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 VAN BUREN COUNTY, IOWA.

BY

CLARENCE LOUNSBURY, OF THE U. S. DEPARTMENT OF AGRICULTURE, IN CHARGE, AND H. W. REID, OF THE IOWA AGRICULTURAL EXPERIMENT STATION.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1915.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1917.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., August 30, 1916.

SIR: In the extension of the soil survey in the State of Iowa during the field season of 1915 a survey was undertaken in Van Buren 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 1915, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

Soil map, Van Buren County sheet, Iowa.

SOIL SURVEY OF VAN BUREN COUNTY, IOWA.

By CLARENCE LOUNSBURY, of the U. S. Department of Agriculture, In Charge, and H. W. REID, of the Iowa Agricultural Experiment Station.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Van Buren County lies in the southern part of Iowa, bordering the State of Missouri and separated from the Mississippi River by only one tier of counties. It is bounded on the north by Jefferson County, on the east by Henry and Lee Counties, on the south by Clark and Scotland Counties, Mo., and on the west by Davis County, Iowa. Van Buren County has an area of 482 square miles, or 308,480 acres.

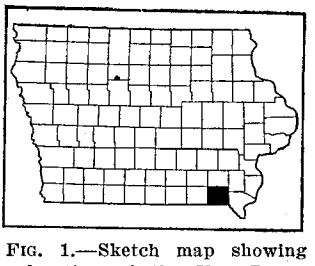

FIG. 1.—Sketch map showing location of the Van Buren County area, Iowa.

The surface of the county as a whole is that of a plain, originally level but now dissected by streams. Between the stream valleys, and having the same general direction, are broad divides that represent remnants of the original plain little modified by erosion. The Des Moines River, which crosses the county diagonally, is bordered by a strip of more or less eroded land that, with its deeply cut valley, comprises in all more than one-half the total area of the county. The tributary streams in their upper courses flow through the glacial drift beds, but in their lower courses they have generally cut into the underlying rock, and their valleys here are consequently characterized by sharp deflections and more or less prominent stony bluffs. In the northeastern corner of the county the topography is quite broken from the erosion of streams tributary to Big Cedar Creek, and the southwestern corner is traversed by the narrow but sharply cut valleys of Fox and Little Fox Rivers.

It is noticeable in many parts of the county that southerly slopes generally have a smooth surface and gentle incline, while those facing north are usually broken and rugged. The country along Holcomb Creek represents these conditions very well. The topography about the heads of minor branches is much more broken than along their lower courses.

The largest drainage divide in the county stretches across the northeastern part, between the Des Moines River and Big Cedar Creek

basins. It is very irregular in width and outline, having ragged lobes extending toward the main streams between the tributaries. The surface is mostly undulating, with the exception of irregular winding areas on the crest of the divide, which are nearly flat. The divides southwest of the Des Moines River are more generally eroded by stream action and the surface is slightly more rolling.

The alluvial land bordering the streams may be subdivided into high terraces, now lying above the limit of overflow, and first bottoms, the latter comprising the present flood plain of the streams. Alluvial lands are not widely developed along the Des Moines River except near the place where it enters the county and in the great bend near the center of the county. In both these places the greater part of the alluvial land is represented by high terraces. The rapid cutting of the stream into its rocky bed has prevented any extensive deposition of sediment within recent times. The smaller streams also have deposited little alluvium except Fox River, which is bordered by a rather uniform belt more than a mile wide. The surface of the high terraces is either almost flat or very gently undulating. The lower bottoms are flat and the areas are somewhat cut up by the shifting streams.

On the plain north of the Des Moines River at Birmingham the elevation above sea level is 758 feet.[1] To the east of this point there is a slight downward slope. At Mount Zion, near the southern extremity of a southward projecting divide, the elevation is 724 feet. South of the river, at Milton, is the highest recorded elevation in the county, 800 feet. Here the plateau slope is eastward through Cantril, which stands at an elevation of 770 feet. The plateau elevation east of Mount Sterling is 734 feet, while the latter place, just above the Fox River bottoms, stands 635 feet above sea level. The Des Moines River has a gradual fall from 647 feet at Selma to 563 feet above sea level at Farmington.

Probably more than three-fourths of the area of the county is drained by the Des Moines River. The drainage from the remaining part is carried to the Mississippi by the Fox and Little Fox rivers, in the southwestern part of the county, and Big Cedar Creek, in the northeastern part.

The Des Moines River enters the county near the northwestern corner and leaves it near the southeastern corner, dividing the county into two nearly equal parts. Near the center of the county the river makes an abrupt bend, inclosing an area several square miles in extent. Many tributaries enter the Des Moines, the largest of which are Lick, Copperas, Coates, and Reeds Creeks from the north, and Holcomb, Chequest, and Indian Creeks from the south. All these

[1] Elevation data are taken from the Geology of Van Buren County, by C. H. Gordon, Annual Report of the Iowa Geological Survey, 1894.

streams are bordered by rather wide belts of eroded land and comparatively narrow flood plains. Big Cedar Creek crosses the extreme northeastern corner of the county and its tributaries extend several miles within the area. Fox River, which pursues a nearly direct southeasterly course across the southwestern corner of the county, meanders through a uniform belt of alluvial land in a comparatively shallow channel which is insufficient to carry off the flood waters, and the frequent inundations keep much of the heavy bottom-land soil along this stream from full agricultural development.

Over most of the county fairly good drainage prevails. There is some deficiency on the broad plateau level in the northeastern part, where drainage ways have not yet become thoroughly established.

Practically all the residents of Van Buren County are native Americans, being mainly descendants of the original settlers, who came largely from the eastern Central States. The census of 1910 reports the population of the county as 15,020, all of which is classed as rural. The density of settlement is 31.5 persons to the square mile. The farming population is fairly evenly distributed.

Keosauqua, with a population of 1,009, is the county seat. It is situated nearly in the center of the county, in the great oxbow bend of the Des Moines River. Farmington, with a population of 1,165, the largest town in the county; Bonaparte and Bentonsport, in the southeastern part; and Douds Leando, Selma, and Kilbourn, in the northwestern part, are the principal towns on the Des Moines River. Milton, Cantril, and Mount Sterling, in the southern part, and Birmingham and Stockport, in the northern part, are the most important of the other towns. All these places are shipping points.

Good railroad transportation is provided by the Chicago, Rock Island & Pacific Railway and the Chicago, Burlington & Quincy Railroad. A line of the Rock Island between Keokuk and Des Moines follows the general course of the Des Moines River, with a branch extending from Mount Zion to Keosauqua. A line of the Burlington system between Fort Madison and Ottumwa crosses the northeastern part of the county and the Burlington-Carrollton branch of this system traverses the southern part. The Des Moines River formerly afforded water transportation to some extent.

The main public highways of the county, some of which are under the supervision of the Iowa State Highway Commission, are generally kept in good condition. Telephone and rural mail delivery service reaches all parts of the county.

Coal is mined near Douds Leando and to a limited extent in various other parts of the county, the product for the most part being used locally. Brick and drain tile are manufactured at Farmington and Stockport. Farmington also has a canning establishment and a pickling plant.

Some of the minor farm products of Van Buren County are disposed of locally or at near-by towns of southeastern Iowa. The live stock usually is marketed at St. Louis, Chicago or Kansas City. From Keosauqua the distance to St. Louis is 328 miles; to Chicago, by way of Eldon, 311 miles; and to Kansas City, 240 miles.

CLIMATE.

The climate of Van Buren County is characterized by cold winters and warm summers. The mean annual temperature is 50.6° F. There is considerable range in temperature, the absolute extremes recorded ranging from 112° F. to −31° F. Such extreme temperatures, however, are rare, and temperatures even approaching these extremes are of short duration.

The rainfall, averaging 34.97 inches a year, is fairly well distributed, the heaviest precipitation coming in the spring and summer months. The average depth of snowfall is 22 inches.

The average date of the last killing frost in the spring is April 25, and that of the first in the fall October 9. There is thus an average growing season of 167 days. Killing frost has occurred, however, as late in the spring as May 14, in 1895, and as early in the fall as September 20, in 1896. In the spring farm work often can begin the latter part of March, and, in the fall, plowing and the gathering of late crops can be carried on well into December. Oats are seeded about the middle of April and corn is planted the first half of May.

