U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE IOWA AGRICULTURAL EXPERIMENT STATION,
C. F. CURTISS, DIRECTOR; W. H. STEVENSON, IN
CHARGE, SOIL SURVEY.

SOIL SURVEY OF RINGGOLD COUNTY, IOWA.

BY

E. C. HALL, IN CHARGE, AND W. E. THARP, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND F. B. HOWE, OF THE IOWA AGRICULTURAL EXPERIMENT STATION.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets, Field Operations of the Bureau of Soils, 1916.]

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1918.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., June 15, 1917.

SIR: In the extension of the soil survey in the State of Iowa during the field season of 1916 a survey was undertaken in Ringgold County. This work was done in cooperation with the Iowa Agricultural Experiment Station, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1916, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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SOIL SURVEY OF RINGGOLD COUNTY, IOWA.

By E. C. HALL, In Charge, and W. E. THARP, of the U. S. Department of Agriculture, and F. B. HOWE, of the Iowa Agricultural Experiment Station.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Ringgold County is situated in the southwestern part of Iowa, bordering the State of Missouri. It is 80 miles southwest of Des Moines, Iowa, and about 70 miles northeast of St. Joseph, Mo. It is the fourth county east of the Missouri River. Ringgold County is bounded on the north by Union County, Iowa; on the east by Decatur County, Iowa; on the south by Harrison and Worth Counties, Mo.; and on the west by Taylor County, Iowa. Its area is 540 square miles, or 345,600 acres.

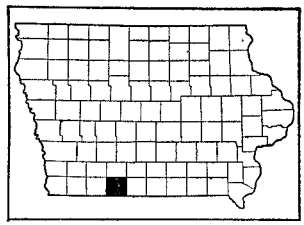

FIG. 1.—Sketch map showing location of the Ringgold County area, Iowa.

Physiographically Ringgold County is a plain incompletely dissected by erosion. It constitutes a part of the so-called loess plain of southern Iowa and northern Missouri and is probably a part of the loess plain of central Nebraska, having been cut off by the erosive work of the Missouri River. The upland of Ringgold County was undoubtedly at one time a smooth to gentle undulating plain, but the surface is now prevailingly undulating and gently rolling to rolling, as a result of stream erosion. In some areas there has been little erosion and the surface is still smooth, but the greater part of the county is gently rolling or rolling. Numerous valleys have been cut into the upland, mainly in a nearly parallel north and south direction. The broad intervening belts have been in turn dissected by small drainage ways which enter the larger valleys from the east or west, forming many smaller ridges or divides with an east and west trend. Many of the slopes near the streams are forested with a thick growth of oak, hickory, hazel, and other trees and shrubs. There is considerable local variation in the upland surface. In the south-central and northeastern parts of the county the surface is prevailingly rolling, as is the case in various smaller areas along stream courses. There are many steep slopes, comparatively deep valleys, and very narrow, ridgelike divides, which, however, are nearly level across the tops. From the southern part of the county northward the slopes gradually become more gentle and the ridges

and divides broader and more nearly level. In some parts of the county as south of Kellerton, southeast of Ellston, south of Tingley, and west of the Platte River, much of the upland is undulating to gently rolling, the stream divides being in places several miles wide. There are very few upland areas with an apparently dead level surface.

The larger streams have cut valleys 75 to 125 feet below the general upland level. The deeper valleys are those of the Platte River, the East and West Forks of Grand River, and Sand Creek. In general, the larger valleys are wide, with nearly level floors, with old channels, ponds, and cut-offs or ox-bow lakes near the river channels. The stream channels usually lie near the mid-line of the alluvial belts. As a rule the upland slopes are steep on one side of the valley and gentle on the other. The stream bottoms vary in width from one-eighth mile to 1½ miles. Much of the bottom land is subject to overflows, which usually occur in the spring. Parts of the bottoms were originally forested with walnut, elm, oak, hickory, cottonwood, ash, maple, hazel, haw, plum, and other trees, with considerable undergrowth.

Stream terraces or second bottoms are not extensively developed in Ringgold County. A few level to faintly undulating terrace areas occur along the Platte River and the East and West Forks of Grand River, rising to a maximum elevation of 20 feet above the adjoining first bottoms. A few of the terrace areas rise gradually from the first bottoms to the upland, and in some places there is no sharp line of separation between the terraces on one side and the upland or first bottoms on the other. The terraces range in width from about 100 to 1,200 yards.

There is little range in the upland level of the county. Mount Ayr lies 1,246 feet above sea level; Shannon City, on the north county line, 1,153 feet; Redding, 1,173 feet; and near Benton, on the West Fork of the Grand River, the elevation is 1,157 feet. The general slope of the county is southward.

Ringgold County lies within the Missouri River basin. About four-fifths of its area is drained into the Grand River through Sand Creek, the East and West Forks of Grand River, and Lots Creek. These streams occupy deep channels and are slowly cutting them deeper. Their valley walls are gently sloping near the headwaters of the streams, but become steeper with increased distance southward. The western fifth of the county is drained by the Platte River, which discharges into the Missouri River a few miles northwest of Kansas City. All the larger streams have sluggish currents and follow meandering courses. Small intermittent tributaries reach every part of the county and drainage is practically everywhere good and in places excessive. Only a very small area of upland is poorly drained and

there is not one square mile of land in the county without a drainage outlet. The streams can not be depended upon to furnish sufficient water for stock throughout the year and the permanent supply is obtained from bored wells. A large number of farms are equipped with gasoline engines or windmills for pumping water.

The early settlers in this territory came largely from Missouri, Illinois, Indiana, Ohio, and Kentucky. The first permanent settlements were made in the southeastern part of the county, about 1844. The pioneers made their homes adjacent to stream courses, where there was shelter from the cold and where fuel, water, and game could be most readily obtained. Ringgold County was created by an act of the Iowa Legislature February 4, 1851. The Federal census reports the population of the county in 1910 as 12,904. The State census for 1915 reports the population as 13,280. The entire population is classed as rural, and settlement is well distributed over the county. About 98 per cent of the people are native Americans. About 200 Bohemians have settled on farms in the vicinity of Diagonal within the last 20 years. There are practically no negroes in the county. Mount Ayr, the largest town and the county seat, is situated near the center of the county. It had a population of 1,646 in 1910. Other locally important towns are Redding, Maloy, Delphos, Diagonal, Benton, Knowlton, Tingley, Beaconsfield, Ellston, and Kellerton. Ringgold County has no important manufacturing industries. Its interests are almost exclusively agricultural.

The county is well provided with transportation facilities. A line of the Chicago Great Western from Des Moines to Kansas City traverses the western part, passing through Shannon City, Diagonal, and Benton. At Diagonal this road crosses the Keokuk and Red Oak Branch of the Chicago, Burlington & Quincy, which traverses the northern part of the county in an east and west direction, passing through Tingley, Beaconsfield, and Ellston. The Togo and Albany Branch of the same system traverses the southwestern and central parts of the county, passing through Redding, Delphos, Mount Ayr, and Kellerton. These various lines afford ready communication with Kansas City, St. Joseph, Omaha, Chicago, and Des Moines. The public roads of the county follow land lines. They are in good condition the greater part of the year. Rural mail-delivery routes and telephone service reach every part of the county. Mount Ayr and other towns serve as local markets and as shipping points for the larger markets of Kansas City, St. Joseph, Des Moines, and Omaha.

