

SOIL SURVEY OF MONTGOMERY COUNTY, IOWA.

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DESCRIPTION OF THE AREA.

Montgomery County is in the southwestern part of Iowa, in the second tier of counties north of the Missouri State line. One county separates it from the Missouri River and the State of Nebraska on the west. The western boundary is approximately 45 miles from Omaha. The county is bounded on the north by Pottawattamie and Cass Counties, on the east by Adams County, on the south by Page County, and on the west by Mills County.

It is rectangular in outline, measuring 24 miles from east to west and 18 miles from north to south. The county contains 12 townships, comprising a total area of 424 square miles, or 271,360 acres.

Physiographically, Montgomery County consists of an elevated plain that has been modified by the erosional action of an extensive drainage system until it consists of a succession of broad, smoothly rolling to strongly rolling divides and almost level stream valleys that have a general southwest trend.

The uplands constitute approximately 80 per cent of the county. Along the Middle Nodaway and West Nodaway Rivers and Seven Mile Creek the country is rough and broken. The slopes are steep and irregular and gullies soon cut into the soft loess, making cultivation of these slopes difficult. Small areas having similar topography occur along the east side of the Nishnabotna River just north of Stennett, and along the east side of Tarkio Creek for a short distance before it leaves the county. The strips of rough country extend back from the streams only one-half mile to 3 miles, where they merge with the more smoothly rolling topography which predominates over the greater part of the county. Throughout this main body of upland the hills are smooth and rounded and the slopes gentle and uniform, giving rise to a gently rolling landscape. This is particularly true in the northwest township and throughout the divide between the Nishnabotna River and Tarkio Creek, locally

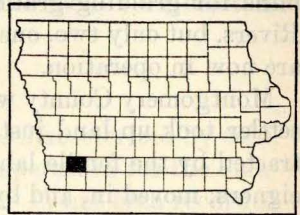


FIG. 44.—Sketch map showing location of the Montgomery County area, Iowa.

known as "Frankfort Ridge." Along the rivers there are strips of first bottoms, and occasionally of second bottoms, varying in width from a few hundred feet to $2\frac{1}{2}$ miles. Narrower strips of alluvium occur along the smaller drainage ways throughout all sections of the county.

In elevation above sea level Montgomery County ranges from 1,000 feet where the Nishnabotna River leaves the county to about 1,260 feet on the ridge 2 miles west of Stanton. The elevation at Coburg is 1,003 feet, at Red Oak 1,092 feet, at McPherson 1,114 feet, at Stanton 1,175 feet, and at Villisca 1,055 feet. The prevailing slope is toward the southwest.

The county is drained by the East Nishnabotna, West Nodaway, and Middle Nodaway Rivers, and Seven Mile, Tarkio, Walnut, and Indian Creeks. These streams have a sluggish flow. The flood plains lie 100 to 200 feet below the general level of the uplands 1 to 3 miles away. Numerous intermittent drainage ways branch through all parts of the county. Formerly there were a number of water-power mills for grinding grain along the East Nishnabotna and Nodaway Rivers, but only two, one at Grant and one 2 miles north of Red Oak, are now in operation.

Montgomery County was organized in 1851. In 1847 the first white settler took up land just south of the present town of Villisca. Attracted by the fertile lands a number of settlers, including some foreigners, moved in, and by 1870 the population had increased to 5,934. Most of these pioneers were of Swedish descent, and they came largely from Knox and Henry Counties, Ill.

The population of Montgomery County in 1915, as reported by the State census, was 17,297. Approximately 40 per cent of the population is of Swedish, Welsh, or German descent. Red Oak is the only city with over 2,500 inhabitants, and 71 per cent of the population is classed as rural. The rural population is well distributed over the county, settlement being densest in the vicinity of the towns.

Red Oak, the county seat, is situated near the center of the county. Its population in 1915 was 5,601. Villisca, the second town of importance, is in the southeast corner of the county. It has a population of 2,132. Stanton, with a population of 705; Elliott, with 558; Grant, with 314; and Coburg, with 176, are incorporated towns of local importance. Smaller towns are distributed throughout the county along the railroads and principal highways.

Montgomery County has good transportation facilities, except in the extreme northeast corner. In all other sections no farm is more than 9 miles from a railroad. A main line of the Chicago, Burlington & Quincy Railway crosses the southern half of the county and is the principal means of transportation. The Red Oak-Nebraska City

branch runs south from Red Oak, along the east bank of the Nishnabotna, and other branches extend north from Red Oak, along the Nishnabotna and south from Villisca to Clarinda in Page County.

The public roads all follow land lines except where detours are made necessary by the topography. The highway system is very good, serving all sections of the county. None of the roads have been hard surfaced as yet, but they are gradually being improved. The steeper hills on the main highways are being graded, and concrete bridges and culverts are gradually taking the place of the old wooden bridges. The roads are dragged after heavy rains and kept in good condition the greater part of the year.

Rural mail routes serve all parts of the county, and most of the farmers have telephone service. Schools are maintained at intervals of approximately 2 miles throughout the county. The schools in the Wales district have been consolidated and the pupils are taken to and from school in public conveyances. Public schools and high schools are maintained in the largest towns. A few independent school districts have been organized. Churches have been built at convenient places throughout the county.

CLIMATE.

Montgomery County has a healthful climate, characterized by cold, long winters and hot summers. The mean temperature for the summer is 72° F. A maximum temperature of 108° F. has been recorded in July, but extremely hot spells are of short duration. The mean winter temperature is 22° F. The temperature often drops to -20° F. or lower. Blizzards occur frequently and the snowfall is heavy. In summer hot winds from the southwest may fire the corn and do considerable damage to other crops, and during the winter months high northwest and north winds often cause unprotected stock to suffer. The mean annual temperature is 48.1° F.

The average date of the last killing frost in the spring is April 30, and of the first in the fall October 8, giving an average growing season of 161 days. The date of the latest recorded killing frost in the spring is May 18, and of the earliest in the fall September 15.

The mean annual rainfall of 32.81 inches is well distributed for the growing and harvesting of crops. The mean rainfall for the spring is 10.05 inches, and for June, July, and August, which constitute the main growing season, 12.05 inches. Periods of excessive rainfall sometimes occur during the late spring or early summer, and crops on the bottoms may be damaged or drowned out. The summer rains come in the form of thunderstorms, some of which are heavy. Tornadoes and hailstorms are not uncommon, but are of local extent. Sometimes during the passage of a low area

from the southwest toward the Great Lakes rain is general over a large area for several days at a time. During the fall the precipitation gradually becomes lighter and the weather, as a rule, is excellent for the harvesting of crops. The mean precipitation for the winter is 3.39 inches. This generally comes in the form of snow, and plowed ground is not damaged by erosion. The snow protects winter wheat, clover, and alfalfa.