The following table, compiled from records of the United States Weather Bureau, gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at the Bonaparte station:

Normal monthly, seasonal, and annual temperature and precipitation at Bonaparte.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1898).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December	28.0	63	−15	1.37	1.30	0.93	3.7
January	23.4	65	−21	1.64	1.05	3.33	6.0
February	23.0	65	−31	1.30	1.17	1.00	7.9
Winter	24.8	65	−31	4.31	3.52	5.26	17.6
March	38.3	88	− 5	2.53	2.50	5.08	1.7
April	51.2	91	10	3.21	1.34	3.71	1.0
May	62.3	92	25	4.61	1.30	6.11	0
Spring	50.6	92	− 5	10.35	5.14	14.90	2.7

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

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1898).	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
June	71.0	102	38	4.62	2.26	9.01	0
July	75.4	112	46	3.72	0.94	3.15	0
August	74.1	106	40	4.51	0.31	10.55	0
Summer	73.5	112	38	12.85	3.51	22.71	0
September	67.3	103	26	3.92	2.46	7.30	0
October	54.9	96	16	1.71	0.90	4.09	T.
November	38.8	76	− 6	1.83	0.82	1.21	1.7
Fall	53.7	103	− 6	7.46	4.18	12.60	1.7
Year	50.6	112	−31	34.97	16.35	55.47	22.0

AGRICULTURE.

Agriculture in Van Buren County began with the first settlements, which were made between 1833 and 1840. Settlers came up the Des Moines River, occupying first the uplands close to the stream and later taking the land farther back. Many settlers established themselves on the forested lands adjoining the prairies, on account of the availability of building material and the protection from the fires which swept the prairies annually. Some farmers considered these lands better suited for farming. At first the settlers lacked suitable implements for breaking the prairie sod, and they utilized this open land chiefly as stock ranges.

General-farm crops were grown from the first in Van Buren County, but in a somewhat limited way, chiefly for the subsistence of the family and for supplementary stock feeding. Later some grain, especially wheat, was grown for sale, but as the principal interest was early centered upon stock raising, other farm operations generally were kept subordinate. Flax was at one time grown as a money crop, but this cereal has been abandoned.

The present type of agriculture in Van Buren County is based on the raising of stock, consisting of beef cattle, hogs, sheep, and, to some extent, horses and mules. The production of crops is primarily to support the animal industries. The crops produced in connection with stock raising include corn, oats, wheat, rye, and barley, with a variety of forage crops, principally timothy, clover, alfalfa, and millet.

Corn leads all other crops in acreage, occupying in 1909, according to the census, 54,937 acres, with a production of 1,767,418 bushels, or about 32 bushels an acre. Oats in the same year were sowed on 18,543 acres, producing 527,332 bushels, or about 28 bushels an acre. Wheat occupied 6,630 acres and produced 126,714 bushels, the yield averaging about 19 bushels an acre. Most of the wheat grown is of the winter varieties. Rye in 1909 was seeded on 722 acres, and 9,771 bushels were produced, while 118 acres were devoted to barley, producing 2,495 bushels. The cereal output of 1909 had a cash value of $1,308,810. The census reports 40,021 acres in tame grasses in 1909, producing 51,559 tons, of which 30,838 tons were of timothy and clover mixed, 18,668 tons of timothy alone, and 1,193 tons of clover alone. Occasionally some hay, as well as wheat or other grain, is marketed, but, as a rule, this crop is utilized with the others in maturing live stock for the market or for feeding the work stock.

Minor income crops of the county include apples, pears, strawberries, various bush berries, cucumbers, and tomatoes, the latter two crops being grown mostly in the southern and southeastern parts of the county. Poultry products and dairy products have importance as sources of income on many farms, the former, according to the census of 1910, having a value of $323,159, and the latter a value of $112,086, home use excluded. In 1909 the value of vegetables produced amounted to $64,174, and of fruits and nuts, $79,507.

Subsistence crops, or those grown primarily for home consumption, include Irish and sweet potatoes, as well as the common garden vegetables and various tree, bush, and vine fruits. Practically every farm furnishes the meat, butter, milk, and eggs used in the home.

In the census the value of all animals sold or slaughtered on farms in 1909 is reported as $2,029,228. The number includes 1,245 calves, 21,959 other cattle, 45,935 hogs, and 24,592 sheep and goats. In the same year 5,891 horses and mules were sold. The principal breeds of beef cattle represented are the Shorthorn, Aberdeen Angus, and Hereford; of hogs the Duroc Jersey, Poland China, and Chester White; and of sheep the Delaine and Shropshire. The wool production in 1909 reached a value of $70,256.

In the growing season the live stock subsists mostly on pasturage. In the case of cattle and sheep grain is usually fed, especially in finishing the grown animal. Hogs are allowed to follow cattle and also are finished with corn and other grain. The winter feed consists largely of hay, with silage fed to some extent, supplemented more or less with grain.

Dairying is for the most part incidental to general stock raising. Much of the milk produced is from the beef type of cattle, only a few cows being milked on any one farm. On a few farms dairy types of

cows are kept, principally Jersey, but to some extent Holstein. Summer dairying is the more common, but in the last few years some farmers have taken up winter dairying. Cream is separated on the farm and most of it is sold to creameries in Ottumwa or Keokuk. At Stockport is located the only creamery in the county. Stockport butter is marketed to some extent in Chicago. The 1910 census shows 7,648 dairy cows on farms reporting the production of dairy supplies.

There is no marked variation in the relative distribution of crops over the county. Probably more corn is grown on the Grundy silt loam and Wabash loam and silt loam types than on the Memphis silt loam and similar soils, on account of the better adaptedness of the Grundy and Wabash types. In wet seasons greater success is had with corn and to some extent with other crops on the more rolling Memphis silt loam and the lighter textured soils such as the Wabash fine sandy loam than on the Grundy and Calhoun silt loams, with their prevailingly level surface and heavy subsoils. Because of the more or less rough surface, more land is used for pasture on the Memphis silt loam and its eroded phase and on the Shelby loam, and consequently stock raising is carried on more extensively on farms on the Memphis and Shelby soils. Hog raising naturally is most general on those soils which are best suited to corn. The farmers on the whole recognize that corn is best suited to the dark-colored Grundy silt loam and clay loam and the loamy Wabash soils; that the Memphis silt loam is less well adapted to corn, though perhaps slightly better suited to small grains; and that the Memphis silt loam, eroded phase, and the Shelby loam are the best bluegrass lands.

The methods of crop production apparently are not influenced in any marked degree by local soil conditions. Farms in localities where there are predominating areas of the eroded phase of the Memphis silt loam and of the Shelby loam are usually a little larger than on smoother soils, because of the more extensive use of these rougher lands for pastures.

The farm equipment in use in Van Buren County is generally ample for the efficient handling of the various soils. As most of the soils are of relatively heavy texture, there is not much variation from place to place in the character of the equipment. The cultural methods followed usually are thorough and well suited to maintaining the various soils in good condition. Land usually is plowed 6 to 7 inches deep, a large proportion of the land intended for spring crops being plowed in the fall. Sulky plows generally are used. Draft types of horses and mules are employed, the animals weighing not less than 1,200 or 1,300 pounds. Three or four horses are used in breaking the heavier soils and usually a less number on the loamy

and sandier types. Disk and smoothing harrows are later used to prepare the ground for seeding. Corn is planted with the check-row type of planter, and small grains with the drill or broadcast seeder. Most of the corn crop is gathered from the standing stalks. Some corn is made into silage, which has recently come into favor in stock feeding. Small grains are harvested with binders and thrashed in the field, either from stacks or directly from the shock. A considerable proportion of the hay crop is stacked.

A crop rotation followed on most of the soil types consists of corn one or two years; oats and wheat or rye, each a year; and clover and timothy, two or more years. Frequently the rotation consists of corn, oats, and clover and timothy.