CLIMATE.

Ringgold County has a temperate, healthful climate, well suited to general farming and stock raising. Total crop failures never occur.

The mean annual precipitation as recorded at Mount Ayr is 35.47 inches. About 70 per cent of the annual rainfall occurs during the growing season, and when the precipitation is well distributed it is ample for all the common crops. The months of May, June, and July have the heaviest precipitation. In the driest year on record, 1901, the precipitation amounted to 27.4 inches, and in 1909, the wettest year, to 52.97 inches. Droughts sometimes occur during the summer months, and if they are of several weeks' duration growing crops suffer severely. The rainfall is lightest during the fall and early-winter months, or the harvesting period.

The mean summer temperature is 73.6° F. Periods of excessive heat are common. The winters are generally cold, the mean winter temperature being 24.5° F. Short periods of intense cold often occur, and are sometimes accompanied by cold winds, which are severe on live stock. Groves of evergreens and other trees have been planted on some farms to serve as shelter for stock. Forested areas along streams are also used for this purpose.

The earliest killing frost recorded in the fall occurred September 22, and the latest recorded in the spring on May 10. The average date of the first killing frost in the fall is October 11, and that of the last in the spring April 26. There is thus an average growing season of 168 days. Crops are usually well matured before the occurrence of frost. The average grazing season is about 215 days in length.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation, and the precipitation in the wettest and the driest years on record, as compiled from the records of the Weather Bureau station at Mount Ayr:

Normal, monthly, seasonal, and annual temperature, and precipitation at Mount Ayr.

Month.	Temperature.	Precipitation.		
	Mean.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1909).
	°F.	*Inches.*	*Inches.*	*Inches.*
December	27.0	1.39	1.24	2.63
January	21.8	1.07	.76	1.60
February	24.6	1.38	1.52	1.90
Winter	24.5	3.84	3.52	6.13
March	36.8	1.88	3.04	1.84
April	51.2	3.15	2.22	5.55
May	62.2	5.70	2.90	4.85
Spring	50.1	10.73	8.16	12.24

Normal, monthly, seasonal, and annual temperature, and precipitation at Mount Aur—Continued.

Month.	Temperature.	Precipitation.		
	Mean.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1909).
	°F.	*Inches.*	*Inches.*	*Inches.*
June	70.6	4.84	4.59	8.11
July	76.0	4.67	3.62	12.20
August	74.1	3.50	.75	1.38
Summer	73.6	13.01	8.96	21.69
September	65.9	3.58	3.12	4.30
October	53.6	2.79	2.36	4.32
November	37.9	1.52	1.28	4.29
Fall	52.5	7.89	6.76	12.91
Year	50.1	35.47	27.40	52.97

AGRICULTURE.

The early settlers in this region made their living largely by hunting and trading. They had their homes along the streams, where wood and water were abundant and where the forest growth afforded protection from the winter winds. As the population increased settlements were made on the prairie lands, and grain growing and the feeding of live stock became the principal farming practices. Luxuriant native grasses furnished excellent pasturage for horses and cattle, and hogs fattened upon nuts and acorns in the woods. As larger numbers of farmers settled in the county, gradual changes took place in the farming methods. Since the construction of railroads and the introduction of improved farm machinery progress has been rapid. The table below shows the acreage and production of the principal crops as reported by the censuses of 1880, 1890, 1900, and 1910:

Acreage and production of the principal crops.

Census year.	Corn.		Hay and forage.		Wheat.		Oats.	
	Acreage.	Production.	Acreage.	Production.	Acreage.	Production.	Acreage.	Production.
		Bushels.		*Tons.*		*Bushels.*		*Bushels.*
1880	68,857	2,689,549	15,127	18,433	10,179	86,115	13,836	411,840
1890	70,921	2,830,875	64,082	82,135	256	3,342	27,345	912,973
1900	90,276	3,282,530	63,140	81,149	270	1,870	27,189	810,200
1910	68,968	1,453,248	63,232	73,387	3,433	37,780	26,767	559,691

Corn, hay and forage, oats, and wheat are the principal crops of Ringgold County. All these crops except wheat are grown principally for subsistence, the surplus being sold. The principal hay crops are mixed timothy and clover, occupying 45,163 acres in 1909; timothy alone, occupying 12,142 acres; millet, grown on 848 acres; and clover alone, on 565 acres. Alfalfa, rye, flax, kafir, sorghum, and rape are grown in small fields for local use, and potatoes and other garden products are grown to some extent on practically every farm. The 1910 census reports 138,704 fruit trees in the county, principally apples, peaches, and plums. There were 14,322 grapevines in 1909, producing 150,064 pounds.

The 1910 census reports 39,161 head of cattle, 14,707 horses, 1,079 mules, 47,031 hogs, and 15,350 sheep in the county. Nearly every farmer sells a few head of stock each year. There are no large commercial dairies in the county, but a few small dairies are operated near the larger towns. A large number of farmers milk a few cows each and sell the cream to local creameries. Cattle feeding is an important industry, a large number of feeders being shipped in each year to be fattened for market. In 1909 there were 24,806 head of cattle, 58,089 hogs, and 5,558 sheep sold or slaughtered on farms. The raising of live stock could well be extended in Ringgold County. Cattle raising in particular would probably be more profitable on the rougher uplands than the growing of cultivated crops, as good grazing can be had the greater part of the year on slopes that are too steep to cultivate with safety. The excellent bluegrass pastures, the abundant water supply, the good transportation facilities, and the ready access to large markets combine to favor stock farming. This branch of agriculture at present consists mainly of fattening feeder cattle, which are largely shipped in in the spring from Kansas City and St. Joseph. They are kept on pasture until late in the fall and marketed as grass fed. The stock is wintered on silage and hay. The cattle are mostly of the Hereford, Shorthorn, Angus, Red Poll, and Durham breeds.

Hogs are, as a rule, more profitable than cattle. They are put on the market usually when 6 to 10 months old. Practically no hogs are shipped into Ringgold County. The most popular breeds are Poland China, Duroc, Berkshire, Chester White, and Tamworth. Sheep raising is of minor importance as compared with cattle and hog raising. There is an increasing tendency toward improving the types of stock. At the present time few herds of cattle consist exclusively of pure-bred stock.

The relative importance in different parts of the county of the three principal lines of farming, viz, general farming, the raising and fattening of live stock, and hay production, depends to some extent upon the character of the soil and the topography. General

farming is more extensively developed in the smoother, more nearly level parts of the county, where the Grundy silt loam predominates. Hay production and stock raising predominate in the rougher areas, occupied largely by the Shelby loam. A large proportion of the bottom land is not tillable, owing to spring overflows, and is used largely for pasture. Where cultivated, the bottom land soils are used principally for corn and other general-farming crops. The acreage devoted to grass is probably increasing at a faster rate than that devoted to any other crop, but wheat, alfalfa, and sweet clover are also becoming more important. The Grundy silt loam is recognized as best adapted to all the common crops, and it is used largely for general farming. The Shelby loam is devoted largely to grass, because of its tendency to erode badly when in cultivation.