The following table, compiled from the records of the Weather Bureau station at Corning, which is in the adjoining county to the east, represents the climatic conditions existing in Montgomery County:

Normal monthly, seasonal, and annual temperature and precipitation at Corning, Adams County.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1894).	Total amount for the wettest year (1915).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	24.7	62	-23	1.34	.84	.42
January.....	19.7	57	-32	.89	.89	1.86
February.....	21.6	61	-15	1.16	1.72	3.12
Winter.....	22.0	62	-32	3.39	3.45	5.40
March.....	34.1	84	-19	1.80	.84	1.50
April.....	49.6	93	18	3.03	1.29	2.31
May.....	60.6	93	24	5.22	1.29	9.50
Spring.....	41.4	93	-19	10.05	3.42	13.31
June.....	69.4	100	34	4.10	3.59	4.20
July.....	74.4	108	43	4.01	3.30	15.83
August.....	72.2	105	34	3.94	.37	2.25
Summer.....	72.0	108	34	12.05	7.26	22.28
September.....	63.9	102	24	3.28	3.13	7.21
October.....	48.7	88	14	2.67	2.31	.86
November.....	35.7	76	- 4	1.37	.85	1.43
Fall.....	49.4	102	- 4	7.32	6.29	9.50
Year.....	48.1	108	-32	32.81	20.42	50.49

AGRICULTURE.

In 1852 the farming population of Montgomery County consisted of several families of whites, who had settled along the Middle Nodaway, growing subsistence crops on a small acreage of cleared land. Hunting was the principal means of support. Gradually more attention was paid to the growing of corn, spring wheat, oats,

and vegetables, but as outside markets were inaccessible no effort was made to increase production. At the time of westward immigration large numbers of people crossed this section of the State, and created a ready market for all foodstuffs. By 1869 the railroad reached this territory, and the population steadily increased and a larger acreage was put under cultivation. Corn, spring wheat, and oats were the principal crops. The Civil War resulted in a general demand for live stock. Hogs were raised principally by the farmers who lived along the Nodaway River, and were shipped, as a rule, to Council Bluffs, at that time the largest stock market in the State. The animals lived on the range the greater part of the time, and were only fed on corn a few weeks to put them in shape for market.

The population of Montgomery County increased from 5,924 in 1870 to 10,389 in 1875, in which year 86,026 acres were in cultivation. Corn was at that time, as to-day, the principal crop, occupying 39,251 acres and producing 1,441,467 bushels. Spring wheat, oats, and hay ranked in the order named. The value of farm products was reported as \$1,072,127. By 1880 the area in corn had increased to 98,161 acres, and the production to 4,314,280 bushels. Wheat was grown on 30,733 acres, producing 285,308 bushels; oats on 8,503 acres, producing 260,705 bushels; and hay on 11,223 acres, producing 12,044 tons. A small acreage was devoted to rye, barley, buckwheat, flax, and garden truck to supply the local demand. In 1880 there were 29,739 hogs and 13,611 cattle in the county.

According to the census of 1890, the population of the county was 15,848, and 1,841 farms were operated with an average size of 140.62 acres. The area in corn had increased to 98,290 acres, with a production of 4,262,098 bushels. The oats acreage was greatly increased this year and 957,401 bushels were harvested from 25,745 acres. The area in wheat fell off to 5,309 acres and the production to 74,283 bushels. Rye, barley, buckwheat, alfalfa, clover, wild and tame grasses, potatoes, apples, berries, melons, and all kinds of garden truck were important crops at this time.

By 1900 the area devoted to corn had increased to 107,883 acres, producing 4,837,180 bushels. Wheat was grown on 25,049 acres, producing 298,560 bushels, and oats on 19,210 acres, producing 611,040 bushels. Alfalfa, clover, millet, sorghum, wild and tame grasses, rye, barley, buckwheat, flax, potatoes, and garden truck were extensively grown. Apples, strawberries, dewberries, and raspberries were produced in a small way by most farmers. The value of animals sold or slaughtered in 1899 is reported as \$1,186,211. The value of poultry raised was \$71,492 and of dairy products sold \$81,178.

The total number of farms in operation decreased by 174 from 1900 to 1910, while the average size of farms increased 10.7 acres. In 1910,

55.8 per cent of the farms were operated by owners, 43.4 per cent by tenants, and 0.8 per cent by managers. Corn, oats, and wheat, in the order named, were the most important crops. Each was grown on a smaller acreage than in 1899. Corn in 1909 occupied approximately one-third of the total acreage of the county, or 92,624 acres, and produced 3,661,134 bushels. Oats were grown on 16,546 acres, producing 412,884 bushels; and wheat on 19,366 acres, producing 255,374 bushels. Clover, alfalfa, and timothy had an important place in crop rotations and were grown extensively for hay and pasturage. Rye, millet, barley, melons, potatoes, cherries, apples, plums, grapes, strawberries, dewberries, and all kinds of garden truck were produced by most of the farmers to supply the local demand. The raising and feeding of cattle and hogs had become an important industry, and \$2,470,655 worth of animals were reported sold or slaughtered in 1909. The value of dairy products for that year is reported as \$148,114, and of poultry and eggs produced \$233,631.

At the present time the agriculture of Montgomery County consists of the growing of general farm crops for sale and for home use; the feeding, and, to a limited extent, the raising of beef cattle; hog raising; and the feeding of sheep.

Dairying is carried on to a limited extent, and gardens and orchards are maintained on nearly every farm to supply in part the home demand. Corn is the principal crop, followed by wheat and oats. Rye, barley, clover, timothy, alfalfa, flax, potatoes, and garden truck are also grown.

Corn occupies by far the largest acreage, and in 1915,¹ 84,564 acres, a little less than one-third of the total area of the county, was planted to this crop, with a production of 3,249,751 bushels, or an average of 38.4 bushels per acre. Ordinarily all the corn is used for feeding hogs, work stock, and dairy cows, and for fattening the large number of steers that are fed out each year. A small quantity is ground into meal to supply the local demand. A considerable acreage is devoted to corn for ensilage.

Wheat ranks second in acreage and value, and is one of the principal money crops. Formerly only spring wheat was grown, as it was supposed winter wheat could not stand the severe winters. The acreage has gradually shifted and now spring wheat is grown only in very backward seasons. In 1915, 30,401 acres were seeded to this crop, producing 637,675 bushels. A small part of the crop is used locally, but the bulk is sold. In years of unusually large crops the mills of the county can not grind all the wheat, and the surplus is shipped to Omaha and St. Louis.

¹ Production figures in this report later than the year 1910 are taken from the Iowa State Census of 1915.

Oats are grown on nearly every farm, and are the third crop in importance. The 1915 census reports a total of 17,953 acres in oats, with a production of 676,351 bushels. The oat crop is nearly all fed on the farm, but part is occasionally sold to local elevators. The oat straw is nearly always fed to stock on the farm. Some oats are shipped out of the county.

Rye is grown on a small scale by most of the Swedish and German farmers. The grain is generally thrashed and ground for home use, although a considerable acreage is grown for early spring and late fall pasturage. In 1915 there were 197 acres in rye and 3,404 bushels were produced.

Barley is not a very important crop. The census of 1915 reports 5,238 bushels produced on 316 acres. The grain is soaked or ground and fed to hogs. The straw is inferior to oat straw as feed, owing to the beards.

Timothy is an important hay crop. According to the State census, 18,118 acres were devoted to it in 1914, with a total production of 19,993 tons, valued at \$207,087. Generally timothy is sown with clover and forms a small proportion of the growth until the second year. Most of the timothy hay is used within the county to feed the work stock and cattle, but a small percentage is shipped to outside markets. In 1914, 454 acres of timothy were thrashed, producing 1,815 bushels of seed.