Stable and barnyard manure constitute almost the only fertilizer used in Van Buren County. On most farms the manure is distributed with manure spreaders on land to be put in corn. Very little or no commercial fertilizer is used on the farms. Green manuring crops are grown to some extent.

Farm labor is more or less scarce in Van Buren County. In some instances all the labor is performed by the farmer and his family, but many farms require extra hands. The monthly wage for single men ranges from $20 to $30, with board, and for married men from $25 to $40, in addition, usually, to a house, garden plot, and a supply of meat and milk. Day laborers receive about $1.50 a day.

The 1910 census reports 98.4 per cent of the area of the county as being in farms, and 74.2 per cent of the farm land as improved. The average size of farms is 141.4 acres, and the total number in the county is reported as 2,126. Nearly three-fourths of the farms are operated by owners, 27 per cent being worked by tenants. Where land is rented the accounting is generally on a share basis, with the owner having part ownership in the live stock. Occasionally a cash rental is paid, varying from $2.50 to about $6 an acre.

Land values in Van Buren County are advancing rapidly. During the period from 1900 to 1910 the average value of land as reported by the census increased 114 per cent. The census of 1910 states the average land value as $57.59 an acre. Prices for farm lands vary considerably, depending on the soil, location, and state of improvement. The better lands, such as most of the Grundy silt loam and some of the more desirable areas of the Memphis silt loam and the Wabash soils, have a value ranging from $60 to $150 an acre. Less desirable lands, such as the eroded phase of the Memphis silt loam and some areas of the Shelby loam, are held as low as $30 or $40 an acre. Farm land in the broad flat area in the northeastern part of the county, occupied largely by the Grundy silt loam and Grundy clay loam, in general has a higher value than in other parts of the county.

SOILS.

The soils of Van Buren County may be divided, according to origin, into three classes, glacial, loessial, and alluvial. The greater part of the county is covered with glacial drift over which lies a thin mantle of loess, and these formations give rise to the upland soils. The alluvial soils include both stream-bottom and terrace or second-bottom types.

Some time after the recession of the glaciers, and probably after some erosion of the glacial till had taken place, there was deposited over this part of the United States a thin mantle of wind-blown material, mainly silt, known as loess. This material is responsible for the silty character of the surface soil in the smooth upland areas. Where slopes have been eroded and most of the loess removed the soil is composed largely of the underlying glacial material. The glacial deposit in this county is known as the Kansan drift. The material consists of bowlder clay, composed of yellow clay overlying blue clay, each including more or less sand and gravel. In general the drift sheet varies in thickness from 50 to 100 feet, being thicker in the southwestern than in the northeastern part of the county.

The bedrock underlying the glacial drift consists of indurated rocks of the Carboniferous period.[1] The greater part of the county is directly underlain by the Des Moines formation of shales and sandstone, beneath which is the St. Louis limestone, resting in turn upon the Keokuk and Burlington formations. These rocks are exposed mainly along the Des Moines River and its tributaries, and do not exert any appreciable influence on the soils of the county.

The alluvial soils are composed of materials washed in part from the loessial and in part from the glacial deposits. These soils represent stream-deposited material, laid down by water currents which have varied in velocity and direction from time to time and from place to place, giving rise to soils differing in texture and other characteristics. The soils more or less subject to overflow are classed as first-bottom types and those standing above overflow as second-bottom, or terrace soils.

Based on color, origin, physiographic occurrence, and other characteristics, the soils are arranged in certain groups or series. On the uplands the soils over most of the dark-colored areas, mainly prairie, are classed in the Grundy series, while those prairie soils of lighter color are grouped in the Putnam series. The light-colored, forested soils are classed in the Memphis and Marion series. These four series comprise the soils of the loessial division.

[1] Statements concerning geology are based on the Geology of Van Buren County, by C. H. Gordon, Annual Report of the Iowa Geological Survey, 1894.

The Grundy series is characterized by dark-colored or black surface soils, underlain by dense, plastic, mottled clay subsoils. The members of this series differ from those of the Putnam series chiefly in their darker color and the general absence of a white layer between soil and subsoil, though in places this subsurface stratum is developed. The Grundy soils occupy flat, level or slightly depressed prairie areas and seem to be derived from loessial deposits modified by accumulations of finer material and organic matter, possibly under ponded or swampy conditions. In Van Buren County the Grundy series is represented by the silt loam and clay loam members.

The Putnam series includes light-colored surface soils overlying impervious drab or brown subsoils of fine texture and close structure. One of the principal characteristics is the presence of a whitish silty layer between the soil and subsoil. The types of this series occupy level to gently undulating upland prairies and are derived from loessial deposits. On account of the rather level surface and the dense, "hardpan" structure of the subsoil, drainage is seldom adequate. The Putnam soils differ from the true Shelby soils in containing little or no glacial till in the subsoil, though this usually underlies the soils at greater depths. In Van Buren County the Putnam silt loam is recognized.

The Memphis series includes the light-brown soils derived from silty material of possible loessial origin. The silty covering in this series is always thick enough to form the subsoil as well as the surface soil, the deeper lying glacial till being far enough below the surface to have had no marked influence on the general character of the soil. The topography is gently undulating to rolling and the surface is generally well drained. The Memphis silt loam, with an eroded phase, is mapped in Van Buren County.

The Marion soils are ash-colored to gray, with a lighter colored, nearly white layer extending to a depth of 12 to 18 inches. The lower part of this layer often contains a great many iron concretions, forming a hardpan layer. Beneath this stratum lies a tough clay, brown, gray or light yellow to reddish yellow and mottled; this layer also sometimes contains iron concretions. The Marion silt loam is mapped in Van Buren County.

The soil of the glacial division is classed in the Shelby series.

The surface soils of the Shelby series are yellowish gray or yellowish brown to dark brown in color and, as far as recognized, consist of loams and sandy loams. The subsoils are yellow and reddish-yellow or light-brown, tenacious sandy clays, noticeably heavier than the surface soils, which to a considerable extent are influenced by remnants of a former loessial covering. The subsoil not infrequently con-

tains iron pipes and nodular masses and streaks of calcareous material. The Shelby loam type is encountered in Van Buren County.

The alluvial soils comprise first-bottom and second-bottom or terrace types. The second-bottom alluvial soils are classed in the Jackson, Buckner, and Calhoun series, while those of the first bottoms, or present flood plains, are classed in the Wabash series.

The surface soils of the Jackson series are light brown or brown and are underlain by light-brown or grayish, mottled subsoils. The Jackson series includes second-bottom soils developed along small streams in the glaciated areas of the Central Plains States. These soils are intermediate in position between the Wabash types of the River Flood Plains province and the Judson soils of the Glacial and Loessial province. While they are about similar in color and physiographic occurrence to the Lintonia soils, the material is derived principally from drift, modified to a slight extent by wash from loessial and residual soils. The soils are partly alluvial and partly colluvial in their mode of formation. They are not usually subject to overflows. The Jackson silt loam is mapped in Van Buren County.

The Buckner series is characterized by brown to dark-brown surface soils. The subsoils are brown to yellowish brown or grayish in color and of about the same texture as the surface soils. The Buckner soils are developed on terraces or in other areas holding essentially the position of a terrace or second bottom, in the alluvial plain of the Mississippi and Missouri Rivers and other of the more important streams of the Central West. The soils are well drained. In Van Buren County the Buckner gravelly sandy loam and fine sand types are identified.

The surface soils of the Calhoun series are gray to brown in color and are underlain by gray or drab heavy clay subsoils, of tenacious, waxy structure. Iron concretions are very common. Some of the soils have a substratum of sandy material. In this county the Calhoun silt loam type only is mapped.

The Wabash series includes surface soils of dark-brown to black color and high organic-matter content, with slightly lighter drab or gray subsoils. The members of this series are developed typically in the first bottoms of streams in the Central Prairie States, the material being derived principally from the loessial and associated soils of the region. In Van Buren County the Wabash fine sandy loam, loam, silt loam, and clay loam are encountered.

