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Soil Survey
of
Vernon County, Wisconsin

By

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and
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Wisconsin Geological and Natural History Survey

Bureau of Chemistry and Soils

In cooperation with the
Wisconsin Geological and Natural History Survey
and the University of Wisconsin, College of Agriculture

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SOIL SURVEY OF VERNON COUNTY, WISCONSIN

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COUNTY SURVEYED

Vernon County is in the southwestern part of Wisconsin. (Fig. 1.) Mississippi River forms its western boundary, and the southern boundary lies about 65 miles north of the Illinois State line. Viroqua, the county seat, in the west-central part of the county, is 30 miles southeast of La Crosse, and Hillsboro, near the middle of the east county line, is 65 miles northwest of Madison. The total area of the county is 807 square miles, or 516,480 acres.

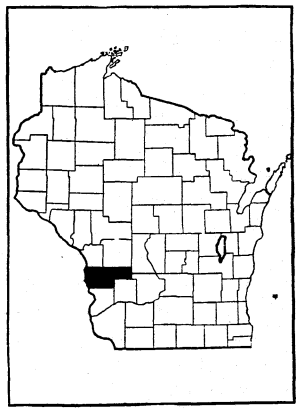

FIGURE 1.—Sketch map showing location of Vernon County, Wis.

The greater part of the county occupies a deeply and thoroughly dissected upland. The valleys are comparatively narrow and steep sided, and the ridges, which range from gently rolling to rolling, vary in width, most of them being from one-third to 1 mile wide. The one notable exception to this thoroughly dissected surface is the undulating or gently rolling ridge which extends north and south about 18 miles east of Mississippi River. The difference in elevation throughout the county ranges from about 200 feet to approximately 550 feet. On the Wisconsin side of Mississippi River the steep rocky bluffs rise almost directly from the first bottoms of the stream to a height ranging from 400 to 500 feet. The total area of the Mississippi River terrace within the county is almost negligible.

Two main stream valleys, and their tributary stream valleys, extend eastward into the county from the Mississippi for a distance of approximately 15 miles. These valleys are very steep walled, there being but narrow strips of alluvial lands in the stream bottoms. The axes of the main ridges in the western part of the county extend in an east and west direction, and the branching side ridges lie approximately at right angles to the main ridges. The relief of the main ridges for the most part is gently rolling, but the side ridges are more rolling and are very narrow. The difference in elevation of the western part of the county ranges from 300 to 500 feet.

East of the steep rough western part of the county lies a broad undulating or gently rolling ridge. This ridge near the northern boundary is about 2 miles wide, but from the vicinity of Westby south to the Crawford County line, it is from 4 to 6 miles wide.

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A prairie occupies the central or main part of the ridge, beginning south of the village of Westby and extending southward beyond Viroqua to the vicinity of Liberty Pole. Small areas and irregular but connected extensions of the main prairie extend southwest, south, and southeast from Liberty Pole for distances ranging from 5 to 9 miles.

That part of the county east of the broad ridge resembles the part west of the ridge in that it is completely dissected. The surface of most of this land is rolling or steep, and the ridges are comparatively narrow. The stream valleys, however, are not so hemmed in by steep bluffs, as broader areas or strips of rolling land occur between the stream bottoms or terraces and the steep stony escarpments. The difference in elevation also is less in this part of the county, ranging from about 280 feet to approximately 420 feet. The northeastern part of the eastern half of the county (that part lying within the drainage system of Baraboo River) has fewer and shorter steep precipitous slopes, and the relief in general is more continuously rolling.

The entire area of Vernon County lies within the drainage basin of Mississippi River, the western third of the county draining directly into the river. Kickapoo River, a tributary of Wisconsin River, drains the central part and the headwaters of Pine and Baraboo Rivers, both tributaries of Wisconsin River, are in the eastern part. Wisconsin River joins the Mississippi about 30 miles south of Vernon County.

With the exception of the Mississippi River bottoms, the bottom lands of the streams of Vernon County are very narrow. The Coon Creek bottoms, which are the widest, average only about one-half mile wide, and the Kickapoo River bottom lands south from Viola are also about one-half mile wide, but in the valleys of Bad Axe and Baraboo Rivers the bottom lands are one-fourth mile or less in width. That part of the Mississippi River bottom which lies in Vernon County ranges in width from 3 miles at the La Crosse County line to practically nothing at Genoa.