The census of 1915 reports 6,771 acres in clover, with a production of 7,509 tons. This crop was harvested for seed on 1,290 acres and produced 1,746 bushels. Clover is finding a more important place in the rotations each year. It is generally sown with oats as a nurse crop, although a considerable acreage is sown with timothy. Clover ordinarily is pastured the first year, although some farmers cut it for hay. The second year two crops are cut and the third pastured. All of the hay is fed to work stock, milk cows, and beef cattle. In addition to the timothy and clover grown alone, the census of 1910 reports 15,627 acres devoted to a mixture of these crops. The supply of hay is not equal to the demand.

Alfalfa was grown on 3,809 acres in 1914, producing 7,979 tons. The value of alfalfa as a soil builder and hay crop is recognized, and the majority of the farmers endeavor to keep a small acreage devoted to it. Alfalfa gives good results for five to seven years without re-seeding, and three to four cuttings are obtained each season. The average yield per acre for the season of 1914 was 2.09 tons, but total yields of 3 and 4 tons are not uncommon. Hogs are often pastured on alfalfa, and where only a few are turned into a field the yields do not seem to be impaired.¹ The Missouri loess area is recognized

¹Bul. No. 137, Iowa Agr. Expt. Sta.

as the best section of the State for the growing of alfalfa. The loess soils of this county, with the exception of the lower subsoil in a few small areas, do not give a lime reaction, and best results are obtained where the alfalfa fields are limed and inoculated. All the alfalfa is used in the county to feed work stock, hogs, and beef cattle.

Hogs are the principal live stock. In 1915 there were 73,351 head in the county. The average farmer raises 150 to 400 each year. After supplying the home and local demand the hogs are sold to buyers, who ship them in carload lots to Chicago, St. Louis, and Omaha. The most popular breeds are the Duroc-Jersey, Poland-China, Hampshire, and Chester White.

The feeding of beef cattle is also an important industry. There are a number of breeding herds scattered throughout the county, but most of the farmers buy their feeders on the Omaha market, shipping them in about October of each year. Some of these cattle are carried through the winter on rough feed and marketed the following summer or winter, while others are marketed the same winter they are bought. The breeding herds and the cattle that are kept a year or more are pastured during the summer months, turned into the corn fields in the fall after the corn has been husked, and fed on corn and hay during the winter. On many farms silage is coming into use as a feed for beef cattle. The favorite breed is the Short-horn, but considerable numbers of Hereford and Angus cattle were seen during the progress of the survey. According to the 1915 census there are 10,708 calves and 18,398 other cattle in the county. Most of the beef cattle are sold to buyers, who ship them to Omaha, Chicago, and St. Paul.

Dairying is conducted on a small scale to supply the local towns and farm demands. The census of 1915 reports 6,239 milk cows in the county.

In 1915 there were 1,316 sheep in Montgomery County. Since then the feeding of sheep has increased, and during the year of the survey (1917) large numbers of western sheep were brought in to be fed during the winter and early spring. The sheep are turned into the cornfields or pastures, where they forage for themselves until cold weather.

The raising of poultry is an important side line on every farm. In 1915 there were 223,737 fowls raised and 999,533 dozen eggs produced, representing a combined value of \$287,316. The surplus after supplying the home and local demand is sold to produce dealers, who ship to outside markets.

The farm work stock consists mostly of draft mares. Colts are generally raised from these mares each year. The 1915 census reports 10,654 horses and 1,173 mules in the county, representing a total value

of \$1,190,379. All the animals above those needed on the farms and in the towns are sold to stock dealers in Red Oak and the principal towns.

Small apple orchards are maintained on most farms. Very little care is given them, and only in a few instances are the trees pruned and sprayed. The fruit is sold in the towns in good years. Some of the principal varieties are the Jonathan, Winesap, Grimes Golden, Ben Davis, and Siberian Crab. Cherries do very well. Almost all the crop is used for making preserves. Pears do fairly well when sprayed. The Lincoln, Angoulême, and Kiefer are the leading varieties.

In 1915, according to the census, 432 acres were devoted to Irish potatoes, producing 43,034 bushels, and 6 acres to sweet potatoes, producing 379 bushels. Sweet corn is grown extensively, the product being sold to the canning factory in Red Oak. Melons, sorghum, millet, soy beans, navy beans, strawberries, dewberries, and all kinds of garden truck are grown to supply in part the home and local demands.

The farmers of Montgomery County recognize that the Marshall silt loam is the most valuable soil for all the staple crops, and that it is particularly well suited to the growing of corn, oats, alfalfa, and clover. The Wabash silt loam is a productive type. Frequent overflows make crops uncertain, but excellent crops of corn and small grain are obtained in favorable years. A large acreage of the Wabash silt loam and its colluvial phase is devoted to pasture, as the natural grasses grow rank and water is near at hand. The Wabash silty clay loam is considered the best wheat land in dry years. The Waukesha silt loam is well suited to all the crops of this section, particularly corn, small grain, and hay.

In preparing the land for corn, the new ground or land that has been in pasture a number of years is plowed deep in the fall. The next spring this is cross-disked and then leveled off with a smoothing harrow. Where corn is grown to succeed itself a stalk cutter or disk harrow is run over the field, after which the ground is plowed, disked, and harrowed. In many cases the land is disked and harrowed in the spring without replowing. The general practice is to put the corn in with a planter, but in late seasons a small acreage may be listed. Where a planter is used the seed may either be drilled in rows or planted in hills. The planter is usually set for a 3-foot 6-inch check row. Planting is done from the 1st to the 20th of May, and the crop is generally "laid by" by the middle of July. It receives three cultivations and sometimes four. The four-bladed wheel cultivator is in general use. Most of the corn is husked in the field by hand, but some is harvested with a corn binder and

stacked in the field, where it remains until fed. A small acreage, increasing each year, is cut green and used for filling silos.

Where wheat or oats follow corn the seed is drilled in without re-planting. The stalks are first cut with a cutter or disk, after which the land is redisked and harrowed. In severe winters when the snowfall is light wheat may be killed and a number of the farmers guard against this by broadcasting manure or wheat straw over the fields in the late fall. Clover is generally broadcasted over the wheat fields in February or March, during a light snow. After the wheat is harvested the clover remains on the land and is either pastured or cut for hay. The same fall timothy is sown in the clover. Timothy and clover are sometimes pastured, but are generally cut for hay. The clover disappears after the second year and the timothy is subsequently pastured or cut for hay several years before the land is returned to corn.

Alfalfa is seeded both in the fall and spring, with good results, the latter being the preferred seeding time. The crop is generally grown on the uplands where drainage is good. The ground is broken deep in the fall and disked and harrowed several times the next spring, after which about 20 pounds of alfalfa seed per acre is drilled in. A prevailing practice is to plant about 1 bushel of oats per acre with the alfalfa, to serve as a nurse crop. The seed is nearly always inoculated and in a few cases the fields have been limed. Alfalfa is pastured and cut for hay. The stand lasts 6 to 10 years, the plants eventually being crowded out by bluegrass. It is customary to return the alfalfa ground to corn after 5 or 6 years.

