between the different soils may be more or less arbitrarily drawn.

Lamoure silt loam is rather extensive. It occurs throughout the first bottoms of Rock and Little Rock Rivers and Mud Creek as well as along most of the smaller creeks and drainage ways. Most of the bodies are narrow, but along the rivers many of the bottoms spread out to a width ranging from one-half to three-fourths of a mile.

The areas are prevailingly flat or gently sloping, though in a few places the surface is undulating or billowy. Most of the soil lies from 2 to 4 feet above the normal level of the creeks and from 5 to 10 feet above that of the rivers. Natural drainage in most places is insufficient for crop needs.

The greater part of Lamoure silt loam is in its virgin condition and is used for pasture. Bluegrass and other wild grasses make a favorable growth, and on most farms a few beef cattle, dairy cows, and hogs are pastured. Crop yields average about the same as on Waukesha silt loam except during rainy seasons when they are less. The few areas of Lamoure silt loam under cultivation are handled in essentially the same manner as the adjoining Waukesha silt loam.

Lamoure silt loam is very rich and is high in content of the necessary plant-food elements. When properly drained and protected from overflow these soils are highly prized. Drainage is the most serious problem. Streams should be straightened and dredged and lateral tile drains laid at closer intervals. In many places it will

even be necessary to throw up dikes to protect the land from overflow. Deeper plowing, the incorporation of barnyard manure, and applications of superphosphate are recommended for improvement of the soil.

The value of Lamoure silt loam is lower than that of the adjoining terrace soils.

LAMOURE LOAM

The surface soil of Lamoure loam, to a depth of 15 or 17 inches, is very dark grayish-brown or almost black loam. It is underlain by black heavy loam which passes, at a depth of about 20 inches, into dark grayish-brown calcareous loam. As in all bottom-land soils numerous variations from typical occur. Along Little Rock River, in the vicinity of George, are a few areas which differ from the typical soil in that a gravel or sand substratum is reached at a depth ranging from 20 to 30 inches. Had such bodies been large and of sufficient importance they would have been separated as Cass loam.

Lamoure loam occurs in the bottoms of Rock and Little Rock Rivers, where it occupies a position about 4 feet above normal stream level. Drainage is moderately well established.

Lamoure loam is comparatively inextensive. Most of the bodies are narrow, and, owing to the fact that they are frequently overflowed, few of them are cultivated. Bluegrass and other wild grasses make an excellent growth and afford pasturage for the few head of cattle commonly kept.

LAMOURE SILTY CLAY LOAM

Lamoure silty clay loam is practically identical with Lamoure silt loam in all characteristics except the texture of the surface horizon, which is silty clay loam. Like Lamoure silt loam, the soil is derived from sediments which were brought down from glacial and loessial soils farther upstream. The profile of the areas is not everywhere typical, and in many bodies the soil may be made up of successive layers of light and dark materials. Such variations, however, are of small extent and could not be separated on a small-scale map.

Lamoure silty clay loam, which is inextensive, occurs only along some of the creeks in the eastern third of the county. The largest areas are along Otter and Rat Creeks in the extreme southeast corner. The narrow bottoms along the smaller creeks are frequently overflowed, but the more extensive areas are covered with water only during periods of very heavy rains.

The greater part of Lamoure silty clay loam is left with its native covering and is utilized for pasture. The cultivated fields are used in conjunction with adjoining upland soils, and they give very good returns where well drained and not damaged by flood waters. Corn is the principal crop, and yields compare favorably with the average yield on Marshall silt loam except during dry seasons.

Lamoure silty clay loam is naturally rich and productive, and when protected from overflows and well drained is considered very valuable. The streams should be straightened and dredged and in some places dikes would be of great benefit. When well drained the soil will respond favorably to small applications of barnyard manure, and additions of superphosphate may be of value.

WABASH SILT LOAM

The surface soil of Wabash silt loam consists of very dark grayish-brown mellow friable silt loam from 14 to 17 inches deep. The content of organic matter is high, and plowed fields appear intensely black after rains. The subsoil is dark grayish-brown or dark-gray silty clay loam or silty clay slightly mottled with black oxide of iron stains. In many places the change in color from the surface downward is slight, and the very dark grayish-brown silt loam may extend to a depth of 3 or more feet without change. In many other places the soil profile shows a laminated or layerlike arrangement caused by the deposition of sediment during succeeding flood periods. Some areas of Wabash loam and Wabash silty clay loam, too small to separate, have been included with this soil in mapping.