An extensive type of farming is carried on, and the size of the farms has a tendency to increase rather than decrease. This tendency is encouraged, to some extent, by the development of the live-stock industry and the introduction of labor-saving farm machinery.

In most parts of Ringgold County the farms are well equipped, and good farming methods are followed. Nearly all the farmers use 2 to 5 horse turning plows, disk plows, spring-tooth or spike-tooth harrows, riding cultivators, mowing machines, manure spreaders, hay stackers, hay loaders, rakes, grain binders, and corn binders. Gasoline engines are used for power on many farms. Thrashing machines move from farm to farm in the fall. The farm houses, as a rule, are large and well built. Many of the barns are large, with large mows for the storage of hay and grain.

In preparing the seed bed for corn the land is plowed generally in the late summer or fall and allowed to remain rough until spring. The average depth of breaking is 5 or 6 inches, but some farmers break 7 or 8 inches deep. The depth depends largely upon the structure of the soil. Corn is planted between the last week in April and June 1. Practically all the crop is check-rowed. Over almost the entire county the land is carefully harrowed immediately after planting, as the rolling surface causes washing away of the seed. This begins in the track left by the wheel of the corn planter, and in some cases whole fields of corn have been lost by neglecting to stir up the soil in the wheel track. Corn is cultivated three to five times, depending upon the season. Much of the corn is used for ensilage, other crops seldom being used for this purpose. Corn is gradually being grown more extensively for forage. Part of the crop is cut and shocked in the field to be shredded or fed whole, but most of it is husked, the stalks being pastured during the winter. In some cases rape or cowpeas are sown in corn fields at the last cultivation, to be "hogged down" in the fall. This is an easy means of enriching the

soil. The principal varieties of white corn grown are Boone County White, Iowa Silver Mine, and Johnson County White. Reids Yellow Dent is the most popular variety of yellow corn. In 1909, according to the census, the average yield of corn for Ringgold County was 21 bushels per acre. In a normal year the average yield at present is probably at least 30 bushels per acre.

Oats almost invariably follow corn. The land is prepared by disking and harrowing. Oats are usually sown broadcast, but some farmers drill the seed. The crop is considered less profitable than some other grains, but it fits in well with corn growing. Oats are usually cut with a binder and thrashed from the shock. They are used principally as feed for work stock, but part of the crop is sold. The straw is valuable for roughage and bedding. The principal varieties of oats grown are Early Champion, Red Rustproof, and Swedish Select. The average yield for the county in 1909 was almost 21 bushels per acre.

Wheat has been of little importance during the last few years, but its acreage is steadily increasing. The crop usually follows oats or corn. When oats are the preceding crop the ground is plowed in late summer. Following corn the land is merely disked thoroughly and harrowed. The seed is drilled in between September 1 and October 1. Practically all the wheat grown is of the winter varieties, principally Fultz and Turkey Red. Wheat is grown by many farmers as a source of revenue or as a nurse crop for clover and timothy. The Hessian fly is a troublesome wheat pest.

Hay and forage crops include timothy, clover, bluegrass, alfalfa, sweet clover, and prairie grasses. Timothy and clover mixed, and timothy alone are the principal hay crops. Many farmers grow timothy for seed. After harvest the hay lands are used for pasture. Fields are often kept in timothy sod for long periods of time, resulting in decreased productiveness of the soil and an inferior quality of hay. Timothy alone on the average gives slightly lower yields than timothy and clover mixed. The combination yields 1 to 4 tons per acre. Clover is an important crop, not only for its value as hay but also on account of its effect on the soil. As the productiveness of the soil decreases more attention is paid to growing the leguminous crops, such as clover and alfalfa. Attempts to grow alfalfa have been only fairly successful, but the crop is in only an experimental stage, and it is quite possible that it can be made very profitable. Bluegrass does remarkably well, and is used exclusively for pasturage, about 1½ acres being sufficient to support one steer on soils of average productiveness. Bluegrass pastures if not grazed too closely make enough growth to furnish late pasturage. Sweet clover grows luxuriantly along road cuts, especially where the subsoil of the Shelby loam is exposed. The acreage in this crop is being grad-

ually extended. Millet, rape, sorghum, and rye are grown to a small extent, millet and sorghum usually being sown together and harvested for winter roughage.

No systematic crop rotation is generally practiced, but a large number of farmers are beginning to rotate crops. Many farmers alternate corn and oats, from year to year, and on some farms a rotation consisting of corn, oats, and timothy or mixed timothy and clover is followed. Probably the most successful rotation in use consists of corn, oats, wheat, and timothy or mixed timothy and clover. In many instances fields are seeded to corn year after year, until the yield begins to decrease, when the land is kept in pasture for several years.

Little commercial fertilizer is used in this county. Some farmers use bone meal or acid phosphate on wheat, especially when clover and timothy are to follow. The application of ground limestone or lime is necessary in some areas to obtain a stand of clover or alfalfa. Practically all the barnyard manure produced is utilized. It is generally distributed with a manure spreader on corn or grass land.

Most of the farm laborers employed are native Americans. Labor is scarce, as there is usually little demand for farm hands except during the busy seasons. Many farmers, however, hire farm hands for the entire year, paying $25 to $35 a month, with room and board. Day laborers during harvest season are paid $2 to $3 a day, and at other times $1.50 to $2 a day.

Farms in Ringgold County range in size from 40 acres or less to several thousand acres. The average size in 1910 is reported by the census as 158.5 acres, an increase of 24 per cent over the average size in 1880. The census reports a total of 2,053 farms in the county in 1910, comprising 94.2 per cent of its area. Approximately 90 per cent of all land in farms is reported improved.

In 1910, 68.7 per cent of the farms were operated by owners, 30.2 per cent by tenants, and 1.1 per cent by managers. General-farming land rents for $5 to $8 an acre, and pasture land for $2 to $2.50 an acre. Under the share system most commonly practiced the owner furnishes only the land and receives one-half the crops.

Land values vary with the location of the farm with reference to markets and transportation facilities and, to a slighter degree, with the topography, character of the soil, and improvements. Land values are steadily increasing, but they are still much lower in this section of the State than in any other. Throughout the greater part of the county farm land is held at $50 to $125 an acre. Some land may, however, be bought for less than $50 an acre, and as much as $150 an acre would be asked for some farms. The average value of farm land in 1910 is reported by the census as $58.71 an acre.

SOILS.

Ringgold County lies in the Glacial and Loessial province of the United States. The soils are derived mainly from two layers of material overlying the country rock. The top layer, considered loess by some investigators, is composed of fine-textured silty material, predominantly free from stone, gravel, and sand. It is reasonable to believe that it originally covered the entire county, having been deposited to a depth of possibly 15 to 20 feet over the underlying Kansan drift. With the development of the present drainage system much of this loess mantle has been removed, and it now ranges in thickness from a few inches to possibly 15 feet, depending upon the degree of erosion to which it has been subjected. From this loessial layer the Grundy and Clinton silt loams have been formed. The Clinton soil is light in color, while the Grundy soil is dark because of the organic matter it contains, resulting from a heavy growth of grasses and other prairie plants. The Clinton soil on the other hand developed under a forest cover. The subsoils of both these types are heavier than the surface soils, ranging from silty clay loam to clay. The seeping or leaching action of rainwater has carried the finer particles downward from the surface soil into the subsoil, giving rise to a predominantly clay texture. The Grundy and Clinton soils occupy the higher uplands of the county and probably lie at the original prairie level.