The dwellings throughout the county, especially on the farms operated by owners, are generally large, substantial, two-story houses. The barns are generally built on concrete or stone foundations and are large, having a place for the work stock and a space for hay storage. Several circular barns with silos in the center have been built, and there are a number of other silos of hollow-tile and wood construction throughout the county. The fences are of woven or barbed wire, and in good condition. The machinery in general use consists of 14-inch gang plows, disk harrows, spike harrows, cultivators, mowing machines, hay rakes, corn and small-grain binders, manure spreaders, and hay loaders. A large number of windmills are used for pumping water. Small gasoline engines are kept on a number of the farms, and many of these engines are mounted on trucks, so that they can be moved from place to place. Thrashers, owned by individuals or companies, travel from farm to farm in the fall. A few tractors are in use and give excellent results. The work stock consists of heavy draft horses and a few mules.

Definite crop rotations are practiced by the farmers of Montgomery County. The one in general use consists of corn for 4 to

7 years, followed by winter wheat or oats for 1 or 2 years. Timothy and clover or alfalfa is then grown for a term of years, after which the land is returned to corn. The more progressive farmers do not leave the land in corn more than 2 or 3 years before it is seeded to small grain or put in pasture. The legumes, alfalfa, and clover are being grown more extensively, and in a few cases soy beans have been planted between the rows of corn with good results. On most of the farms manure is carefully saved and applied to the fields.

The census reports laborers employed on 913 farms in 1909, and an average of \$258.27 per farm paid out for help. All of the labor is white and quite efficient. The farm hands as a rule are hired by the month and receive from \$35 to \$45, together with a house to live in and a garden. A milk cow and firewood are also furnished. Some of the labor is employed by the year. During corn husking time laborers are paid by the bushel and receive board, room, and laundry in addition.

The farms of Montgomery County vary considerably in size, ranging from 60 to 80 acres in the extreme east-central part to more than 500 acres in the western part. The average size has gradually increased from 150.9 acres in 1910 to 165.6 acres in 1915. The census of 1910 reports 55.8 per cent of the farms operated by owners, 43.4 per cent by tenants, and 0.8 per cent by managers. The farms are rented for one year or a term of years. A number of tenants pay cash rent, which ranges from \$7 to \$10 per acre. In 1915, 76,377 acres were reported leased for cash, and 61,266 acres leased on shares. Where rented on shares the owner generally gets one-half of all the crops. Occasionally the owner draws up a contract requiring the tenant to keep at least half of the land in pasture or grass, or to return to pasture the equivalent of all the new land put in cultivation. Partnership agreements are sometimes entered into in which the landlord furnishes only the land and the tenant the labor and work stock, the total earnings of the farm being divided equally. In case feeders are bought the owner advances half the money.

The 1915 census reports a total of 1,558 farms operated, representing a total of 258,246 acres. The total value of the farms was reported at \$32,895,578, or an average value per acre of \$127.38. Land values vary according to the improvements, the location with reference to towns and railroads, and the topography. The rough, strongly rolling land in the eastern part at some distance from a railroad sells for \$100 to \$150 an acre, while in the same vicinity smoothly rolling to undulating farms, located on the same type of soil, may bring \$200 an acre. Along the railroads near the principal towns land values range from \$200 to \$300. Throughout the greater part of the county farm land is held at \$185 to \$250 an acre.

SOILS.

Montgomery County is part of a great plain which has been deeply covered by two kinds of soil-forming material. The region was first overrun by a great continental ice sheet, which left a covering of *débris*, principally boulder clay. Later this was buried by silty material, known as loess, which was deposited over the surface to a depth varying from 8 to 12 feet. The underlying rocks outcrop through these superficial deposits in narrow ledges, but have not contributed directly toward forming any considerable areas of soil.

The soils of the area may therefore be divided upon the basis of origin and the process by which the soil materials were accumulated into three general classes—loessial, glacial, and alluvial. Soils which are similar as regards color, origin, chemical composition, topography, and structural characteristics are grouped into series. A further subdivision into types is based upon texture.

The superficial covering of loess is the parent material from which the greater part of the upland soil has been weathered. It is broken only by small patches of exposed drift and comprises more than two-thirds the total area of the county.

The loess in its unweathered condition is an even-grained material composed largely of silt and very slightly cemented with carbonate of lime. The color ranges from pale yellow to yellowish brown. The material has a rather coherent structure where undisturbed, but breaks down readily into a loose, floury mass. Under erosion it has a tendency to maintain vertical walls and to break in roughly vertical columns in exposed sections. The lime content in the original material was rather high, and a small percentage of iron is indicated by rusty blotches and streaks. The origin of loess is still a subject of disagreement among geologists, but the most generally accepted theory is that it represents in this area fine material deposited over vast areas by wind.

The soil in this area derived from the loess is classed with the Marshall series. The loess has been greatly changed and converted into its present state as a productive soil by the processes of weathering, by the accumulation of organic matter, and by slow chemical and physical changes. The dark color of the surface soil is due to the presence of black organic matter. Weathering and leaching have resulted in the partial removal of lime and other more soluble salts, and to the accumulation to a slight extent of the finer silt and clay in the subsoil. In the case of the Marshall silt loam the subsoil has not become heavier than a heavy silt loam or a light silty clay loam, and the structure is open and porous.

The glacial drift is exposed only in the rougher parts of the area, mainly where the deeply cut valleys have narrow bands of this material along the lower slopes. These are found in the eastern part, but

in other parts of the county small isolated patches occur on the points of hills where erosion has removed the mantle of loess. By a process of weathering similar to that which has taken place in the loess, the drift has been converted into a dark-colored soil of similar texture, but having a subsoil of more variable composition. Only one glacial type, the Shelby silt loam, was mapped. The drift soil has been modified in most places by loess washed in from the surrounding higher land. Small spots of soil apparently derived from sandy glacial deposits have been shown on the map as the Knox fine sand.

Strips of terrace and first bottoms border many of the larger streams. The sediments from which these soils have been built up represent reworked loessial soil with a small admixture of reworked drift. None of the terraces are old, and weathering has not advanced far beyond the stage of the upland soils. Only one type, the Waukesha silt loam, is mapped on the terraces.

The first bottoms, which include all land subject to overflow, have somewhat heavier soils than the upland. These soils are black in color, with subsoils heavier than the surface soils. The first-bottom soils are classed in the Wabash series.

The Marshall soils are brown to black, underlain by light-brown to yellow subsoils. The subsoil is silty, and is ordinarily little if any heavier than the surface soil. The Marshall series occurs within the prairie region of the central west. The topography varies from gently rolling to sharply rolling. As a rule the subsoil is calcareous, but in this county only in a few cases does the lower subsoil give a reaction.

The Shelby series has dark-brown to black surface soils and yellow to light-brown sticky sandy clay subsoils, often containing coarse gravel and sand. The soils in this area are derived through the weathering of the glacial till, but in many places have been modified or influenced by the loess. The topography varies from undulating to sharply rolling as the area occurs on slopes where the drift is exposed.

The soils of the Waukesha series are predominantly dark brown to black and the subsoils light brown to yellow. As a rule the subsoil is not compact and impervious, but it is a little heavier than the surface soil. The material forming these soils is derived from loessial uplands and represents old reworked deposits that now lie above overflow.

The Wabash series includes dark-brown to black surface soils and dark-brown, drab, or black subsoils. The content of organic matter in both soil and subsoil is quite high. Ordinarily the subsoil is quite heavy. These soils are subject to overflow, and the boundaries are gradually being enlarged owing to the addition of new sediments.