The elevation of the county ranges from about 635 feet above sea level along Mississippi River to 1,340 feet on the central ridge north of Westby. The approximate elevations of various points in the county are as follows: Mississippi River at Genoa, 635 feet; Bad Axe River, 11 miles from its confluence with Mississippi River, 740 feet; ridge top near Genoa, within one-third mile of Mississippi River, 1,120 feet; broad central ridge north of Westby on the Monroe County line, 1,340 feet; broad central ridge at Folsom near the Crawford County line, 1,180 feet; Kickapoo River at Ontario, Monroe County line, 865 feet; Kickapoo River at Readstown, Crawford County line, 720 feet; Debello School, elevation of high ridges in eastern part of the county, 1,320 feet; low ridge (below limestone) 1 mile southwest of Hillsboro, 1,060 feet; and Baraboo River at Juneau County line, 920 feet.

Vernon County was settled and is still occupied by thrifty agricultural people. Permanent settlement of the county started in 1844 when the first white settler, John McCullough, took up his residence near Liberty Pole. He was followed by a few families who arrived at intervals during the following two years, after which

settlement was rapid, and by 1855 the population of the county was about 4,800. Most of the earlier settlers were of English descent and came from Illinois, Ohio, the New England States, and the North Atlantic States and settled in the vicinities of Liberty Pole, West Prairie, and Springville. The first settlers in the eastern part of the county arrived in 1850.

People of American stock were the early pioneers of the county, but they were followed in a very few years by northern European immigrants, particularly Norwegians, Bohemians, Germans, and Irish. People of Norwegian descent are predominant in the vicinity of Westby and Viroqua, and people of Bohemian descent dominate in the townships of Greenwood and Hillsboro.

According to the 1930 Federal census report,[1] the total population of the county is 28,537, 90.2 per cent of which is classed as rural. The average density of the population is 34.8 persons a square mile. Viroqua, the only city in the county, has a population of 2,792; Westby, the next largest municipality, has 1,366 inhabitants; and Hillsboro, the third largest, has 972. A number of other incorporated towns are well distributed over the county.

Vernon County, prior to 1851, was a part of the then extensive county of Crawford. The present boundaries were established in 1851, and the name Bad Axe given as its designation, but this name was changed to Vernon in 1862.

Vernon County has no near-by large market centers available at which its products may be sold, but it is well supplied with shipping facilities to the dairy and livestock markets of Chicago, Milwaukee, St. Paul, and Minneapolis. The distance by rail to Chicago is approximately 260 miles, and to Milwaukee 185 miles. The 12 shipping points within the county are served by 5 rail transportation lines. The Chicago, Burlington & Quincy Railroad serves the 4 shipping points of the Mississippi Valley including the town of Stoddard; the La Crosse & Southeastern Railway serves Westby, Viroqua, and Coon Valley; the Hillsboro & Northeastern Railway affords Hillsboro an outlet to a trunk line of the Chicago & North Western Railway; a branch line of the Chicago, Milwaukee, St. Paul & Pacific Railroad, joining a trunk line at Sparta, serves Viroqua and Westby; and another branch line of this last-mentioned railroad, extending from its Prairie du Chien division, serves the shipping points of the Kickapoo Valley. In addition to being served by five railroad lines, several bus lines afford scheduled passenger transportation to many of the larger near-by cities and to the distant points of Chicago, Milwaukee, Minneapolis, and St. Paul.

The county is traversed by a complete network of highways that afford easy access to all parts. All the main traveled roads are graded and are maintained under a highway patrol system. Those highways having the heaviest traffic are surfaced with gravel, crushed rock, bituminous material, or concrete. These surfaced highways, together with the surfaced highways of adjoining counties, afford all-weather outlets for highway traffic to the northwest, south, southeast, and east.

[1] Soil survey reports are dated as of the year in which the field work was completed. Later census figures are given whenever possible.