The Kansan drift immediately underlying the mantle of silty loess consists of a mixture of rock, gravel, sand, silt, and clay deposited during the glacial period. Its thickness varies with the degree of erosion to which it has been subjected, ranging from about 50 to 200 feet or more. It is so thick that the underlying consolidated country rock is nowhere exposed. Calcareous mud and limestone are encountered at depths of 100 to 150 feet in places. The drift material in its unchanged condition consists of a bluish, gritty, sticky clay, containing sand, stones, and small bowlders in varying quantities. At depths of 3 to 8 feet it is rich in lime occurring in the form of concretionary nodules. The gravel and small bowlders are made up of greenstone, granite, gneiss, limestone, and quartzite. The most conspicuous rock is red Sioux quartzite. These rocks are foreign to this locality, and at least part of the drift material has been transported from a great distance. The drift contains few bowlders larger than 1 foot in diameter. The various agencies of weathering have changed the upper part of the layer of Kansas drift, where exposed or brought near the surface, into soil. The virgin bluish-drab color has been changed to shades of yellow and brown. The Shelby loam is the predominant soil derived from this material. It is dark colored at the surface, and has a heavy, sticky,

gritty subsoil, usually yellowish brown in color. The Lindley silt loam, which is also considered of glacial origin, really represents a mixture of the loessial and glacial layers. Its surface soil is predominantly silty, while its subsoil is sandy and gritty, resembling that of the Shelby loam. The Lindley soil is light colored and supports a timber growth. The Shelby and Lindley soils occupy slopes and low ridges, lying below the original upland occupied by the Grundy and Clinton silt loams.

The alluvial soils of Ringgold County consist of sediments washed from the uplands of this and adjacent counties and deposited by streams on their flood plains at times of overflow. In the present flood plains, or first bottoms, they consist of recent alluvium, still subject to reworking and to further accumulation at flood stages of the streams, but on the higher lying terraces or second bottoms, which lie farther back from the stream channels and represent former flood plains now standing mainly above overflow level, the soils consist of older alluvium. Near the heads of the smaller streams much of the material is colluvial, having been washed from the near-by slopes, but it differs little from the true alluvium in composition, structure, or other characteristics. The alluvial soils are prevailingly dark colored. The surface material is predominantly a silt loam, and the subsoils are heavier. The alluvial soils in the first bottoms are classed in the Wabash series and on the terraces in the Chariton and Bremer series.

The surface soils of the Grundy series range in depth from about 6 to 20 inches, averaging about 10 inches in Ringgold County. The material is very dark brown or black to a depth of about 3 inches, below which it is somewhat lighter in color, being faint gray in some recently plowed fields. There is a gradual change to the subsoil, which in its upper part is a dark-drab silty clay loam, mottled with yellow and brown. With increased depth it becomes gradually heavier and changes to a clay. Drab and yellow colors predominate in the lower part of the 3-foot section. The topography is undulating to gently rolling.

The Clinton series differs from the Grundy in the lighter color of its soils and in its more rolling topography. The surface soils, extending to an average depth of about 6 to 10 inches, are pale grayish yellow in color, appearing brown when wet. There is a gradual change to the subsoil, which is usually a compact, light yellowish brown, silty clay loam streaked with gray in places.

The surface soils of the Shelby series are brown to dark brown in color, and have an average depth of about 6 inches. The subsoils consist of yellowish-brown, gritty, sticky clay, mottled with drab in the upper part. The lower subsoil and the substratum are highly calcareous. The topography ranges from gently rolling to steep, and

drainage is thorough or excessive. The surface is more rolling than that of the Grundy and Clinton soils, and there is a larger content of grit and gravel in both soil and subsoil.

The Lindley series is characterized by light-brown surface soils underlain by yellowish and brown, heavy textured, gritty subsoils, which may be mottled with gray. The upper soil in this county is derived in part from weathered loess or silt, while the subsoil is made up of weathered glacial till. Only one type, the silt loam, is mapped, but this includes various textures. The Lindley soils differ from the Shelby in being light colored and in supporting a heavier forest growth. They differ from the Clinton in having a gritty clay subsoil.

The surface soils of the Wabash series are dark brown to black, underlain by slightly light colored subsoils, which may be drab mottled with gray or brown. The soils are strong and productive, but they are subject to overflows and are often poorly drained.

The Chariton series includes dark-colored surface soils resting upon a 6 to 10 inch subsurface layer of ashy-gray silt which is abruptly underlain by a heavy, impervious subsoil. These soils occupy low second bottoms, which are not entirely above overflow level.

The Bremer soils are dark brown to black, underlain by heavier subsoils of a dark-drab or black color. These soils occupy low terraces, which are in places subject to overflows. They differ from the Wabash soils only in their slightly higher position.

In the following pages of this report the various soil types mapped in Ringgold County are described in detail and discussed in their relation to agriculture. The name and the actual and relative extent of each are shown in the table below:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Shelby loam	170,240	49.3	Clinton silt loam	1,536	.4
Grundy silt loam	114,688	33.2	Chariton silt loam	896	.3
Wabash silt loam	29,440	14.4	Bremer silt loam	768	.2
Colluvial phase	19,904		Bremer silty clay loam	320	.1
Gray-subsoil phase	512				
Lindley silt loam	4,288	1.2	Total	345,600	
Wabash silty clay loam	3,008	.9			

GRUNDY SILT LOAM.

The surface soil of the Grundy silt loam is a very dark brown to almost black silt loam, appearing dark gray in recently plowed fields when dry. It extends to an average depth of about 10 inches and

grades into a subsoil of dark-drab, light silty clay loam mottled with yellow and rusty brown. With increased depth the subsoil becomes heavier in texture and more yellow in color. In the lower part of the 3-foot section it is a heavy, tenacious clay.

The loessial material from which this soil has originated ranges from about 4 to 20 feet in depth in different parts of the county. In the southern part it is very much shallower than elsewhere, and some sand or gravel may be encountered in the lower subsoil here. The Grundy silt loam is, however, typically free from grit in either soil or subsoil. In the northern and western parts of the county, where the stream divides are wider than elsewhere, the surface soil is prevailingly several inches deeper than in the more eroded areas, ranging in depth from about 8 to 18 inches. It is possible that some small areas of Shelby loam are included with the Grundy silt loam, as it is practically impossible to draw an exact boundary between the two soils where they occur closely associated. In a few places where this type appears to occupy almost perfectly level areas, as 1 mile south of Tingley and southeast of Ellston, there is a faintly developed layer of gray silt between the surface soil and the subsoil.

The Grundy silt loam occurs more or less extensively in all parts of the county. It covers a large percentage of the western and northern parts. The type occupies the highest upland situations. In the more eroded parts of the county it occurs on long, narrow ridges along the tops of divides or in small isolated areas which are remnants of formerly existing ridges. In the more nearly level parts of the county it occurs on smooth uplands and in many places on long, gentle slopes. Its topography is prevailingly level to gently rolling. The surface run-off and the internal drainage are good. Only a few almost flat areas are without a drainage outlet.