The following table gives the name and the actual and relative extent of the various soils mapped in Montgomery County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall silt loam.....	179,392	66.1	Wabash silty clay loam.....	2,112	0.8
Wabash silt loam.....	39,104	27.1	Knox fine sand.....	128	.1
Colluvial phase.....	34,496				
Shelby silt loam.....	10,368	3.8	Total.....	271,360
Waukesha silt loam.....	5,760	2.1			

MARSHALL SILT LOAM.

The surface of the Marshall silt loam is a brown to dark-brown silt loam 16 to 18 inches deep. Where the organic content is high the color is dark brown, and in plowed fields the soil when thoroughly wet has a black appearance. The subsoil is a yellowish-brown silt loam, containing iron stains in the lower part. Faint gray mottlings are encountered in the lower subsoil throughout the entire area. These do not seem due to poor drainage. The type extends over large areas without any perceptible variation in the color, texture, or depth of soil or subsoil.

On the crests of the broad, more level divides the surface soil is 2 to 4 inches deeper than the average and has a dark-brown color, due to the high organic content. This is particularly true in the vicinity of Wales and Wallin and on the "Frankfort Ridge." Bordering the stream courses in the eastern part of the county are narrow strips of rolling to strongly rolling country where erosion has been more active. Throughout such areas the surface soil has a lighter brown color and varies in depth from 10 to 14 inches. There is occasionally a noticeable content of very fine sand, but such areas are quite small and unimportant. In a few small areas of the type west of a north-and-south line drawn through Red Oak lime concretions and accumulations of lime carbonate occur in the lower subsoil. In a number of tests with acid the subsoil gave no effervescence except in such spots.

The Marshall silt loam is the most extensive soil type in Montgomery County. It occurs in large areas in all sections. Parts of Red Oak, Stanton, and Villisca are located on this soil.

The topography in general is undulating to rolling. Throughout the divide between the Nishnabotna River and Tarkio Creek, locally known as Frankfort Ridge, the surface is more level and undulating. Here the hill crests have been rounded off and the slopes are even and gentle, giving the general landscape a more level appearance

than really exists. Similar areas occur in the vicinity of Wales, east of Grant, along the Nishnabotna-Walnut Creek divide south of Salem Church, and throughout the divide between Tarkio Creek and West Nodaway River. Along the rivers and creeks of the eastern part of the county narrow strips often occur where erosion has been more active and the surface is more broken and strongly rolling. This is true of a small area along the east side of the Nishnabotna River in the vicinity of Stennett.

The elevation above sea level varies from approximately 1,050 to 1,260 feet. Drainage is good, the subsoil is retentive of moisture, and crops seldom suffer from excess moisture or drought. In the rougher sections the run-off is more rapid and some of the slopes suffer from erosion.

The Marshall silt loam is the most important agricultural type in Montgomery County. It includes scarcely any waste land, and approximately 95 per cent is under cultivation. The few tracts of timber scattered throughout the type are fast being cleared and put in cultivation. The tree growth consists mostly of soft maple, cottonwood, black walnut, red oak, bur oak, elm, and hickory. Wind-breaks, mostly of cedar, hemlock, mulberry, and Lombardy poplar, have been planted around the farm houses and orchards to give protection from the severe cold winds which are common during the winter months.

The most important crops on this type are corn, wheat, oats, and hay. The growing of corn is the principal industry. Wheat is the second crop in importance, and oats come third, occupying an acreage only slightly less than that in wheat. Hay, which is the fourth crop in importance, consists principally of alfalfa, clover, and timothy, the latter two often being grown together. Some oat straw is fed. As a rule the hay crop is not sufficient to meet the demands and a small quantity is shipped in each year. Considerable corn, oats, and hay is fed to the work stock and milk cows that are kept on nearly every farm, a small quantity is sold, and the remainder is used in the production of meat for market. A relatively small quantity of the corn is ground for home use. In years when few cattle are fed the excess corn is shipped to outside markets. Approximately a third of the oat crop is shipped out of the county each year. Wheat is the principal money crop. The wheat not needed for home use is either sold to elevators or hauled to flour mills at Red Oak, Stanton, Villisca, and Grant. The raising and fattening of hogs and the feeding of beef cattle and sheep are the principal live-stock industries. Of these hog raising is the most important. From 150 to 400 head are raised on each farm every year. Breeding herds of beef cattle are kept on a few farms, but as a rule the feeders are

bought in Omaha. An average of from 1 to 5 carloads per farm is shipped out each year. Dairying is conducted only on a small scale, to supply in part the demands of the towns. A small acreage, which is being increased each year, is devoted to sweet corn. The crop is hauled or shipped to the canning factory in Red Oak, where it is canned and resold in the county or shipped to outside markets. Barley, sorghum, flax, and rye are grown on a small scale. Melilotus grows wild and makes a valuable forage crop. Small orchards and gardens are maintained on nearly every farm, but fruit is not grown on a commercial scale.

Corn¹ on the Marshall silt loam yields 35 to 80 bushels per acre, the higher yield being obtained where crops have been carefully rotated and cared for. Wheat yields 15 to 20 bushels per acre, oats 40 to 60 bushels, rye 15 to 25 bushels, and hay 1 to 2½ tons.

The soil of this type is mellow and easily cultivated. It does not bake badly on drying and can be plowed under varying moisture conditions with equally good results. As the content of organic matter is naturally high the soil responds quickly to manuring, and with good methods of cultivation such as are practiced by the best farmers, the productiveness is easily maintained. Crops are generally rotated, the following rotation being in almost universal use: Corn is grown 3 to 5 years, when winter wheat or oats are seeded. The land is left in small grain for 1 or 2 years, then either seeded to timothy and clover or put in alfalfa, after which corn is again planted.

Cottonseed meal, oil meal, and tankage are shipped in in varying quantities each year to supplement the protein in the corn ration. Manure is carefully saved on most farms and applied to the land with a manure spreader. The application of lime has given excellent results.

Land of the Marshall silt loam sells at prices ranging from \$100 to \$300 an acre, according to location and improvements.

Crop rotations in which the legumes, alfalfa, clover, or soy beans, play an important part should be more extensively followed on this soil, and a large part of each farm should be kept in pasture. The growing and turning under of green-manuring crops would prove beneficial. Thorough preparation of the seed bed is very necessary for best results, and the land should be plowed deep and disked and harrowed thoroughly before planting. The steeper slopes should be terraced to prevent erosion.

The excellent results obtained on this type at the Iowa Agricultural Experiment Station indicate that the growing of apples on a commercial scale would be profitable. Wherever the trees are pruned

¹ Yields as given in this report are based on statements of farmers.

and sprayed good results are obtained. The varieties of apples that do best are the Jonathan, Grimes Golden, Winesap, Ben Davis, and Siberian Crab. In favorable years some peaches are produced, but the crop is very uncertain. The type is well suited to the growing of tomatoes, beets, cabbage, parsnips, potatoes, beans, eggplant, onions, and strawberries. The principal variety of corn is Reids Yellow Dent, but some Silver Mine and Boone County White are grown. The Kherson, Iowa 103, and Iowa 105 are the leading varieties of oats grown, while the Turkey Red and Iowa 404 are the most important varieties of wheat. Dairying is profitable and might be extended.