CLIMATE

The climate of Vernon County is characterized by comparatively long cold winters and short but warm summers. The humidity, as compared to oceanic humidity, is low, rapid temperature changes are common, and there are no prevailing winds controlled by a large body of water. The variation in temperature during all seasons is wide, the usual range during the coldest winter months being from 50° or 55° F. to about −25°. During the summer the temperature ordinarily ranges from 48° to 95°. Extremes beyond the above ranges, however, are not infrequent. The coldest periods of the winter are generally of two or three days' duration and are followed by gradually rising temperatures. Hot periods are invariably experienced during the summer but seldom last more than a few days.

The western edge of Vernon County has a noticeably longer period between the average dates of the last and the first killing frosts than does the eastern part of the county, the difference amounting to approximately 30 days. There is also a noticeable difference in the length of the frost-free period on the high ridge land areas as compared to that in the comparatively low-lying valley lands. Owing to the higher elevation of the ridges and the consequent better air drainage, they are free from frost for a longer period of time than are the valleys. The frost hazard, however, is not severe enough in any part of the county, except on the low stream bottoms, to prevent the profitable growing of corn, although it is frequently damaged. The common use of silos throughout the county acts as a guaranty against severe losses of the corn crop due to untimely frosts. The tobacco crop occasionally suffers from early fall frosts, and fruit from late spring frosts. Winter wheat and new clover and alfalfa seedings are sometimes damaged because of injury to the roots by alternate freezing and thawing during winter or early spring. The average dates of the latest and earliest killing frosts at Viroqua are May 5 and October 4, respectively, and at Hillsboro are May 18 and September 23, giving an average frost-free season of 151 days at Viroqua and 127 days at Hillsboro. Killing frosts have been recorded at Viroqua as late as June 1 and as early as September 13, and at Hillsboro as late as June 12 and as early as August 30.

The rainfall is adequate and well distributed for crop production. Almost 70 per cent of the total annual precipitation occurs between April 1 and September 30, which period practically includes the entire growing season. Short periods of drought, which occur mostly during the summer, interfere to some extent with the proper growth and development of crops. Severe droughty periods seldom last more than 10 days and very seldom cause the total loss of any one crop. Shallow-rooted pasture grasses are generally the first to suffer from dry weather. Occasionally grazing on these grasses becomes scant during July and August. The climatic conditions plus the diversified farming of Vernon County practically insure good yields from some, if not all, of the crops grown.

Tables 1 and 2 give the more important climatic data for Vernon County, as recorded at the United States Weather Bureau stations at Viroqua in the west-central part of the county and at Hillsboro near the middle of the eastern county boundary.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Viroqua, Wis.*

[Elevation, 1,274 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1906)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	20.7	54	−27	1.39	0.83	1.79	9.8
January	15.0	55	−33	1.15	1.10	2.51	10.8
February	16.9	56	−31	1.05	.68	.96	8.0
Winter	17.5	56	−33	3.59	2.61	5.26	28.6
March	33.0	79	−18	1.86	[1]	3.66	6.0
April	45.6	87	10	3.09	2.90	.86	2.4
May	56.8	92	23	4.78	1.83	7.92	.1
Spring	45.1	92	−18	9.73	4.73	12.44	8.5
June	65.9	100	30	4.35	.25	6.51	.0
July	71.0	103	42	4.27	1.98	3.10	.0
August	68.6	100	35	3.66	4.10	3.32	.0
Summer	68.5	103	30	12.28	6.33	12.93	.0
September	60.8	95	21	3.89	5.03	5.30	.0
October	49.1	86	10	2.70	.97	3.14	1.0
November	33.5	70	−10	1.68	.44	2.44	4.3
Fall	47.8	95	−10	8.27	6.44	10.88	5.3
Year	44.6	103	−33	33.87	20.11	41.51	42.4

[1] Trace.