In subsequent pages of this report the different soil types recognized are described in detail and their relation to agriculture discussed. The distribution of the soils is shown on the map accompany-

ing this report, and the table below gives the actual and relative extent of each type mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Memphis silt loam	72,256	42.4	Wabash fine sandy loam	3,392	1.1
Eroded phase	58,240		Putnam silt loam	2,176	.7
Grundy silt loam	113,152	36.7	Marion silt loam	1,664	.5
Shelby loam	18,624	6.1	Jackson silt loam	704	.2
Wabash silt loam	14,912	4.8	Buckner fine sand	576	.2
Wabash loam	8,896	2.9	Buckner gravelly sandy loam	384	.1
Calhoun silt loam	5,696	1.8	Total	308,480	
Wabash clay loam	4,352	1.4			
Grundy clay loam	3,456	1.1			

GRUNDY SILT LOAM.

The surface soil of the Grundy silt loam consists of a dark-gray or dark-brown to nearly black friable silt loam, 8 to 12 inches deep. The subsoil to a depth of 18 or 20 inches is composed of a grayish-brown silt loam which becomes heavier with depth and occasionally shows slight yellowish-brown mottlings. Below 20 inches the material changes gradually to a bluish-gray or drab, dense, plastic silty clay, mottled with brown and yellow and containing small quantities of black mealy iron concretions, which continue to a depth of 36 inches or more. The color becomes lighter and the mottling more pronounced with increase in depth. The dark color of the soil is due to the relatively large content of organic matter. There is often a thin grayish-white layer consisting of mealy silt material in the lower part of the surface soil. This feature is more common in those areas south of the Des Moines River. Because of its dense, impervious character, the subsoil is often spoken of locally as "hardpan," although the material is not indurated.

The Grundy silt loam occupies the more important ridges and other elevated areas and is the dominant soil in the southwestern and northeastern parts of the county. A small area occurs east of Selma and another southwest of Farmington.

The topography generally is nearly level or undulating, becoming somewhat rolling or sloping in the vicinity of some of the streams. Most of the steeper slopes, however, do not include this type, being mapped as the Shelby loam.

Drainage over the Grundy silt loam is fairly well established, except in some of the flatter, more level areas, where surface water moves sluggishly and the dense, impervious subsoil prevents its ready downward percolation. Here in wet seasons crops are below normal in development; if the condition exists during harvesting

the soft ground makes the use of machinery difficult. On many farms tile drains have resulted in considerable improvement, though these drains are not so effective as on soil types having less dense subsoils. Broad, high bedding of the land is followed with good results in some cases.

Because of its relatively high content of organic matter and ease of cultivation, this soil type is considered one of the most desirable in the county for general farming. Its high productiveness and the general absence of waste land make it suitable for working intensively. Practically all the type is in farms and nearly all the included land is improved.

The Grundy silt loam is one of the best soils in Van Buren County for corn. The dark color and friable nature of the soil tend to stimulate early growth and the topography permits thorough intertillage with little danger of erosion. Small grains, including oats, wheat, and, to some extent, rye, as well as grass crops, do well on this soil and have a regular place in the crop rotations. Clover is easily grown, and alfalfa, which has recently come into favor, succeeds, especially where the drainage is thorough.

The raising of live stock is incidental to general farming on the Grundy silt loam. As is the case in general throughout the county, there are more beef cattle than dairy cattle. While many cattle are raised, the type is not so generally devoted to grazing as are the Shelby loam, various bottom-land soils, and other types included in farms on which the Grundy silt loam is developed. Some sheep are kept, and hog raising is an important industry. The raising of horses and mules is developed to some extent.

According to reports of farmers, corn on the Grundy silt loam yields from 30 to 80 bushels per acre, averaging about 45 bushels; oats from 25 to 85 bushels, with an average of about 42 bushels; wheat 20 to 35 bushels per acre, averaging about 25 bushels; and rye 20 to 25 bushels per acre. Timothy and clover hay yields from 1 to 2 tons per acre, the average yield being about 1¼ tons. Alfalfa yields 2½ to 3 tons per acre.

Efficient methods are generally followed in farming this land. Breaking is about 6 inches deep. Care is taken in preparing the seed bed and frequent cultivation is given intertilled crops. Practically no commercial fertilizer is used, and green manure is incorporated to only a slight extent. Stable manure is the principal fertilizer.

The selling price of land of the Grundy silt loam varies somewhat with the location and improvements. In the areas south of the Des Moines River values usually are lower than in the northeastern part of the county. In the former localities land of this type is valued

at $100 to $125 an acre and in the latter section of the county at $100 to $165 an acre.

In general, the agricultural methods on this soil are well suited to maintaining it in good condition, crops being diversified to a considerable extent and a large quantity of live stock being kept. Burning stubble and cornstalks, as is sometimes done, is an objectionable practice, as this vegetable matter if returned to the soil would aid in maintaining the organic-matter supply.

GRUNDY CLAY LOAM.

The surface soil of the Grundy clay loam, to a depth of 10 or 12 inches, consists of a dark-brown to black, fairly friable clay loam. The material grades below into a dark-brown or dark brownish drab, compact, plastic silty clay which at about 18 inches shows dull-brown mottlings and contains a few small iron concretions. Beginning at about 22 inches and continuing to 36 inches, the material consists of a sticky, plastic clay or heavy silty clap, of light-drab or grayish-drab color mottled with yellow or rusty yellow and containing small iron concretions. Below 30 inches the color becomes a little lighter and the mottling more pronounced. The texture of the soil in some places tends toward a silty clay loam and in others toward a silty clay.

Scattered here and there throughout the type are less productive white spots, varying in extent from a few square yards to an acre or more. The soil here differs from the typical Grundy clay loam. Borings reveal a layer, 6 to 8 inches deep, consisting of a dark-brown or grayish-brown clay loam or silty clay loam which tends to become compact when wet. This rests on a gray or drab-gray, silty clay loam, occasionally showing brown mottlings and containing small concretions. Below a depth of 10 or 12 inches there is a grayish-brown or dull-drab, sticky, plastic, nearly impervious clay or silty clay, mottled with brown or yellowish brown. Below 24 inches the subsoil does not differ much from that of the typical areas.

The Grundy clay loam is developed entirely in the belt of Grundy silt loam extending in a northwest-southeast direction through the northeastern part of the county. It occurs in strips and isolated patches, one-fourth to one-half mile wide, on flat, level divides. Its principal development is in the vicinity of Stockport, the area extending northwest, southeast, and south from that place.

Drainage on the Grundy clay loam is somewhat deficient, on account of the characteristically nearly level and occasionally slightly depressed surface. The unfavorable surface features and the dense structure of the subsoil lessen the effectiveness of tile drainage.

Practically the whole extent of the type is under cultivation. It is considered fully as productive as the silt loam in seasons of normal

rainfall and is used for the same general-farming crops. Corn is an important crop and usually yields higher than on the silt loam. Small grains, grasses, and clover give good returns.

Corn yields under careful management 65 to 70 bushels, oats about 60 bushels, wheat 25 to 30 bushels, and clover and timothy hay 1¼ to 1½ tons per acre. On the "white spots" corn may be practically a failure and wheat and oats yield below normal. Timothy and bluegrass usually thrive on these spots, but clover may or may not attain a satisfactory growth.

The soil is farmed in about the same way as is the Grundy silt loam. As the type is heavy in texture, it requires care in handling, and for good results must be plowed when moisture conditions are favorable. In preparing the land heavier teams usually are employed than on the lighter textured soils of the county. Fall plowing is practiced whenever possible.

Land values on the Grundy clay loam are said to range about the same as those on the adjoining Grundy silt loam.

Increasing the productiveness of the white spots seems to be the chief problem in connection with the development of this type. No definite conclusions were reached as to the cause of this peculiar condition, though it seems to be due to an accumulation of some injurious constituent of the soil. Improvement of drainage is needed throughout the type. Near Stockport dynamiting of the soil has been tried, but without permanent increase in crop yields or improvement in tilth.

PUTNAM SILT LOAM.