This is an extensive and important soil. Practically every acre of the type is tillable, and most of it is under cultivation or in pasture. The soil is locally known as "prairie." It was never forested, but may have supported a sparse growth of brush and some scattered trees. The native vegetation consisted of prairie grass or bluestem.

This soil is strong and productive, and it is recognized as the best soil in the county for all the common crops. Corn probably occupies the largest acreage, followed by oats, hay, and wheat. Wheat is exclusively a money crop. Corn, oats, and hay are used largely to feed work stock, hogs, and cattle. Alfalfa, rape, sorghum, rye, sweet clover, and millet are grown in a small way. The main live-stock industries consist of raising hogs and feeding steers for market. A few cows are kept on most farms and small quantities of cream are sold to local creameries. Corn yields 30 to 75 bushels per acre, oats 25 to 55 bushels, and wheat 15 to 35 bushels. Timothy alone or mixed

timothy and clover yields 1 to 4 tons of hay per acre. Alfalfa and sweet clover are grown only in an experimental way. This soil is easily handled. It dries quickly after rains and does not clod or bake badly if properly tilled. It is readily improved by manuring and can be kept in a productive condition.

There are few farms in the county situated on this soil alone. Farms composed wholly or largely of the Grundy silt loam have a selling value of $75 to $150 an acre.

This soil would be benefited by the use of lime, as it shows an acid reaction with litmus. One of its principal needs is a greater content of organic matter which can most readily be supplied under a system of more extensive live-stock farming. Barnyard manure should be liberally applied and crop rotations, including legumes to be used as green manures, should be followed. Alfalfa should be grown more extensively. It can be successfully seeded if proper methods are used. A good rotation in a system of live-stock farming consists of corn for two years followed by oats and this crop by grass for about three years. This soil is not eroded as badly or as readily as the Shelby loam, but it is washed to some extent at each rain. Where practicable a cover crop should be grown during the fall, winter, and spring and the soil should be kept in grass as much of the time as possible. Small ditches and washes should be stopped as soon as they appear. Tenant farming, as at present carried on, is not wholly satisfactory to owner or tenant. Plans should be made by which the productiveness of this soil on the tenanted farms could be maintained.

The following table gives the results of the mechanical analyses of samples of the soil and subsoil of the Grundy silt loam:

Mechanical analyses of Grundy silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
331603, 331615.....	Soil.....	0.2	0.6	0.4	1.0	5.2	66.8	25.6
331604, 331616.....	Subsoil.....	.2	.6	.4	1.3	4.6	63.9	28.9

CLINTON SILT LOAM.

The Clinton silt loam, to an average depth of about 10 inches, consists of a grayish-yellow or light-brown, smooth, uniform silt loam, which appears brown when wet. This surface soil gives way very gradually to a more compact, brown silt loam to light silty clay loam. In the lower part of the 3-foot section the subsoil becomes a heavy, friable but very compact, silty clay loam, often slightly mottled with gray. At depths of 4 to 10 feet the Kansan drift is encountered.

The type is characteristically free from grit, but in places some very fine sand occurs in the surface soil.

The Clinton silt loam occurs on the tops of narrow ridges, usually near some drainage way. Some of the larger areas are mapped at Ringgold and extending north from that place about 1½ miles and west nearly 1 mile, 1 mile south of Diagonal, and in the extreme northeastern part of the county. The type has a nearly level to sloping topography. Its surface drainage and internal drainage are good. The run-off is excessive in places and the soil tends to wash badly.

Owing to its small extent, this type is not important agriculturally. It occurs very closely associated with the Lindley silt loam, which is rough and broken, and only a small part of it is under cultivation. Most of the type supports a growth of scrub oak, white oak, hickory, hazel, and underbrush. Corn and alfalfa are apparently the most important crops grown. Hogs, cattle, sheep, and goats are raised in small numbers. Corn yields 20 to 50 bushels per acre and alfalfa about 2 to 3 tons of hay per acre.

This soil is productive and easily cultivated, but its value is comparatively low on account of its occurrence in small areas closely associated with rougher land, so that it is almost impossible to establish regular-sized fields. The land ranges in price from $35 to $85 an acre.

The Clinton silt loam is low in organic matter. Alfalfa is apparently the most valuable crop to grow on this soil. The suggestions made for the treatment of the Grundy silt loam can be used also for the improvement of this type.

The following table gives the result of the mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Clinton silt loam:

Mechanical analyses of Clinton silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
331609, 331623	Soil	0.0	0.2	0.4	2.4	8.2	66.0	23.0
331610, 331624	Subsoil	.2	.8	.4	1.7	6.6	63.4	26.6
331625	Lower subsoil.	.1	.5	.2	3.2	5.6	51.5	38.8

SHELBY LOAM.

The Shelby loam consists of a dark-brown, loose loam, 6 to 10 inches deep, grading rather abruptly into a subsoil of yellowish, heavy, tenacious, gritty clay, mottled with brown and drab and becoming more drab in color with increased depth. Scattered over

the surface and embedded in both soil and subsoil are fine and coarse sand, gravel, and stones. Much of this material is foreign to this locality. It consists largely of quartz, quartz sand, quartzite, limestone, granits, and greenstone. The type has a calcareous lower subsoil. This and the substratum where exposed in ditches and road cuts show lumps and streaks of lime. These lime concretions often occur much nearer the surface. This content of lime appears to be a secondary enrichment[1] deposited from the overlying material.

The Shelby loam occurs in all parts of the county, occupying the steeper slopes between the ridge tops and the more level uplands and bottom lands. Its topography varies from undulating or gently rolling to hilly and broken. In the northern and northwestern parts of the county the slopes occupied by this soil are smooth, while in the south-central part they are very steep and rough. Drainage is everywhere thorough, and in some places, owing to the loose surface soil, heavy subsoil, and surface relief, the type is subject to damaging erosion.

A considerable part of the Shelby loam is waste land. Most of the type is used for growing hay or as pasture land, but it could be devoted to a wide range of crops if protected from erosion. Part of the type, especially along streams, was originally forested with oak, hickory, elm, ash, hazel, many other trees, and underbrush. All the common crops are grown to some extent. Hogs, cattle, and sheep are raised in considerable numbers. Cattle are bought in the spring, fattened upon grass, and sold in the fall. Dairying is carried on in a small way, practically every farmer selling some cream. Yields of crops average slightly lower than on the Grundy silt loam. Corn ordinarily yields 30 to 40 bushels per acre, oats about 30 bushels, and wheat about 18 bushels. Hay gives almost as good yields as on the Grundy silt loam. Alfalfa and sweet clover make a luxuriant growth. These legumes have been grown in only a small way, but they have proved satisfactory.

Owing to the large area of rolling land included in this type, the farmers are gradually changing their methods of handling this soil in order to prevent permanent injury through erosion. Heretofore practically all the type except the very steep slopes has been farmed in much the same manner as the Grundy silt loam. The type is now being put largely in grass and devoted to the raising of live stock rather than to grain growing. One farmer uses a system of terraces on this soil to prevent erosion.