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

[Elevation, 980 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1925)	Total amount for the wettest year (1913)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	19.6	57	−32	1.43	2.05	0.38	9.9
January	13.8	53	−45	1.39	2.30	1.65	10.5
February	15.2	62	−44	1.27	.75	.80	9.4
Winter	16.2	62	−45	4.09	5.10	2.83	29.8
March	29.4	80	−26	1.86	.70	4.11	6.5
April	44.3	86	4	3.02	.75	2.38	2.4
May	55.2	91	21	4.60	2.93	7.77	.1
Spring	43.0	91	−26	9.48	4.38	14.26	9.0
June	64.7	100	25	4.43	2.01	4.02	.0
July	69.2	106	35	3.66	2.46	6.91	.0
August	66.7	102	28	3.38	3.22	2.69	.0
Summer	66.9	106	25	11.47	7.69	13.62	.0
September	59.5	96	16	3.56	1.62	6.57	[1]
October	47.6	87	4	2.45	.12	2.73	.6
November	32.7	71	−15	1.64	1.38	1.77	3.0
Fall	46.6	96	−15	7.65	3.12	11.07	3.6
Year	43.2	106	−45	32.69	20.29	41.78	42.4

[1] Trace.

AGRICULTURE

During the early years of Vernon County's agricultural development, wheat was the main cash crop. Other crops, such as corn and hay, were produced for feed for the few necessary domestic animals and for household use. According to the meager information available, a few years after settlement was well on its way, sheep raising began to develop beyond local needs. With increased settlement, improved transportation facilities, and a greater number of accessible markets, other farm products, particularly animal products, increased in volume.

Table 3 gives the acreage and production of the principal crops grown in Vernon County in stated years. The data given for the years 1879 to 1924, inclusive, are taken from the reports of the Federal census, and the data for the years 1926 and 1927 and the average acre yields, 1918–1926, are taken from a State bulletin.[2]

TABLE 3.—*Acreage and production of principal crops in Vernon County, Wis., in stated years*

Crop	1879		1889		1899	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	21,655	707,536	28,711	925,451	30,477	940,010
Oats	24,810	829,947	46,949	1,707,619	60,107	1,895,020
Wheat	51,316	657,708	22,837	372,057	18,333	280,510
Barley	4,207	93,445	4,467	133,095	6,120	168,140
Potatoes		149,882	2,728	318,199	2,536	248,553
		Tons		*Tons*		*Tons*
Tame hay	[a] 26,753	34,761	[a] 42,816	59,172	54,805	73,004
Clover					5,973	8,525
Alfalfa					7	7
Wild hay					810	955
Grains cut green					416	563
		Pounds		*Pounds*		*Pounds*
Tobacco	39	35,170	338	458,750	3,833	4,759,520
	Trees		*Trees*		*Trees*	
Maple sugar		34,291		13,140		
		Gallons		*Gallons*		*Gallons*
Maple sirup		3,828		3,083		86
		Bushels		*Bushels*		*Bushels*
Apples			20,208	30,091	90,981	18,701
	Vines	*Pounds*	*Vines*	*Pounds*	*Vines*	*Pounds*
Grapes					4,245	9,186

Crop	1909		1919		1924	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	26,017	791,272	24,152	977,572	13,173	307,392
Oats	42,589	1,276,326	43,177	1,422,784	44,310	1,460,395
Wheat	3,894	73,087	12,148	218,634	3,607	90,182
Barley	16,487	429,964	9,776	245,212	4,727	144,626
Potatoes	2,425	319,026	2,016	138,652	1,596	231,209
		Tons		*Tons*		*Tons*
Tame hay	69,820	109,440	74,849	113,917	[a] 91,007	125,825
Timothy	11,865	17,553	13,378	18,733	12,006	
Timothy and clover	55,357	87,379	58,173	89,675	67,416	
Clover	1,492	2,851	2,355	3,997	3,482	
Alfalfa	21	65	261	606	1,899	
Wild hay	1,877	2,693	1,366	2,124	2,110	

[a] All hay.

[2] EBLING, W. H. WISCONSIN AGRICULTURE, A STATISTICAL ATLAS, 1926–1927. Wis. Dept. Agr. Bul. 90, 102 p., illus. 1928.

TABLE 3.—*Acreage and production of principal crops, etc.*—Continued.