The Putnam silt loam consists of a light-brown, brown, or more rarely dark grayish brown, silt loam, 8 to 12 inches deep. The material is floury as a rule, the crumb structure common to the darker soils being usually absent. Beneath the surface soil lies a lighter colored, friable, usually floury layer, slightly heavier than the surface soil and occasionally carrying a small quantity of iron concretions. This layer is often nearly white. It extends to a depth ranging from 16 to 20 inches, where there is an abrupt change to a heavy clay, tough and plastic when wet, and hard and intractable when dry. Although this clay is reddish brown in exposures, as in cuts, in fresh borings it is mottled dark drab, dark reddish brown, yellowish brown, and gray. The thickness of the layer varies from a few inches to nearly a foot. It changes gradually downward into a more friable and slightly lighter silty clay loam, mottled yellowish brown and bluish gray, the former increasing as a rule with depth until at 3 feet the color is mainly yellowish brown.

The Putnam silt loam occurs on the margins of prairie areas and of forested areas lying on the crests of ridges. It extends out from

the prairies along the broader ridges between the tributary streams flowing into the Des Moines River and the larger creeks. The type is confined to the eastern part of the county, and its total area is only 3.4 square miles. It is much less extensive in this county than in Lee County to the east, since the upland soils become darker colored westward from the rougher lands along the Mississippi River and the light-colored soils disappear.

The Putnam silt loam is derived from the same parent material as is the Grundy silt loam, whether loess or weathered glacial till, the difference between the two soils being largely in color. There has been a translocation of the clay particles originally contained in the surface soil, and their lodging in the subsoil forms the heavy clay layer.

The type is somewhat less productive than the Grundy silt loam and is less easily worked. Under ordinary methods of farming, but without the use of manure or fertilizers, it yields about 25 to 35 bushels of corn or about 40 bushels of oats per acre. Timothy does well, the yields of hay being a ton or more per acre. Under natural conditions clover does not do well, although with the use of bone meal it can be grown with fair success.

MEMPHIS SILT LOAM.

The surface soil of the Memphis silt loam, to a depth of about 8 inches, consists of a light-brown or grayish-brown moderately compact silt loam. Below this is a lighter colored or yellowish-brown silty clay loam, sometimes mottled with yellow and gray, which gradually becomes heavier, and at 20 to 24 inches approximates a heavy plastic silty clay of yellowish-brown or light grayish brown color, mottled with yellow and gray and sometimes with dark brown or black. Generally, small black iron concretions are present in the subsoil and occasionally in the surface soil, as was observed north of Farmington. In many places, especially in areas adjoining the Grundy or Putnam silt loams, the lower part of the surface soil often shows 2 or 3 inches of grayish silt loam, the soil resembling in this characteristic the Putnam series.

The Memphis silt loam and its eroded phase are developed principally in an irregular belt of country, 6 to 10 miles wide, extending northwest and southeast through the county on either side of the Des Moines River. This belt is broadest between Kilbourn and Douds Leando. A small area of the type occupies the slopes along Big Cedar Creek in the northeastern part of the county, as well as the slopes bordering the lower half of Indian Creek. The type is characteristically developed along the more deeply cut main stream slopes, these being broad along the lower course of the streams and narrowing back into the uplands.

On many of the ridges the topography varies from undulating to gently rolling. It is somewhat more rolling on the margins of ridges where the typical soil grades more or less indefinitely into the eroded phase.

Good drainage prevails over most of the type. In some of the more nearly level areas the rain water runs off slowly, and here the drainage is slightly deficient. The dense subsoil, in addition, retards the downward movement of water and crops may be injured in wet seasons. In some places on this type tile drains have been installed, with good results.

The Memphis silt loam ranks second to the Grundy silt loam in importance. Most of the type is in use for general farming. It was originally forested and occasional small tracts still support a growth of white, red, and bur oak, hickory, and elm.

The crops, usually produced in connection with raising live stock, are the same as grown on the Grundy silt loam. Corn is important, although the Memphis is not naturally so well suited to this crop as the Grundy silt loam. Oats, and to some extent wheat and rye, are grown. Timothy and clover succeed. Alfalfa, which is coming into more favor, usually gives good results in well-drained situations. Potatoes and various garden vegetables are produced for home consumption and there are apple and pear orchards, usually of small extent, on nearly every farm. One successful commercial orchard, consisting principally of apples and covering about 160 acres, has been established on the Memphis silt loam near Bonaparte.

Cattle and hogs are raised on all the farms on this type. The cattle in general are kept for beef production. On some farms the raising of horses and mules receives attention, and sheep raising is quite well developed.

Corn yields from 25 to 50 bushels, averaging about 27 bushels per acre; oats, 30 to 60 bushels, averaging about 35 bushels; and wheat ordinarily from 20 to 25 bushels per acre. The yield of timothy and clover hay is ordinarily 1 to 1½ tons per acre.

The cash value of land of this soil type varies with the location and improvements. Prices range from $75 to $150 an acre, being ordinarily between $100 and $125 an acre.

Usually the soil is well farmed. Full use of the stable manure available is generally made, and under the prevailing system of raising live stock in connection with diversified cropping the soil is in general kept in a good state of productiveness. It would, however, be advisable in many cases to increase the supply of organic matter, which could be done by turning under a green-manure crop at some step in the rotation.

Memphis silt loam, eroded phase.—Much of the soil material of the eroded phase does not differ widely from that of the typical Memphis

silt loam, the separation being based on topography, which is steeper and rougher than in case of the typical soil. Over part of the phase there is a lighter colored and shallower surface soil and less subsoil mottling than is true of the typical Memphis silt loam. In some places the subsoil is quite friable and shows little mottling. Bordering many of the ravines, where streams have cut down into the underlying glacial till, are irregular strips of soil essentially the same as the Shelby loam. Here the texture often varies widely, the soil ranging from a yellowish or yellowish-brown, sticky, silty clay to fine and coarse sand. These small areas were not mapped with the Shelby loam, because of the difficulty of showing them on a map of the scale used in the present survey.

The eroded phase of the Memphis silt loam occurs throughout the section occupied by the typical soil. It is in many places not very distinct from the typical Memphis silt loam, the two soils merging gradually into each other. In such places the separation is rather arbitrary. The eroded phase occupies the more or less steep slopes bordering stream courses and is especially well developed along the south valley slopes of eastward or westward flowing streams. The surface usually is more broken nearer the heads of streams than along their lower courses.

Owing to the rolling topography of the phase, the drainage is good to excessive. In seasons of abundant rainfall crops do well, but in droughty seasons they may suffer from lack of moisture.

About the same range of crops is grown as on the typical soil, but much less of the phase is under cultivation, the rough surface being unfavorable for farming. Except for the considerable proportion in forest, chiefly of hickory, white oak, red oak, and elm, the land is largely used for pastures.

Ordinarily crop yields are lower on the eroded phase than on the typical Memphis silt loam because of the shallowness of the surface soil and the lack of uniformity in the soil on the eroded slopes. The pastures on the phase, consisting largely of bluegrass, are excellent and the quality of the growth is considered superior to that of grass on the Grundy silt loam.

Because of limitations in its use, the price of land of this type of soil is low. Usually the phase forms but parts of the farms, the remainder being typical Memphis silt loam or some other soil. Prices as reported by farmers range from $40 to $75 an acre.

In order to maintain the productiveness of the soil and prevent serious erosion, much care is necessary. Deep plowing is advisable, and in addition fields should be kept in some cover crop or vegetative growth as much of the time as possible. When once started the extension of ditches and gullies is difficult to control. All the steeper

and rougher areas can best be used as permanent pasture or forest land.

MARION SILT LOAM.

The soil of the Marion silt loam consists of a light-brown to gray silt loam extending to a depth of 6 to 10 inches, resting on a subsurface layer, 8 to 12 inches thick, of gray to white color, flourlike structure, and silty texture, usually a little heavier than the surface soil. Iron concretions usually are present in the surface soil and may be present in the subsurface material. Beginning abruptly below the latter is a layer of tough, plastic clay, which becomes very hard and compact on drying. Its color in the upper part is brownish and in the lower part mottled gray and rusty brown. This clay extends to depths ranging from 24 to 36 inches, and is underlain by a more friable silty clay layer.

The Marion silt loam occurs in a belt formerly or at present covered with forest as distinguished from the prairie section. To the forest cover is due the relatively low content of organic matter. The occurrence of this type on the flat-topped ridges has favored the development of the tough subsoil layer, which is thought to be due to the translocation of clay particles from the upper part of the soil material.