Land of this type is rarely sold alone. It is valued at about $50 to $100 an acre, depending upon the location, the improvements, and the topography.

[1] Dr. S. W. Beyer, Geologist, State Agricultural College at Ames.

This soil produces excellent bluegrass, and more extensive stock raising would be profitable. Where possible, crops should be confined to the more nearly level areas, and the land should be kept in a cover crop during the fall and winter months. Where plowed in the fall it should be broken deeply and left rough and open. Unless this is done it will wash badly. This soil declines rapidly in productiveness under poor management. One of its foremost needs is the prevention of erosion. In many places large washes and ditches have already been formed, and it is no easy matter to stop these. Quick-growing grasses should be sown along the bottoms and sides of the gullies. Some farmers lay a tile drain along the wash and gradually fill in above it with brush and earth. In some cases when the washes are very large, dams are built across them, pierced by a tile drain which has an upward turn, allowing the escape of water but collecting the sediment. This gradually fills up the wash.

LINDLEY SILT LOAM.

The Lindley silt loam consists of a light yellowish brown or brown silt loam, passing rather abruptly at about 8 to 10 inches into a yellowish-brown or brown, gritty silty clay loam, which grades at about 18 to 20 inches into a brown, stiff clay, in places mottled with drab. The substratum is the typical Kansan drift. When dry the surface soil is light gray in color. It is typically free from sand, gravel, or stones, but these are usually encountered in the subsoil. This type in some places is coarser or finer than typical, but a silt loam texture predominates. In many places, especially on very steep and broken slopes, the surface soil has a loam texture, and is possibly darker colored than typical.

The Lindley silt loam occurs in scattered small areas adjoining many of the drainage ways. The largest area occurs in the south-central part of the county, west of Ringgold. Smaller areas are mapped in the extreme northeastern corner of the county, 1 mile south of Diagonal, and in secs. 29 and 30, T. 67 N., R. 30 W.

The type occupies steep slopes and broken land adjacent to stream courses. Underdrainage is good, and in place surface drainage is excessive.

The Lindley silt loam is not important agriculturally. Only a few areas have been cleared and put under cultivation. The native forest growth consists principally of white oak, hickory, ash, hazel, and elm, with various other trees and shrubs. The soil is locally known as "white-oak" land, owing to the predominance of that tree. Corn and oats are grown in a few small fields. The type is used almost wholly as pasture land for cattle, hogs, sheep, and goats. Cattle are grazed upon the native grasses, and hogs feed upon the acorns and

mast. Sheep and goats are used to kill small brush and sprouts when clearing is undertaken. This soil is considered droughty, and all the crops grown give lower yields than on the other soils of the county.

This land sells at $30 to $75 an acre, the price depending largely upon the forest growth, the topography, and the availability of water.

The Lindley silt loam is very deficient in organic matter. When cultivated it should be given liberal applications of barnyard manure and green manures. Owing to its broken topography and tendency to erode it should be kept in bluegrass as much of the time as possible and used as pasture land.

CHARITON SILT LOAM.

To a depth of 7 to 9 inches the Chariton silt loam consists of a dark-brown, uniform silt loam, having a smooth, velvety feel. It grades into a light silty layer, often mottled with brown. This layer varies in thickness, but it ordinarily continues to about 18 inches, where it rests upon a tough, hard, relatively impervious clay, which is dark brown to black but becomes slightly lighter in color and coarser in texture at the bottom of the 3-foot section. Except for the occurrence of very fine sand in the surface and subsurface soil in places, the type is everywhere uniformly and typically developed.

The Chariton silt loam occurs on low terraces in the larger stream bottoms. The principal areas occur three-fourths mile northwest of Lincoln Center School, one-fourth mile south of Diagonal, 1 mile northwest of Redding, and 1 mile south of Watterson. The terraces occupied by this soil are smooth and have a gradual slope from the first bottom to the upland. They do not lie entirely above overflow. The surface drainage is good in some places and poor in others, and the underdrainage is retarded somewhat by the heavy, almost impervious subsoil.

This soil is productive, and practically all of it is under cultivation to the common farm crops of corn, oats, wheat, and hay. At one time it probably supported a sparse growth of oak. Crops give about the same yields as on the Shelby loam. The type has a deep, loose surface soil, and is in general easily plowed and cultivated. In some places it holds water after rains, delaying planting operations in the spring.

Improvement of the surface drainage and internal drainage would benefit the type materially. It is low in organic matter, which should be added by the use of green manures. Land of this type is usually sold in connection with the Wabash soils. It is held at practically the same prices.

BREMER SILT LOAM.

The Bremer silt loam, to a depth of 10 to 12 inches, consists of a smooth, uniform, very dark brown silt loam, which appears black when wet. This grades into a black silty clay loam, which in turn passes into a dark-brown, crumbly, friable silty clay loam. At 30 to 36 inches the subsoil becomes a black, heavy silty clay loam to clay. The type is free from grit.

In three included areas aggregating less than 200 acres in extent the soil consists of a brown silt loam, 12 to 15 inches deep, underlain by a subsoil of brown, heavy silt loam, which changes to a silty clay loam in the lower part. The three areas of this soil occur, respectively, in the southeast quarter of sec. 20, T. 67 N., R. 31 W., 1 mile south of Maloy, and an area of 4 or 5 acres in the extreme northeast corner of sec. 1, T. 70 N., R. 28 W. They occupy terraces that lie 5 to 15 feet above the first-bottom soils.

The Bremer silt loam occurs on low terraces along the outer margin of the valleys of the Platte and Grand Rivers. It is doubtful whether several of the areas are really terraces. The type as mapped 2½ miles northwest of Benton and in several smaller areas really occupies alluvial fans. The principal areas of the type occur 2 miles north of Redding; one-half mile northwest of Maloy; at the Taylor County line in sec. 31, T. 68 N., R. 31 W., and sec. 6, T. 67 N., R. 31 W.; in the southwest quarter of sec. 3 and the southeast quarter of sec. 4, T. 68 N., R. 31 W.; and 2 and 2½ miles north of Caledonia. The surface is typically level to gently sloping and fairly uniform in all the areas of the type except on the alluvial fans mentioned above. which have been slightly dissected by the stream by which they were formed. The type has fairly good surface drainage and underdrainage.

The Bremer silt loam is a strong productive soil. It is practically all under cultivation, corn, wheat, oats, and hay being the principal crops. The type is closely associated with the Wabash silt loam and resembles that type in all physical characteristics. The only essential difference is that it lies at a slightly higher elevation. Crops yield approximately the same as on the Wabash silt loam. The soil is deep and loose and easily farmed. It is held at about the same price as the Wabash silt loam. Artificial drainage in the few low areas would be beneficial.

BREMER SILTY CLAY LOAM.

To an average depth of about 6 to 8 inches the Bremer silty clay loam consists of a black silty clay loam, which grades into a heavier dark-brownish silty clay loam. The subsoil is a black, heavy silty

clay loam to clay. It becomes lighter in color with depth and at about 24 inches is a dark-drab clay, mottled with yellow. This type closely resembles the Wabash silty clay loam, differing only in occupying a slightly higher position.