Crop	1909		1919		1924	
	Acres	*Tons*	*Acres*	*Tons*	*Acres*	*Tons*
Grains cut green	279	442	516	753	1,486	
Silage crops			7,031	60,373	[b] 15,542	99,764
		Pounds		*Pounds*		*Pounds*
Tobacco	6,541	7,279,245	8,858	10,707,138	8,317	7,407,813
	Trees		*Trees*		*Trees*	
Maple sugar	26,649	2,889	23,055	506		
		Gallons		*Gallons*		*Gallons*
Maple sirup		7,703		7,073		
		Bushels		*Bushels*		*Bushels*
Apples	70,925	72,848	66,119	35,885	49,413	11,022
	Vines	*Pounds*	*Vines*	*Pounds*	*Vines*	*Pounds*
Grapes	2,754	6,667	2,721	14,206	4,552	

Crop	1926		1927		Average acre yield, 1918–1926
	Acres	*Bushels*	*Acres*	*Bushels*	*Bushels*
Corn	18,310	732,400	12,650	493,350	42.1
Oats	43,670	1,484,780	40,350	1,573,650	38.4
Wheat	3,230	65,540	3,340	74,380	18.6
Barley	7,150	235,950	9,420	348,540	31.4
Potatoes	1,560	198,120	1,560	145,080	114.1
		Tons		*Tons*	*Tons*
Tame hay	89,000	153,127	90,480	191,116	1.54
Timothy and clover	82,050	139,485	83,460	175,266	1.58
Alfalfa	3,100	8,060	3,560	9,968	2.53
Wild hay	2,020	3,232	1,820	2,002	1.32
Silage crops	12,210	94,017	17,450	106,445	8.5
		Pounds		*Pounds*	*Pounds*
Tobacco	6,780	7,458,000	7,100	8,094,000	1,141.2

[b] In addition to corn harvested for grain and that cut for silage, 3,560 acres were cut for fodder and 1,350 acres were hogged off.

According to the United States census report of 1880, the acreage of wheat in 1879 was 49 per cent of the total grain acreage, whereas in 1919, immediately following the World War, the wheat acreage was only 13 per cent of the total grain acreage. According to Bulletin 90 of the Wisconsin Department of Agriculture, the wheat acreage in 1927 was only 3.8 per cent of the total grain acreage. During the last 45 years, the acreage of oats has increased from 24 per cent of the total grain acreage to 46 per cent, corn from 21 per cent to 40 per cent, and barley from 4 per cent to 11 per cent. Although the increased acreage of grain other than wheat covers some of the loss shown in the wheat acreage, a greater increase is shown in the acreage of hay. In 1879, the acreage of all hay crops was equal to 25 per cent of the grain acreage, but in 1924, the acreage of hay crops was equal to 104 per cent of the grain acreage.

A desirable change is evident in the hay crops grown in the county. The United States census reports show that the acreage of legume hay has increased markedly during the last 25 years. In 1899 alfalfa was grown on only 7 acres, but in 1919 the acreage had increased to 261 acres, and in 1927 alfalfa was grown on an estimated area of 3,560 acres. The acreage of clover has also increased.

Tobacco, the most important cash crop of the county, showed a continuous increase in acreage between 1879 and 1919, and the acreage has remained about the same since the latter date. Throughout the central part of the county, tobacco is a very important factor, both in the determination of the farm income and in the cropping system.

The great change in the relative acreage of grain and hay crops has been brought about by the change from wheat farming to that of livestock farming, particularly dairying. During the early development of livestock farming, beef production was of greater importance than was the production of dairy products, but during the last 20 or 30 years the trend has been in favor of dairy products. According to United States census figures the value of dairy products, excluding those used at home, in 1919 was three times their value in 1909 and sixteen times their value in 1899. It must be remembered, however, that the value per unit of production was lower in 1909 and 1899 than in 1919. For example, according to the United States Department of Agriculture Yearbook for 1927, the average wholesale price of butter scoring 92 on the New York market in 1910 was 30 cents a pound, and in 1927 the average price was 47 cents a pound.

In Vernon County the agriculture of to-day consists largely of dairying supplemented by hog or sheep production and in some localities by cash crops. On many farms, the production of both meat animals and cash crops supplement dairying. A flock of poultry is raised on every farm.