Wabash silt loam is widely distributed along most of the streams over the western half of the county. Throughout the bottoms of Big Sioux River the areas are small and isolated. They are most extensive along Mud Creek.

Drainage in general is poor. In the bottoms of Mud Creek and the smaller streams water stands over the surface for considerable time after heavy rains and floods. The higher-lying bodies along Big Sioux River are seldom overflowed and are sufficiently well drained for crop needs.

Wabash silt loam is not an important agricultural soil. Approximately a fourth of the total area is in cultivation, and the remainder is left in its natural condition and used for pasture. Corn is the principal crop and when not damaged by poor drainage or overflows produces from 40 to 55 bushels to the acre. The crop can be grown for much longer periods on the same piece of land without loss of yield than in the uplands. Oats are grown to some extent, but the crop lodges badly. Yields of 30 and 35 bushels have been reported. Wheat is a minor crop and yields from 15 to 19 bushels to the acre. Wild grasses make a very good growth and produce from 1½ to 2½ tons.

Wabash silt loam is a rich, productive soil. Its greatest need is drainage. Protection from overflows can be accomplished in some places by straightening and dredging the streams, but in other places the construction of dikes or levees will be necessary. Ample tile drainage is recommended for the improvement of this soil, after which small applications of barnyard manure and superphosphate will no doubt prove beneficial. Ground limestone would also be of benefit.

WABASH LOAM

The topsoil of Wabash loam to a depth of 10 inches consists of dark grayish-brown fine-textured loam high in organic matter. Beneath this and extending to a depth of 20 or 22 inches is black heavy silt loam or silty clay loam, which is in turn underlain by very dark grayish-brown silty clay loam. Neither soil nor subsoil is calcareous, though at a depth ranging from 4 to 5 feet the soil mass shows some traces of carbonates. The soil is derived from recently deposited alluvium and like all first-bottom soils shows some variations. Near the outer edges of the bottoms the surface soil may be lighter in color and texture, owing to the thin layer of material that has been recently

washed from adjoining slopes. Included also are some few bodies of Wabash silt loam and Wabash silty clay loam too small and unimportant to separate on a small-scale map.

Wabash loam occurs throughout the strips of alluvium that border most of the streams of the county. Most of the bodies are small and narrow, the largest occurring along Little Rock River. Areas along the smaller creeks are subject to frequent overflows, but along the rivers and larger creeks inundation occurs only during heavy floods.

The greater part of the soil is left in its natural condition and is used for pasture. Where cultivated it returns good yields of corn.

SUMMARY

Lyon County is in the extreme northwest corner of Iowa, and it includes an area of 576 square miles.

The surface relief of the greater part of the county is that of an undulating or rolling plain. Toward the west the country becomes rougher, culminating in a narrow belt of strongly rolling or rough and broken land bordering the valley of Big Sioux River. The elevation of the upland plain ranges from 1,375 to 1,470 feet above sea level. The prevailing slope is toward the south.

Drainage is carried by Big Sioux and Rock Rivers. Creeks and small drainage ways ramify to all sections of the county, affording excellent drainage to most of the farms. Tiling is necessary in only a few places.

Most of the farming population is native-born white. The 1920 census reports 15,431 inhabitants, an average of 26.5 persons to the square mile. Rock Rapids, located near the center of the county, is the principal town and had a population of 2,172 in 1920. Other towns located at convenient points afford excellent trading facilities.

Lyon County has good railroad facilities. The dirt-road system is complete. The roads are dragged after rains and are excellent during dry weather. A number of the county highways have been brought to grade and graveled.

The climate of Lyon County is favorable for the production of corn and all crops suited to this section of the country. The average frost-free season is about 145 days, and the annual precipitation is about 26 inches.

The upland soils of Lyon County have been derived from two different materials, loess and glacial drift. The topsoils are predominantly very dark grayish brown and have been formed under the influence of a luxuriant grass vegetation. Drainage conditions have been responsible for the varied characteristics of the several horizons.

Marshall silt loam, together with its two phases, covers more than two-thirds of the area of the county. It is considered a valuable soil for the production of all crops and is an ideal corn soil. Clarion silt loam and Clarion loam are strong agricultural soils and are considered valuable for general farming. Dickinson fine sandy loam is handled in much the same manner as the Marshall and Clarion soils, but, as it is more droughty, crops have a tendency to fire in dry seasons.

Waukesha silt loam, which is developed on second terraces high above overflow, is highly prized for the production of general farm crops. Sioux loam is also a terrace soil lying well above overflow. This soil is droughty and not so productive as Waukesha silt loam. Bremer silt loam and Bremer loam are developed on second terraces and are only fairly or poorly drained. They are naturally strong agricultural soils and are considered valuable when well drained.