The soil is derived from the thick layer of silty material covering the uplands over the entire county. This may be loessial in origin or it may have resulted from the weathering of a layer of glacial till. The surface and subsurface materials have been leached, their lime and iron and a large part of their other constituents, except silica and alumina, having been removed.

Yields on the Marion silt loam are somewhat lower than those obtained on the Putnam silt loam. Grain crops give moderate to low yields. Timothy does fairly well.

SHELBY LOAM.

The surface soil material of the Shelby loam varies widely. In general it consists of a brown to dark-brown loam or gritty loam 10 to 12 inches deep. This is underlain by a brownish-gray or yellowish stiff sandy clay loam, which at about 18 inches shows mottlings of yellow and orange yellow. Below the material changes to a yellow, plastic clay or sandy clay, mottled with orange yellow or reddish yellow and drab and containing some small lime nodules and quartzite gravel. In places beds or pockets of fine sand, coarse sand, and gravel are encountered at various depths in the soil section.

Practically all the Shelby loam mapped occurs in association with the Grundy silt loam in the southwestern and southern parts of the county. Scattered areas, however, are recognized elsewhere.

The type occupies slopes approaching stream courses, the areas lying between the stream bottoms and the Grundy silt loam of the uplands. It is consequently developed in narrow strips along the larger, more or less steep slopes, with projecting areas following the ravinelike valleys of the smaller branch streams. Bordering the slopes of many of the streams within areas of the eroded phase of the Memphis silt loam are strips of soil essentially the same as Shelby loam, which are included with the Memphis soil on the map, being undifferentiated on account of their small size and difficulty of separation.

Drainage over the Shelby loam is well established, owing to the rolling to steep topography. A few localities have poor drainage, caused by hillside seepage. Erosion is more or less active in places.

Owing to its unfavorable topography, the Shelby loam is not in general under cultivation. Much of it is used as pasture for live stock, including cattle, horses, sheep, and, to some extent, hogs. Some of the rougher slopes support a growth of hickory, oak, and elm.

Gentler slopes and comparatively smooth areas are farmed with satisfactory results. Corn is said to yield 20 to 40 bushels, oats 15 to 40 bushels, and wheat 10 to 20 bushels per acre. Clover grows successfully, and alfalfa thrives in the better situations. The soil is well suited to bluegrass, which forms the chief pasture grass.

Where the Shelby loam is cultivated, deep plowing and other careful measures are necessary to prevent erosion. The best use of the type in general is as pasture land.

JACKSON SILT LOAM.

The surface soil of the Jackson silt loam is a brown to dark-brown, compact, fairly friable silt loam or silty loam 10 to 12 inches deep. The subsoil is a gray or brownish-gray silt loam, mottled below 16 to 18 inches with yellowish brown, and containing occasional iron concretions. The material becomes heavier with depth, and at about 24 inches is a dense, plastic silty clay, mottled gray, brown, and yellowish brown. Iron concretions are abundant in the lower subsoil. In a few places, where the type adjoins the upland slopes, the surface soil is loamy, or even somewhat sandy, evidently as the result of the addition of colluvial material from the Shelby loam.

The Jackson silt loam is mapped in only a few small areas occupying second-bottom positions along the Fox River. The surface is undulating or slightly sloping to nearly level. The type lies 10 to 15 feet above the first bottoms. With the exception of a few narrow swales fairly good drainage prevails throughout the type.

Practically all the Jackson silt loam has been brought under cultivation. Good results are obtained with the general farm crops. Corn gives estimated yields of 30 to 50 bushels an acre, and the small

grains give satisfactory returns. Good stands of clover and timothy were observed on this soil in the course of the soil survey. The agricultural value seems about the same as that of the Wabash silt loam, but the Jackson soil has the advantage of not being subject to overflows.

BUCKNER GRAVELLY SANDY LOAM.

The surface soil of the Buckner gravelly sandy loam consists of about 12 inches of sticky, slightly gravelly, gritty loam of a brown to dark-brown color. The subsoil at 18 to 20 inches is a light-brown gravelly loam, and below this depth the content of coarse gravel and pebbles becomes so great that boring with the soil auger is practically impossible. A gravel pit near Farmington shows a substratum of coarse gravel several feet thick.

This type is of small extent, being developed almost entirely in the vicinity of Farmington. There is a small area just west of Mount Sterling.

The surface is nearly level or slightly sloping. It lies 10 to 30 feet above the first bottoms. Because of the loose structure of the surface soil and the porous nature of the subsoil the drainage is excessive, and the soil is somewhat droughty.

Except for the area occupied by the town of Farmington, most of the type is cultivated. Some corn is grown. The soil is said to yield 40 bushels or more of corn to the acre and fair yields of small grain in favorable years. Clover generally makes a satisfactory growth. The type is used to some extent for growing tomatoes and cucumbers.

BUCKNER FINE SAND.

The surface soil of the Buckner fine sand consists of 8 to 12 inches of brown to grayish-brown, loamy fine sand. The content of organic matter is rather low and the sand sometimes drifts in exposed situations. The surface soil changes gradually into the subsoil, which consists of a yellowish-brown fine sand, usually extending to 36 inches or more, but in places changing at a depth of 28 or 30 inches into a yellowish, sticky fine sandy loam or clay loam.

The Buckner fine sand is very inextensive. It occurs in narrow strips on terrace fronts at various places along the Des Moines River. The type lies 10 to 20 feet above the first bottoms. The surface is nearly level or somewhat undulating. Owing to the loose, open structure of the soil the drainage is excessive and the type is inclined to be droughty.

Owing to its small extent the type has little bearing on the agriculture of the county. Practically all of it has been brought under cultivation, and in seasons of abundant rainfall crops do nearly as well as on the Wabash fine sandy loam. Generally, however, yields are lower.

The soil needs careful methods of management, especially with a view to increasing the organic-matter supply.

CALHOUN SILT LOAM.

The surface soil of the Calhoun silt loam, to a depth of 10 to 12 inches, is composed of a brown to grayish-brown, compact but fairly friable silt loam, which when dry often presents a lighter color, even a whitish appearance. The surface soil in some areas has a darker color, in places closely resembling the Grundy silt loam. The color is dependent upon the quantity of organic matter, being darker where the content is greater.

Beneath the surface soil is a layer, 3 to 4 inches thick, of whitish or grayish-white mealy silt loam, which changes below into a grayish clay loam mottled with brown. The material from 20 to 24 inches usually becomes a drab or bluish-gray, plastic silty clay, mottled with yellow and brown. Below 30 inches the color becomes lighter, with distinct mottlings of yellow and gray. Small iron concretions are nearly always present in the subsoil and occasionally in the surface material.

The most extensive development of this type is along the Des Moines River, where it occurs on terraces. The principal areas are those in the river bend at Keosauqua and along each side of the river valley between Kilbourn and Selma. Smaller areas are encountered along Chequest Creek and Lick Creek.

The surface is level or undulating to slightly sloping. In places the terrace front is a little higher than the surface farther back. The drop to the first bottom often is a gradual slope one-eighth mile or more in length. The slope in many places is cut by ravines and gullies, which in many instances are gradually extending. In these places rock exposures are sometimes encountered. The larger areas are in many places intersected by small streams, generally having their sources in the higher uplands. The line of juncture of this terrace soil with the upland is not always well defined, and in places the boundary in the map is placed arbitrarily.

The larger areas have an elevation above the first bottoms of 50 to 60 feet, while in the case of many of the smaller areas the difference is not over 20 to 30 feet. The drainage is good in most of the smaller areas, but in some of the broader, flat or slightly depressed areas it is deficient.

Except in topography, the greater proportion of the Calhoun silt loam resembles quite closely the upland soils, especially the Memphis silt loam. It is possible that these terraces may have been formed before the deposition of the loess mantle over the region, in which case the soil would naturally have much of the character of the upland loessial types.

Nearly all the Calhoun silt loam is farmed, the level, smooth surface favoring tillage. All the better drained area is cultivated regularly, and where drainage is deficient the land is valuable as pasture. Some inextensive areas, mainly eroded slopes and strips along ravines, still support a growth of oak, hickory, elm, and other deciduous trees.