The Bremer silty clay loam occupies low terraces, which are not wholly above overflow. It occurs in the valley of the East Fork of Grand River 1 mile northeast of Oak Ridge School, in a narrow strip northeast of Stuck School, and 1½ miles north of Caledonia. The surface is prevailingly level, but depressed in some small areas. Surface drainage is only fairly good, and the soil is wet for long periods during the spring.

This type is very inextensive, but it is productive, and most of it is in cultivation. Corn and wheat are the principal crops. Corn yields 30 to 70 bushels per acre and wheat 15 to 35 bushels. Owing to its heavy texture considerable horsepower is required in working this soil. It breaks down thoroughly when plowed under proper moisture conditions, but if plowed when too wet it is likely to bake hard. It has practically the same land value as the Wabash silty clay loam.

The following table gives the results of the mechanical analyses of samples of the soil and subsoil of the Bremer silty clay loam:

Mechanical analyses of Bremer silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
331619	Soil	0.1	0.4	0.4	1.4	3.8	65.5	28.3
331620	Subsoil	.2	.6	.5	1.6	5.0	67.7	24.5

WABASH SILT LOAM.

The soil of the Wabash silt loam, to an average depth of about 6 to 8 inches, is a very dark brown, rather heavy silt loam, which appears black when wet. The upper subsoil consists of a heavy silt loam grading into a dark-brown to black silty clay loam, slightly mottled with brown. At about 20 inches a heavy, black clay with brown and drab mottling is encountered. The soil typically is free from grit.

In many places, as in the bends of streams, the type as mapped includes some small areas of light-brown to brown sandy soil. In a few other places adjacent to stream channels a brownish soil underlain by very fine sand is encountered. Because of their small size these areas are included with the Wabash silt loam. Along East Big

Creek the type includes several areas of Wabash loam and Wabash fine sandy loam. The type is very closely associated with the Wabash silt loam, colluvial phase, and the Wabash silty clay loam, and it often merges into the latter soils gradually. It is quite probable that small areas of those soils are included with the typical silt loam.

The Wabash silt loam occurs as first-bottom land along all the larger streams and many of the smaller ones. It has a typically flat to smooth topography, but is in places marked by old channels and cut-offs. The type is low lying and subject to numerous overflows. Surface drainage is only fair or poor, and underdrainage, owing to the heavy clay subsoil, is not well developed.

This is the most extensive bottom-land soil in the county, and it is important agriculturally. It is strong and productive, high in organic matter, and well suited to all the ordinary crops. Owing to the uncertain periods of overflow, however, little more than one-half the type is under cultivation. The tree growth is sparse except near the stream channels, where there is considerable oak, hickory, elm, ash, sycamore, hackberry, and other trees. In the lower situations there is a heavy growth of slough grass. Corn, wheat, oats, and hay are the important crops on this soil. Bluegrass grows luxuriantly and a large part of the type is devoted to this grass and used as pasture for cattle, sheep, and horses. Hogs also are grazed on this pasture and on nuts and acorns in the forested areas. Corn yields 35 to 80 bushels per acre, wheat 15 to 30 bushels, and oats 25 to 50 bushels.

The Wabash silt loam is loose, friable, and easily plowed and cultivated. For corn it is usually plowed in the fall and allowed to stand rough until spring. Many farmers have tiled this soil in order to permit earlier plowing and seeding in the spring. Others have simply dug shallow ditches through the fields, which hasten the run-off to some extent.

This land has a wide range in value, from $75 to $150 an acre. The selling price depends largely upon the liability to overflow, the improvements, such as clearing and tiling, and the location with reference to markets and transportation lines.

Proposed drainage ditches along the Platte and Grand Rivers will make farming on this soil less uncertain, but they will hardly prevent all inundations. Under present conditions small ditches and tile drains should be of material benefit.

Wabash silt loam, colluvial phase.—The Wabash silt loam, colluvial phase, to a depth of about 12 inches, consists of a very dark brown to black silt loam, which often contains a relatively large proportion of very fine and fine sand. To a depth of 22 to 24 inches the subsoil is a brownish, heavy silt loam to light silty clay loam, underlain to 36

inches by a very black silty clay loam. Below a depth of 8 or 10 inches the material, as seen in cuts, is streaked with gray and mottled with brown. The phase is variable in texture, having been formed by the downward movement of soil particles from the adjoining slopes by rain water and gravity, aided by cultivation and wind action. It occurs in the narrow valleys of practically all the small streams in the county. Along the outer margins of the wider valleys of the larger streams it has been deposited in narrow strips by sheet wash from the adjoining uplands or in some places as alluvial fans or small outwash plains. Drainage at best is only fairly good, and during wet periods is poor.

This soil is not important agriculturally, owing to its small acreage and its occurrence in narrow strips or in narrow valleys. Only a small percentage of it is in cultivation, but it is very productive and one of the most desirable soils in the county. It is used largely for pasture. Corn and hay give excellent yields. Oats and wheat do fairly well, but tend to produce too much straw. This land is always sold with other soils. The phase needs better drainage in many places and erosion should be checked.

Wabash silt loam, gray-subsoil phase.—The soil of the Wabash silt loam, gray-subsoil phase, is a dark-brown to black smooth, uniform silt loam, extending to a depth of 8 to 10 inches, and underlain by a light ashy gray silt. This changes at about 14 inches to a light-colored silty clay loam, which continues to a depth of 18 to 20 inches. Below this intermediate layer there is a heavy silty clay loam to clay of a grayish-brown color, mottled with yellow.

The largest areas of this phase occur in the Platte River Valley just north of Maloy and 1 mile east of Bailey School. It occupies small, flat first-bottom areas along the Platte and Grand Rivers. The surface drainage ranges from fair to poor. The underdrainage is not thorough, as is indicated by the layer of ashy silt between the surface soil and the lower subsoil.

Wabash silt loam, gray-subsoil phase, is not important agriculturally, owing to its small extent. Only a very small percentage of its area is under cultivation. It supports a rank growth of coarse slough grass. Some small areas in corn and oats in 1915 gave fairly good yields, considering the nature of the season. This phase is closely associated with the typical Wabash silt loam, and it is handled in practically the same manner. It can be improved by the same methods. Land values are lower than in the case of the typical soil, some areas selling for only $50 an acre.

The following table shows the results of the mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Wabash silt loam, gray-subsoil phase:

Mechanical analyses of Wabash silt loam, gray-subsoil phase.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
331629	Soil	0.2	0.3	0.4	5.0	10.1	61.2	22.3
331630	Subsoil	.3	.8	.4	3.5	13.6	56.6	24.5
331631	Lower subsoil.	.4	.9	.4	3.3	8.5	58.3	28.0

WABASH SILTY CLAY LOAM.

The surface soil of the Wabash silty clay loam is a dark-brown to black, friable silty clay loam 7 to 9 inches deep. It grades into the subsoil without much change in texture, color, or structure. At a depth of about 18 to 20 inches the subsoil becomes slightly mottled with drab and rusty brown. The lower subsoil is a dark-drab, plastic clay mottled with brown and gray. The type is free from sand or other gritty material.