The silt loam, silty clay loam, and loam members of the Lamoure series are first-bottom soils. When well drained and protected from overflow they are considered strong agricultural soils. A large area is left in native pasture. Wabash silt loam and Wabash loam are first-bottom soils, in which drainage is variable. These soils differ from the Lamoure soils in the absence of lime in the subsoils. When well drained and protected from overflow they produce excellent crops of corn and small grains.

The agriculture of Lyon County consists of the growing of corn, small grain, and hay. The raising and feeding of hogs and beef cattle is also important, and dairying is practiced to a small extent.

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[PUBLIC RESOLUTION—No. 9]

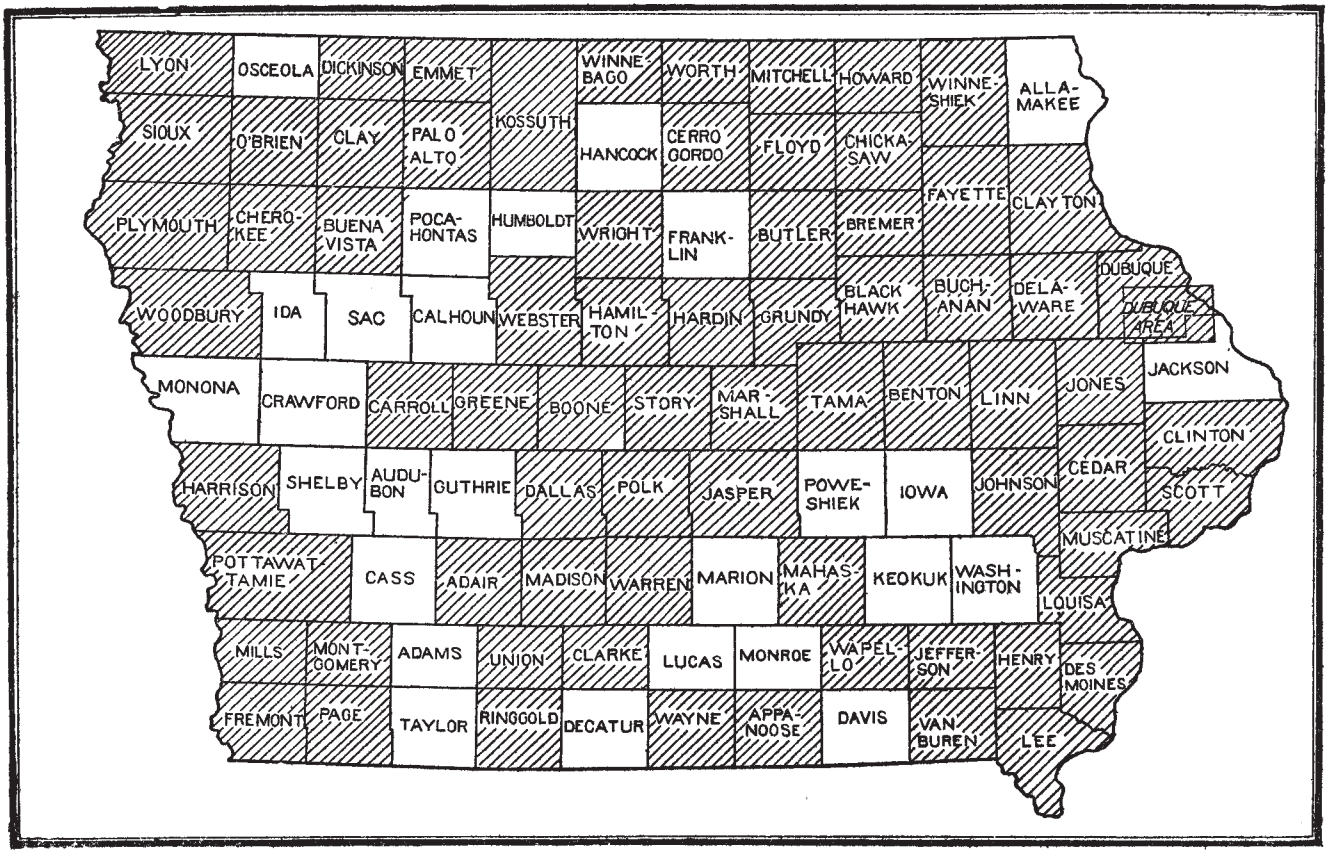
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Iowa, shown by shading

U. S. GOVERNMENT PRINTING OFFICE: 1930

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