SHELBY SILT LOAM.

The surface soil of the Shelby silt loam is a brown silt loam or fine loam, 6 to 12 inches deep. The subsoil is a light-brown to yellowish-brown silty clay mottled with rusty brown, yellow, and gray. The line of demarcation between soil and subsoil is generally quite sharp. Varying quantities of small glacial gravel are mixed through the subsoil, and frequently a heterogeneous stratum of clay, gravel, and small boulders is encountered at 3 feet or more. The glacial boulders sometimes outcrop on hillsides or are exposed in road cuts. On the points of hills and along the steeper slopes where erosion has been more active the thickness of the surface soil varies from 4 to 6 inches, and very small "gall spots," where the surface soil has been entirely washed away, are not uncommon. Along these steeper slopes a very small amount of gravel is scattered over the surface, and in many places there is sufficient gravel in the subsoil to make it difficult to bore into. On some of the slopes the content of very fine sand is quite high, but such areas are small. In a few cases the subsoil is entirely free of gravel and grades into a steel-gray or bluish-gray plastic clay at 24 inches or more. As these different areas are extremely small and difficult to separate, they are included with the typical Shelby silt loam.

The Shelby silt loam is not an extensive type. It occurs principally in the eastern part of the county, but smaller areas are scattered throughout other sections. It usually occurs in narrow, ribbonlike bands bordering the lower slopes. The topography varies from gently sloping to steep. Surface drainage is good and the steeper slopes often suffer from erosion.

The Shelby silt loam is a relatively unimportant soil, although approximately 85 per cent of it is cultivated or in pasture. The timbered areas support a growth of red oak, bur oak, cottonwood, walnut, maple, hackberry, and mulberry.

The type is cultivated in conjunction with the associated Marshall or Wabash soils, and the same crops are grown. It is not as rich

or productive as the two adjoining types. Corn is the principal crop. Oats, wheat, rye, alfalfa, timothy, clover, and all kinds of garden truck are grown. A large area is devoted to pasture, and a few head of hogs and a small number of beef cattle are grazed each year. The steeper slopes are often difficult to cultivate and where cultivated erode badly.

This soil is handled in practically the same way as the Marshall silt loam. The fields are harder to cultivate, owing to the gravel and to the heavy clay subsoil, which often comes close to the surface. Springs and seepage places also interfere with cultivation to a certain extent, but are considered an asset where the land is used for pasture.

The Shelby silt loam is included in farms with the adjoining Marshall and Wabash soils and is only sold in conjunction with these types.

The Shelby silt loam can be improved by the same means that are suggested for the Marshall silt loam. The land should be kept covered as much as possible, to prevent erosion. The soil requires the addition of large quantities of manure and other organic matter for best results. The slopes should be carefully terraced to prevent the washing away of the surface soil. The steeper slopes should be used for pasture or left in timber.

WAUKESHA SILT LOAM.

The surface soil of the Waukesha silt loam is a brown to dark-brown silt loam, 15 to 18 inches deep. The subsoil to a depth of 36 inches or more is a yellowish-brown, heavy silt loam faintly mottled with gray. A few iron stains occur in the lower depths. After a heavy rain cultivated fields have a very dark brown to black color. The texture and color of the soil and subsoil are quite uniform throughout the entire area. West of Red Oak the type includes one small area which has a very dark brown to black subsoil, and which if more extensive would be mapped as Bremer silt loam.

Except for three small areas along Walnut, Tarkio, and Seven Mile Creeks, respectively, the Waukesha silt loam is confined to the second bottoms of the Nishnabotna, West Nodaway, and Middle Nodaway Rivers. The largest areas occur along the Nishnabotna in the vicinity of Red Oak and Elliott, and along the West Nodaway north of Villisca. The surface is level to very gently sloping. The type lies 15 to 20 feet above the normal level of the streams, and 1 to 6 feet above the first bottoms. It is not subject to overflow, and is generally well drained. The subsoil is retentive of moisture and crops seldom suffer from drought.

This is considered a valuable agricultural soil, and practically all of it is in cultivation or used for pasture. Corn occupies the largest

acreage, followed by oats, wheat, and hay. The hay crop consists principally of timothy and clover grown either separately or together; on many farms a small acreage is devoted to alfalfa. About a third of the total acreage is kept in pasture, as the type is well adapted to the growing of grass. All the corn, oats, and hay are used on the farms to feed the work stock, dairy cows, and beef cattle. A small part of the wheat crop is kept to supply the needs of the home; the remainder is sold. Several carloads of cattle are fed each year on nearly every farm, and from 150 to 350 head of hogs are raised and shipped. The cattle and hogs are generally sold to buyers who ship to the Omaha, St. Louis, and Chicago markets. Gardens and small orchards are maintained on nearly every farm. Dairying is engaged in on a small scale. Poultry raising is an important though subordinate interest.

Corn on this soil yields from 35 to 75 bushels per acre, oats 25 to 40 bushels, wheat 15 to 25 bushels, and hay 1 to 3 tons.

This soil is handled in very much the same way as the Marshall silt loam. Where corn is grown to succeed itself the stalks are cut by running a cutter over the field, and the ground is plowed 5 or 6 inches deep, after which it is disked twice in opposite directions and thoroughly harrowed. Where wheat follows oats or corn the same method is used, but if oats follow corn the land is disked and harrowed without replowing. The more progressive farmers employ systematic crop rotations. Corn is grown 2 or 3 years, oats 1 year, and wheat 1 year, with clover or clover and timothy sown with the wheat. After the wheat is harvested the clover and timothy is left for two years or more before the ground is returned to corn.

Commercial fertilizers are never used on this soil. Manure is applied wherever available. It is generally distributed over the land with a manure spreader.

Land of the Waukesha silt loam sells at prices ranging from \$150 to \$250 an acre.

The methods used for the improvement of the Marshall silt loam can be applied equally well to this type. Tiling would improve the physical condition of the soil and increase the yields.

WABASH SILT LOAM.

The surface soil of the Wabash silt loam consists of a dark-brown to very dark brown, mellow silt loam. It ordinarily extends to a depth of 14 to 18 inches, but in some places it reaches a depth of 22 inches. The subsoil is a very dark brown to black, heavy silt loam to silty clay loam, extending to a depth of 3 feet or more.

In depressed areas or where the type occupies a lower level the surface soil is very dark brown to black and the subsoil is heavier, ranging from a heavy silt loam to a silty clay. Throughout these

areas the soil in a few patches consists of Wabash silty clay loam. Where the underdrainage is poor a heavy, plastic clay, bluish gray to mottled grayish brown and yellow in color, is often encountered below 30 inches. North of Sciola the surface soil is somewhat lighter, ranging from brown to dark brown, and frequently the subsoil below 24 inches is a heavy, black silty clay. Along the banks of the streams in many places there are small areas of fine sandy loam and fine sand that would be mapped as Riverwash were they sufficiently large.

The Wabash silt loam occurs as broad, continuous bottom land along the Middle Nodaway, West Nodaway, and Nishnabotna Rivers, and Seven Mile, Tarkio, and Walnut Creeks. Narrow, less extensive areas occur along some of the other large creeks of the county. The most extensive developments are encountered near Elliott and south of Red Oak, where the bottoms of the Nishnabotna have a width of $1\frac{1}{2}$ to $2\frac{1}{2}$ miles.