As mapped the Wabash silty clay loam includes a small total area of Wabash clay, which consists of a crumbly to granular black silty clay loam to clay, overlying a subsoil of heavy, dark-drab, sticky, waxy clay. This subsoil is too dense to allow the ready passage of soil water, and the soil is poorly drained. It supports a heavy growth of coarse grass locally called slough grass. The larger areas of Wabash clay included with the Wabash silty clay loam occur in the Platte River bottoms 1¾ miles west of Benton, 1 mile southeast of Grant Center School, and 1 mile west of Redding, in the Grand River bottoms.

The Wabash silty clay loam occurs as first-bottom land along the larger streams of the county, including the Platte and Grand Rivers. Its principal developments are mapped 2 miles southwest of Maloy, 1½ miles northwest of Delphos, 2 miles southeast of Hill School, 2½ miles west of Diagonal, and 1 mile southwest of Baumann School. The type is low lying and subject to inundations. It has a level to flat surface with many small depressed areas. The surface drainage is poor during wet periods, and the subsoil, while not impervious, is too heavy to permit the rapid downward percolation of water.

Only a small proportion of the type is under cultivation. It supports a heavy growth of coarse "slough grass" and is sparsely forested in places. Corn, oats, wheat, hay, and bluegrass are grown. Cattle and hog raising is an important industry. The soil is strong and productive and under good moisture conditions gives as high yields as the Wabash silt loam. The soil plows easily when not too wet or dry, and the clods break down to a fine tilth owing to the granular structure of the soil and to some extent to its lime content.

This type of soil is usually sold in conjunction with the Wabash silt loam. It has about the same selling value.

The Wabash silty clay loam would be benefited by the construction of drainage canals, as suggested for the silt loam. It can be improved by the methods suggested for the latter soil.

SUMMARY.

Ringgold County is situated in the southwestern part of Iowa, within the Glacial and Loessial province of the United States. It has an area of 540 square miles, or 345,600 acres.

The county includes three topographic divisions, uplands, terraces, and first bottoms. Uplands comprise the greater part of its area.

The population of the county as reported by the 1915 State census is 13,280. Mount Ayr, the largest town and the county seat, has a population of 1,708.

Ringgold County is well supplied with railroads, which furnish direct communication with Des Moines, Kansas City, Chicago, and Omaha and other good markets. Public roads reach all parts of the county.

The climate is temperate, with a mean annual temperature of about 50° F. and a mean annual precipitation of 37.47 inches. Severe winters are of common occurrence. The average growing season is 168 days long and the grazing season about 215 days.

The agriculture of Ringgold County is based upon general farming and stock raising. Most farmers engage in both these branches. Corn and hay are the principal crops, followed by wheat, oats, rye, alfalfa, clover, millet, and sweet clover. Bluegrass is the most important pasture growth. Conditions are highly favorable for the development of dairying and the production of beef cattle.

Nine soil types and two phases are mapped in Ringgold County representing seven series. The soils of the county are of a prevailingly silt loam texture.

The Grundy silt loam and the Shelby loam are the most important upland soils. The Grundy soil is dark colored and of loessial origin. It is known as "prairie land." The Shelby is a dark-colored soil derived from glacial drift material and occupying slopes. It is known locally as "slope land." These soils are productive and are used for all the crops grown in the county.

The Clinton and Lindley silt loams are light colored and timbered. The Clinton soil is of loessial origin and free from grit. The Lindley soil in the surface layer is partly of loessial origin. Its subsoil is derived from glacial drift.

The Wabash silt loam and silty clay loam are dark-colored alluvial soils occurring in practically every stream valley in the county.

They are low-lying first-bottom types generally poorly drained. All the common crops of the county are grown on these soils and good yields are obtained under favorable moisture conditions. Artificial drainage is needed in many places.

The Bremer silt loam and silty clay loam closely resemble the Wabash soils, but occupy second bottoms or low terraces. They are very productive and practically all of their area is under cultivation.

The Chariton silt loam is an inextensive terrace soil characterized by a distinct ashy-gray layer between the surface soil and subsoil. It is a desirable farming type.

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[PUBLIC RESOLUTION—No. 9.]

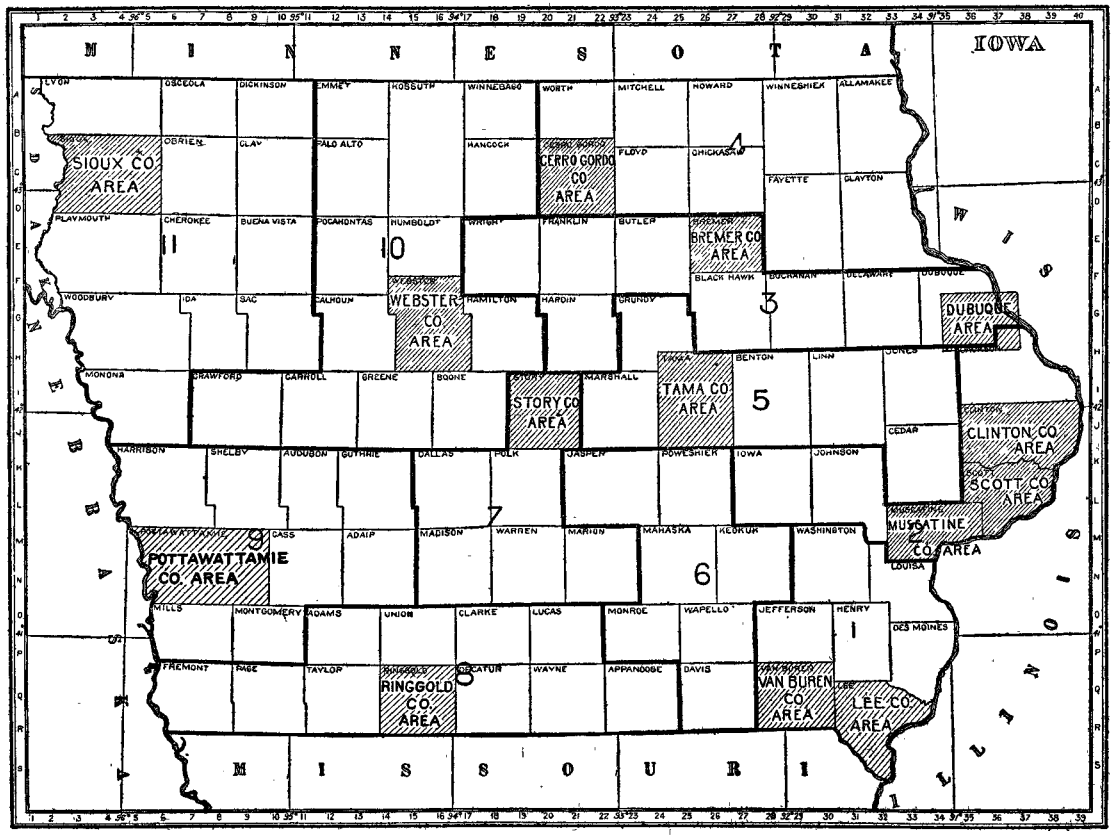
JOINT RESOLUTION Amending public resolution numbered eight; Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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 to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Iowa.

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