Corn usually yields from 25 to 50 bushels, oats 30 to 60 bushels, wheat 20 to 25 bushels, and rye 10 to 20 bushels per acre. Good stands of clover are generally obtained in the better drained areas. Timothy does well on the type, yielding from 1 to 2 tons of hay per acre. Bluegrass makes good pastures. In some places alfalfa probably would give satisfactory results.

Land of this type is managed in about the same way as the Memphis silt loam. The crop rotations followed are usually well balanced. No use is made of commercial fertilizers, dependence being placed mainly on stable manure.

Farms on the Calhoun silt loam are generally valued about the same as on the better areas of the Memphis silt loam. The land usually is held at $75 to $125 an acre, though some well-improved farms in favorable locations are considered worth as much as $150 an acre.

Artificial drainage is needed over parts of this type. The soil is inclined to clod and it should be plowed when in the proper moisture condition. Applications of lime doubtless would aid in improving the tilth. In places the organic content of the soil is low, which in part accounts for the difficulty of obtaining the best seed-bed conditions. Plowing under some green-manure crop and incorporating stable manure are important in the improvement of the soil.

WABASH FINE SANDY LOAM.

The surface soil of the Wabash fine sandy loam is composed of about 12 inches of brown to grayish-brown fine sandy loam of mellow structure. The soil passes gradually into the subsoil, which is a light-brown to brown, slightly sticky fine sandy loam, usually continuing without appreciable change to 36 inches, though in places the subsoil below 20 to 24 inches may become heavier, approximating a loam or sandy clay loam. In this case it is usually mottled with yellow.

A variation of this type occurs in three places in the vicinity of Kilbourn. The soil here consists of a brown to dark-brown sandy loam, 10 to 15 inches deep, underlain by a light-brown sandy loam which at 24 inches changes to a light yellowish brown loamy sand. In position, topography, drainage conditions, and agricultural value this sandy loam soil does not differ greatly from the typical fine sandy loam.

The Wabash fine sandy loam is developed most extensively along the Des Moines River, especially in the southeastern part of the county below Bonaparte and in the vicinity of Farmington. Small areas are encountered just above Keosauqua, and others along Chequest, Holcomb, and Big Cedar Creeks. The areas usually lie along the streams, though occasional areas occur farther back in the bottoms. Along the smaller streams it generally occupies the entire bottoms.

The surface is level to slightly undulating. Drainage is well established, except in a few small sags and swales. In these the soil is often heavier than the typical.

Nearly all the Wabash fine sandy loam has been brought under cultivation. The common farm crops are grown, corn occupying the largest acreage. Corn yields 25 to 45 bushels per acre, oats 30 to 40 bushels, and wheat 15 to 20 bushels per acre. Satisfactory stands of clover are usually obtained and alfalfa is successfully grown in a few places. The soil is well adapted to truck crops, and in the vicinity of Farmington tomatoes are grown to some extent.

Land values on the Wabash fine sandy loam ordinarily range from $75 to $150 an acre.

To maintain the productiveness of this soil it is necessary to add organic matter, and both stable manure and green-manure crops should be turned under from time to time.

WABASH LOAM.

The surface soil of the Wabash loam usually consists of a brown to dark-brown loam or gritty loam, extending to a depth of 10 or 12 inches. This passes below into a light-brown, sticky loam or silty loam, which at 18 to 20 inches becomes slightly mottled with yellow or dark brown. The material gradually becomes heavier, until at 28 to 30 inches it consists of a somewhat sticky sandy clay loam of mottled drab and yellowish-brown color.

This type as mapped is subject to considerable variation, especially in the narrow strips bordering many of the smaller streams. Here sandy, silty, and claylike materials are often mingled in both surface soil and subsoil. These variations also occur to some extent in the more typical areas along the larger streams and abandoned channels.

The type is comparatively inextensive. It is developed mostly along the Des Moines River, where it usually lies adjacent to the stream. Most of the narrower bottom lands of the smaller streams are of this type of soil.

As is typical in general of alluvial bottoms, the surface is level or slightly undulating. Drainage is usually good, but in some of the broader areas there are poorly drained spots.

The agricultural utilization and crop value of the Wabash loam do not vary much from those of the Wabash silt loam. It is perhaps a little better suited to corn and is more easily tilled.

WABASH SILT LOAM.

The surface soil of the Wabash silt loam consists of a grayish-brown to dark-brown silt loam, 10 to 12 inches deep. This passes below into a somewhat more compact silt loam of about the same color, gradually changing into a silty clay loam of lighter color at about 20 inches. At 24 to 30 inches the material becomes a heavy silty clay loam or silty clay of gray or drab color, mottled with brown or yellowish brown. The subsoil of those areas in the vicinity of Douds Leando and Selma usually is a silty clay loam of grayish color, mottled at 12 to 18 inches with yellow and yellowish brown, the color below 24 inches becoming mottled drab. In places, bordering streams and along former stream channels, loamy and sandy variations of the type, of small extent, occur.

The Wabash silt loam is developed along all the larger streams of the county. Along the Des Moines River it is encountered more often bordering a lighter textured soil along the stream and bounded by the upland slope or terrace front on the other side. The type is the predominant soil along Indian Creek and Little Fox River and occurs to a less extent along the Fox River. It is developed along Lick Creek west of Birmingham and in narrow strips along smaller streams in other parts of the county. Areas of this soil seldom exceed one-half mile in width, and most of the developments are not over one-fourth mile wide.

For the most part the surface is level to slightly undulating. In a few places bordering the upland the elevation is a little higher than nearer the stream, and here the type is overflowed only at rare intervals. The areas along the Des Moines River are not so subject to overflow as are those along the smaller streams.

Drainage over the Wabash silt loam is fair, and in seasons of moderate and well-distributed rainfall, when the type is not subject to destructive overflows, crops, as a rule, make good growth.

The soil is considered fairly strong and productive, and a large proportion of the type is cultivated regularly. Some of the lower-lying areas and many of the narrow strips are used for pasture. Some of the less desirable areas are forested with oak, hickory, elm, sycamore, and willow.

Corn is an important crop on this type and is well adapted to the soil. Oats and wheat generally develop satisfactorily, but sometimes these crops lodge before maturity. Corn yields from 20 to 75 bushels per acre, the average being about 45 bushels. Oats yield 30 to 50 bushels per acre and wheat 15 to 25 bushels. Timothy does well, and

good stands of clover are generally obtained. Alfalfa is grown in a few places and should succeed in all well-drained areas.

A considerable proportion of the Wabash silt loam could be improved by drainage. The installation of tile, where other factors justify the expense, would be most efficient, although open ditches are employed in many instances and have proved beneficial. The liability of the type to overflows can be reduced by clearing and straightening the stream channels and by diking. Fall plowing is often necessary in order to make possible suitable preparation of the land in spring.

WABASH CLAY LOAM.

The surface soil of the Wabash clay loam consists of 12 inches of a dark grayish brown to nearly black clay loam or silty clay. The subsoil is a dark-brown or dark-drab, dense, plastic clay or silty clay, mottled with dull brown, yellowish brown or gray and containing occasional iron concretions. This material continues downward to 36 inches without much change, except that the structure becomes more dense and plastic with increase in depth. When wet the soil is sticky, and when dry it becomes hard and forms cracks. It is stiff and intractable, and locally is known as "gumbo."

The Wabash clay loam is developed only along the Fox River, where it occupies most of the bottoms, which are one-half to three-fourths mile wide. Along the outer borders of the bottom there is in many places a small strip of soil of silt loam texture, the result of admixture of material deposited by tributary streams.

The surface of the Wabash clay loam is smooth and level, and in places slightly depressed. Because of this low position and flat surface the drainage is poor. With any considerable rise of the river most of the type is inundated. Overflow waters pass off slowly, and depressed areas often hold water for considerable periods. Some improvement in the drainage has been effected by means of open ditches.