The type has a generally level surface with a slight gradient toward the water courses, and lies 8 to 15 feet above the normal level of the streams. As a whole it is subject to overflow. Surface and subsurface drainage is inadequate. The run-off after rains is slow and frequently water stands in the depressions for long periods. At the foot of the upland slopes, where the bottoms are broadest, benchlike areas in places occupy a higher position. These areas are subject to overflow only at times of very high water, and as a rule they have better surface drainage and underdrainage than most of the type. Around some of the sharper bends of the rivers and creeks the type is subject to severe erosion.

The Wabash silt loam is an important soil agriculturally, though crops are somewhat uncertain on account of overflows. About 85 per cent of the type is either under cultivation or in pasture. Along the streams there remain a few timbered areas in which the growth consists principally of willow, cottonwood, box elder, ash, and walnut.

Corn occupies the largest acreage. It can be grown on the same land for years without showing any decrease in yield. Occasionally the entire crop is ruined by overflow, but the average yield for a term of years is large enough to make the crop profitable even under these adverse conditions. Part of the corn is used to feed the work stock and milk cows on the farm and a small quantity is ground for meal; the bulk of the crop is used in fattening hogs and beef cattle for market. In years when a small number of feeders are bought the surplus corn is shipped to outside markets. Oats is the crop of second importance. The Iowa 105 variety is particularly well adapted to this type of soil. About two-thirds of the crop is fed to work stock, the remainder being sold to elevators, and ultimately shipped out of the county. Wheat is the main cash crop. In favorable years good

yields are obtained, but ordinarily wheat is damaged during the winter by an excess of water in the soil and by heaving. All the crop above the home requirements is sold to flour mills within the county. A large acreage is seeded to grass, which is either cut for hay or pastured. Natural grasses grow rank on this type and furnish excellent pasturage for the large number of hogs and cattle usually kept. Rape is grown by a few farmers and furnishes excellent hog pasture. The main live-stock industries are the raising of hogs and the feeding of beef cattle and sheep. Dairying is of subordinate importance at present. One market garden is maintained, just north of Red Oak, to supply the demands of that city, while a number of farmers raise a large variety of vegetables, including tomatoes, potatoes, beans, cabbage, beets, eggplant, turnips, onions, and parsnips for home use. The excellent results obtained from the scattered apple and cherry trees indicate that the growing of these fruits could well be extended.

Corn on this soil yields from 35 to 60 bushels per acre, oats 38 to 50 bushels, wheat 16 to 25 bushels, and hay 1 to 3 tons. Irish potatoes yield from 60 to 100 bushels per acre.

Great care must be exercised to plow this type under the proper moisture conditions. If plowed too wet the soil is turned up in large clods, which bake on drying and make cultivation difficult. When the fields are very dry the plow also throws up large, compact clods that are hard to pulverize. This bottom land is scarcely ever broken in the fall. Where corn is planted year after year on the same piece of land it is plowed each spring to a depth of 4 to 6 inches, after which it is disked twice in opposite directions and further pulverized with a smoothing harrow. If oats follow corn the land is disked and harrowed without replowing, just as in case of the upland soils. Corn is grown 3 or 5 years and oats 1 year, timothy and clover seed being sown with the oats. After the second year the clover disappears and the timothy is pastured for a term of years. Wheat often follows oats for 1 year in the above rotation.

The selling value of land of this type ranges from \$100 to \$250 an acre, according to location and improvement.

For best results with the Wabash silt loam it is necessary to improve the drainage. The main stream channels should be straightened and deepened and the fields tiled. Where tiling can not be done open ditches would prove beneficial. Deeper plowing should be practiced and green-manuring crops turned under. The use of lime would prove beneficial, especially when the soil is well supplied with organic matter.

Wabash silt loam, colluvial phase.—Along the smaller creeks, branches, and drainage ways there occur strips of mixed alluvial and colluvial material varying in width from 50 feet to a quarter of a mile. The more recent colluvial material predominates here. These

areas are shown on the map as a colluvial phase of the Wabash silt loam.

The surface soil of this phase is a brown to dark-brown, mellow silt loam, 15 to 18 inches deep. The subsoil consists of a darker brown silt loam which extends to 3 feet or more. Frequently the dark-brown, chocolate-colored silt loam extends to a depth of 3 feet or more without an appreciable change in color or texture. Throughout the phase, especially along the larger creeks, there occur many areas of Wabash silt loam and Wabash silty clay loam too small to map separately. A few small bodies of purely colluvial material generally forming a narrow band along the foot of the more gentle slopes, are included.

The topography is level to gently sloping. Drainage is inadequate, and often the water table is only 3 to 7 feet below the surface. Water stands in the depressions for long periods during dry spells and these ponds often furnish water for stock the greater part of the time.

About 60 per cent of this phase is in cultivation, the remainder being devoted to pasture. Along some of the streams a few forested areas remain, the growth here consisting principally of willow, cottonwood, elm, red oak, and walnut.

Practically the same crops are grown as on the typical Wabash silt loam. The yields are also about the same on the two types. Corn occupies the largest acreage, and oats come second. Wheat, rye, barley, timothy, and clover give good results, though this phase is not considered as valuable for small grain as the upland soils. Where the fields have been tilled alfalfa is a profitable crop. A few fields of rape are grown for hog pasture. The areas of the phase that have poor drainage and dry out slowly are kept in pasture. Native grasses grow rank and furnish excellent grazing for cattle and hogs. Corn yields 35 to 70 bushels per acre, wheat 15 to 25 bushels, oats 25 to 40 bushels, and hay 1 to 2½ tons.

This phase is generally farmed in conjunction with the adjoining Marshall silt loam and Wabash silt loam. It is handled in practically the same way as the typical Wabash soil, and can be improved by the same methods. The land has about the same selling value. Tiling of the fields and straightening of the streams are the most important factors to be considered.

WABASH SILTY CLAY LOAM.

The Wabash silty clay loam to a depth of 12 to 16 inches is a very dark brown to black, heavy silty clay loam. The subsoil consists of a black to bluish-black, heavy, tenacious silty clay that becomes slightly lighter colored and more plastic in the lower depths. In places a

few iron stains occur below 24 inches. The areas of this type have a black appearance and stand out prominently from the associated Wabash silt loam. When wet the surface soil has an intense black color, and travel over the land is difficult, as the soil adheres to the wheels and is also very slippery. The dry fields have a finely checkered, crumbly appearance, as the soil usually bakes and forms crevices that extend to a depth of 1 or 2 feet. The color and texture of both the soil and subsoil are quite uniform throughout the areas of the type. This land is locally known as gumbo.

The Wabash silty clay loam is developed in comparatively small, disconnected bodies throughout the bottoms of the Nishnabotna and West Nodaway Rivers and Walnut Creek. The largest areas occur in the vicinity of Villisca and along the Nishnabotna south of Red Oak. It occupies areas lying 1 to 3 feet below the general level of the associated Wabash silt loam, and 10 to 15 feet above the normal water level of the streams. The surface is level to very gently sloping, and drainage is inadequate except in dry years. The type is subject to overflow.