Owing to difficulty of tillage and liability to overflows, full use of this naturally productive soil has not been made. In the spring the soil is so late in warming up that it is often difficult to get corn planted at the proper time, and the crop often fails to mature. In certain favorable situations the yield ranges from 70 to 75 bushels per acre; in other places there may be a total failure. Small grains are somewhat better adapted to the soil than corn, but harvesting machinery is used with difficulty in some seasons on account of the soft condition of the land. Some hay is cut on the type. Good bluegrass pasturage is afforded, and a large part of the type is utilized as pasture land.

In its present condition land values on the Wabash clay loam are variable. Ordinarily the price ranges between $60 and $100 an acre.

The principal need of this soil type is improvement in drainage. At the present time steps are being taken to straighten the course of the Fox River, and when this is accomplished it is probable that ordinary flood waters will be carried off without serious damage. Tile drains probably would be profitable in some areas. A desirable tilth is difficult to obtain, and care must be taken to plow when the soil is in proper moisture condition, otherwise it puddles. Applications of lime undoubtedly would aid in improving the soil structure. With suitable drainage this soil promises to rank among the most valuable in the county for corn and the general-farming crops.

SUMMARY.

Van Buren County is situated in southeastern Iowa, bordering the State of Missouri. It contains 482 square miles, or 308,480 acres. The surface consists of a broad, level plain dissected by southeastwardly flowing streams. The Des Moines River, flowing from the northwest corner to the southeast, divides the county into two nearly equal parts. The smoothest areas in the county are in the northeastern part, though there are other areas of smooth land on divides in the southwestern part. The uplands have an elevation above sea level of between 700 and 800 feet.

Most of the residents of the county are native whites. The population of the county is 15,020, according to the 1910 census. Keosauqua is the county seat. Other larger towns are Farmington, Milton, Bonaparte, and Birmingham. The county has good railroad facilities.

There is a mean annual temperature of 50.6° F., and a mean annual precipitation of 35 inches. The growing season averages 167 days in length.

The prevailing type of agriculture followed in Van Buren County is stock raising and the growing of crops incidental to the support of this industry. The live stock includes beef cattle, hogs, sheep, and horses. The leading crops are corn, oats, wheat, and rye, with clover, timothy, and some alfalfa. Dairying is developed to some extent.

The upland soils of Van Buren County are of loessial and glacial origin, mainly the former. The soils in the stream bottoms are derived from material washed from the uplands. Fourteen types of soil, grouped into nine series, are mapped.

The loessial group comprises the Grundy, Putnam, Memphis, and Marion series.

The Grundy silt loam, mainly a prairie soil, includes the greater part of the dark-colored upland of the county. It is one of the best soils in the county, being well suited to corn and other general farm crops. Some of the flatter areas have slightly deficient drainage. The Grundy clay loam is encountered in narrow strips in the extensive development of Grundy silt loam in the northeastern part of the

county. Though drainage in many places is deficient, the type is a valuable soil for corn, as well as for other crops.

The inextensive Putnam silt loam resembles the Grundy silt loam, but differs in being lighter colored. A characteristic of the type is a light-colored, friable subsurface layer. The type is a somewhat less valuable soil than the Grundy.

The Memphis silt loam, with its eroded phase, ranks in importance next to the Grundy silt loam. It is a light-colored soil, originally forested, and is a good general-farming type, perhaps a little better suited to small grains than to corn. Where not forested the eroded phase is used mostly for pastures.

The Marion silt loam is a light-colored, originally forested soil, low in organic content. Yields are somewhat lower than those obtained on the Putnam silt loam.

The glacial division comprises the Shelby series. The Shelby loam occupies slopes approaching stream courses. Some of the land is cultivated with good success, but owing to the generally steep and uneven topography, the type is largely used for pasture.

The alluvial soils comprise both second-bottom, or terrace, soils and first-bottom soils. The terrace soils are grouped in the Jackson, Buckner, and Calhoun series, and those of the first bottom in the Wabash series.

The Jackson silt loam, derived largely from glacial material, is of small extent, developed only along the Fox River. It is a good soil for general-farming crops.

The Buckner gravelly sandy loam and fine sand are of small extent, and are not of much importance in the agriculture of the county. They are rather droughty soils but give fairly good results with the common crops. The gravelly sandy loam is used to some extent for growing tomatoes and cucumbers.

The Calhoun silt loam, a light-colored terrace soil, is developed mostly along the Des Moines River. It is similar in appearance and crop value to the Memphis silt loam. It differs in having a smoother surface. Most of this type is farmed and is a desirable soil.

The Wabash fine sandy loam is a light-textured soil, developed mainly along the Des Moines River. It is well adapted to the common farm crops, as well as to truck crops. The Wabash loam and silt loam are the most important types of the series. These are good corn soils and they are also well adapted to other crops and to grass. The Wabash clay loam, developed along the Fox River, is a heavy soil, much subject to overflows, and largely undeveloped. It is now used mainly for pastures. Where suitable drainage is established the type should prove to be an excellent soil for corn, and well adapted to grain and forage crops.

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[PUBLIC RESOLUTION—No. 9.]

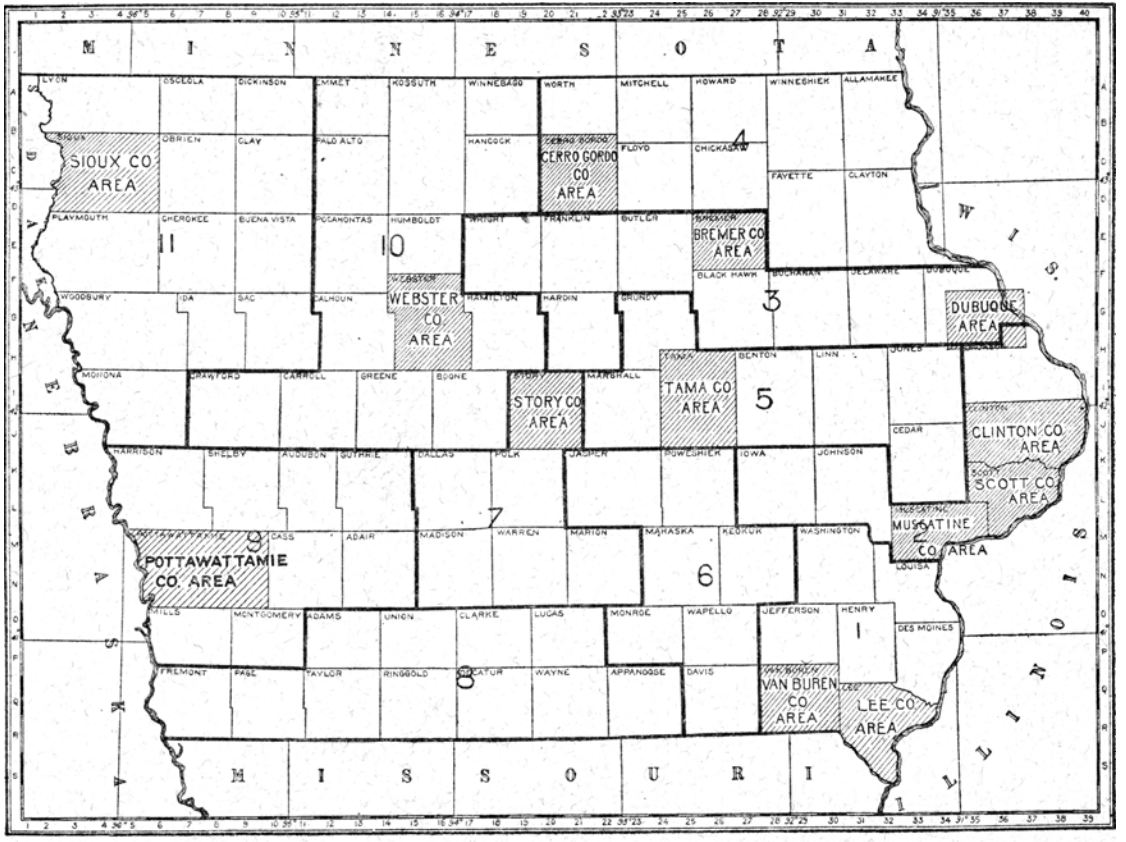
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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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