Approximately 95 per cent of this type is under cultivation or in pasture. The tree growth consists principally of willow, with a few oaks, cottonwoods, and elms.

Corn, wheat, oats, and hay are the principal crops. In favorable years excellent yields of corn are obtained, and the crop is grown indefinitely on the same land without any noticeable decrease in yields. Danger of loss from overflow is the one adverse condition. All the corn produced is used on the farms. A small quantity is ground for meal; the rest is fed to stock. This is considered the best wheat land in the county provided the season is favorable. Wheat is the principal cash crop. Oats, particularly the Iowa 105 variety, do well. The hay crop consists principally of timothy and clover grown either together or separately. The entire crop is used within the county, the supply of hay being insufficient to meet the demand. In wet years water may stand on this soil until after the planting season. A large acreage is devoted to pasture, and the natural grasses do well. The live-stock industries consist of the raising of hogs and the feeding of beef cattle. No special crops are grown.

Yields on this type depend on the precipitation and drainage. Corn in good seasons yields from 35 to 75 bushels per acre, wheat 18 to 26 bushels, oats 35 to 55 bushels, and hay 1 to 2½ tons.

The Wabash silty clay loam is particularly rich in plant food, and commercial fertilizers and manures are never used. It is handled and cultivated in practically the same way as the Wabash silt loam, with which it is closely associated. Where the fields have been tilled or open ditches constructed the yields have increased.

Land values vary from \$100 to \$200 an acre, according to the location and improvements.

Improvement of the drainage is very necessary for best results with this soil. The streams should be straightened, and the fields tiled. Owing to the compact nature of the soil and subsoil the tiles must be placed close together, and tiling is therefore expensive. More care should be given to the preparation of the seed bed. The incorporation of organic matter in the soil would improve its physical condition, and the growing and turning under of green-manuring crops is recommended.

KNOX FINE SAND.

At several places in the county there occur pockets of sand which present a striking contrast to the surrounding soils. The most conspicuous deposit of this kind occurs about $1\frac{1}{2}$ miles north of Morton Mills on the east side of the Nodaway Valley. It occupies the crest of a hill and the slope toward the alluvial land. It consists of pale yellow fine sand that varies in depth from 1 to 10 feet. The area of next importance lies along the east bank of the Nishnabotna 3 miles south of Red Oak, and there are four small bodies along the east side of the West Nodaway between Villisca and Tenville. These last five areas are developed along the lower slopes, have been modified by wash from the Marshall soils, and consist of brown to brownish-yellow fine sand to a depth of 3 feet or more.

These deposits appear to consist of sandy glacial drift. As the sand is on high ground it has been blown and washed for some distance, so that the surrounding soils have been modified in a belt of considerable width. The more sandy areas have a low agricultural value.

SUMMARY.

Montgomery County is situated in the southwestern part of Iowa, one tier of counties separating it from Missouri on the south and Nebraska on the west. It is made up of 12 townships, and has a total area of 424 square miles, or 271,360 acres.

The topography varies from undulating and gently rolling to hilly, being prevailingly rolling. Conspicuous, broad, practically level bottoms are developed along the streams.

The elevation above sea level ranges from 1,003 to 1,260 feet, the greater part of the county lying between 1,100 and 1,250 feet. The general slope is toward the southwest.

The county is drained by the Nishnabotna, West Nodaway, and Middle Nodaway Rivers, and Seven Mile, Tarkio, and Walnut Creeks. These streams flow southwestward, and with numerous tributaries furnish excellent drainage for all parts of the county.

Montgomery County was formed in 1851. The population in 1915 was 17,297, the greater part of which is engaged in agriculture. The principal towns are Red Oak, which is the county seat, Villisca, Stanton, McPherson, Elliott, Grant, and Coburg. Smaller towns are scattered throughout the area.

Transportation facilities, except in the northeast corner of the county, are good. The main line of the Burlington System crosses the southern part. The public roads are good and are generally kept in excellent condition the greater part of the year. Four marked highways pass through the county.

Montgomery County is well supplied with rural-mail routes, telephone lines, churches, and schools. The principal outside markets are Omaha, St. Louis, and Chicago.

The climate is healthful. The mean annual temperature is 48.1° F. and the mean annual precipitation 32.81 inches. There is an average growing season of 161 days.

The agriculture consists principally of the growing of corn, wheat, oats, and hay, together with a few other crops for home use and for sale; the feeding of beef cattle; and the raising of hogs. Small orchards and gardens are maintained on nearly every farm. The raising of poultry and eggs is an important though secondary interest throughout the county.

The farms are generally well improved. The work stock consists mostly of horses of draft type. A number of farm tractors are employed, and improved machinery of all kinds is in general use.

Ordinarily crops are rotated to a certain extent, and systematic rotations are practiced by the more progressive farmers. Manure is generally saved and applied to the fields. The use of lime has proved profitable. Commercial fertilizers are never used.

All of the farm labor is white. The laborers are generally employed by the month, but during the husking season extra hands are hired and paid by the bushel.

The farms vary in size from 60 to 1,000 acres. The average in 1915 was 150.9 acres. Land values vary from \$100 to \$300 an acre, according to the improvements, topography, and location.

The soils of Montgomery County, with the exception of small areas scattered through the rougher sections that have been influenced by the outcropping glacial drift, are derived from the Missouri loess. They are quite uniform in both color and texture. Six types and one phase, grouped with five series, are mapped.

The Marshall silt loam is derived from the Missouri loess, and is the most extensive type in the county. It varies from undulating and gently rolling to hilly. Drainage is excellent, but as the subsoil is retentive of moisture crops seldom suffer from drought. Corn is the most important crop, followed by wheat, oats, timothy,

clover, alfalfa, rye, and barley. Apples and all kinds of garden truck do well. The crops are used mainly in the production of live stock.

The Shelby silt loam is developed principally throughout the rougher sections where the weathering of the outcropping glacial till has modified the Marshall silt loam. It is an inextensive and unimportant type and is only farmed in conjunction with the adjoining soils. Corn, wheat, oats, and hay are the principal crops.

The Waukesha silt loam represents old alluvium occupying second terraces lying above overflow. Small areas are developed throughout the broader bottoms, the largest bodies occurring in the vicinity of Elliott and Red Oak. The type is well adapted to corn, wheat, oats, timothy, clover, barley, rye, and garden truck.

The Wabash silt loam, the principal bottom type, is developed in large, continuous areas along the rivers and larger streams. It is subject to overflow, and its crop adaptation is somewhat limited on this account. It is particularly rich in plant food and under ordinary conditions is the best corn soil in the area. Winter wheat is liable to suffer from freezes and the heaving of the ground. This soil is well adapted to pasture. Its colluvial phase occurs along the smaller creeks and streams, and represents the more recent deposits washed from the Marshall silt loam. The phase is subject to overflow and dries out very slowly. About 50 per cent of it is farmed in conjunction with the Marshall silt loam and the remainder is used for pasture.

The Wabash silty clay loam is developed throughout the first bottoms of the Nishnabotna River, Nodaway River, and Walnut Creek. It occupies depressed areas lying 1 to 3 feet below the ordinary level of the adjoining Wabash silt loam. Naturally it is a very strong, rich soil, but the liability of overflow makes the production of crops uncertain. In good seasons it is considered the best wheat land in the county. The greater part of the type is devoted to pasture.

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