The Wisconsin State Department of Agriculture reports 66,700 head of cattle in Vernon County on January 1, 1928, of which 42,800 head were milk cows and heifers more than 2 years of age. The principal breeds of cattle are Guernsey, milking Shorthorn, Holstein, and Jersey, but most of the cattle of the county are grades and mixed breeds. Some purebred herds are in the county, and constant improvement of the dairy herds through selection and the use of purebred sires is taking place. The milk is made into butter and American cheese with the exception of that part which is taken by the condensery located at Hillsboro, the only one in the county. The Wisconsin Department of Agriculture reports 16 creameries and 22 cheese factories in the county in 1927. Most of the cheese factories are in the eastern half. Some dairy animals are shipped out for milking and breeding purposes.

In addition to the dairy herds some Hereford cattle are raised in Vernon County. It is a common practice of many farmers, those having cattle other than high-grade or purebred Jersey, Guernsey, and Holstein, to raise a few young cattle for beef. Most of the beef animals are spring calves held through two winters and then sold the following fall direct from pasture. Practically no feeding or finishing of beef cattle is practiced.

The Wisconsin Department of Agriculture reports 26,000 head of swine in Vernon County on January 1, 1928. Swine are well distributed over the county although a few farmers raise none. The average number a farm is low, as few farmers raise hogs on a large scale. Most of the market hogs are farrowed in the spring and sold at ages ranging from 6 to 10 months. Some fall-farrowed

pigs are sold on the market the following spring and summer. Spring pigs are run on pasture and fed a comparatively light ration until the fall grain is available for feed. Corn is the most common fattening feed, although some barley and oats are used.

The Wisconsin Department of Agriculture reports 15,400 sheep in Vernon County on January 1, 1928, most of which are raised in the eastern half of the county. Lambs are dropped in spring and fattened for market the following fall or winter. Most of the sheep are of the dual-purpose breeds, being raised for both wool and mutton. Shropshire is the most common breed.

On most farms the flocks of chickens range from 50 to 200 fowls. The total number of poultry in the county on January 1, 1928, was 285,000 which includes chickens, ducks, geese, and turkeys. Poultry and eggs are marketed to a large extent through the local retail dealers. The most common breeds of chickens are White Leghorn and Barred Plymouth Rock.

The principal subsistence crops grown in the county are oats, corn, barley, and tame hay, and the cash crops are tobacco, potatoes, cucumbers, wheat, maple sugar, maple sirup, and berries.

Tame hay, including timothy, mixed timothy and clover, and alfalfa, occupies the greatest acreage of any crop grown and has the greatest farm value. Mixed timothy and clover is the most common hay crop, pure timothy hay being largely the result of the clover having been killed out or having failed to catch. Mixed timothy and clover is grown throughout the county and on all the cultivated soils. Alfalfa, although not so extensively grown, is becoming an important forage crop in Vernon County and is grown on many farms. It is considered the best feed grown in the county for dairy cattle, and it is grown on all the well-drained soils. For best results alfalfa requires an acre application of 2 or 3 tons of crushed limestone. Alsike and mammoth clovers are grown to some extent. Alsike clover is adapted to the more poorly drained soils, and mammoth clover is the most satisfactory legume hay for sandy soils and is also of great value as a green-manure crop. Hay crops of minor importance are soybeans, sweetclover, Sudan grass, and green oats, most of which are emergency hay crops.

The oat crop ranks second in acreage, and it is grown on all the cultivated soils of the county. The best yields are produced on the so-called "clay soils" of the high ridges, such as Clinton and Dubuque silt loams. It is a common nurse crop for clover and alfalfa, although barley and wheat are considered more desirable for this purpose. The grain is fed to all livestock, and the straw is used as bedding for livestock and as forage for horses and young animals. When used as hog feed, oats are generally ground and fed wet.

Corn is the third most important crop grown, both as regards acreage and farm value. It is grown on practically every farm, but in the hilliest sections of the county the acreage is small. Corn is best adapted to the smooth deep silty soils, such as Tama, Waukesha, and Clinton silt loams. It is generally grown in rotation with small grain and hay, and in the hillier sections is very seldom grown two successive years on the same land. About 50 per cent of the corn crop is used as silage and the remainder as grain feed for cattle and hogs, the fodder being fed as roughage to cattle.

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Barley ranks fourth in acreage of farm crops and fifth in farm value. It is grown on all the well-drained soils, but like oats it is best adapted to the light-colored silt loams. It is a common crop but is not so widely grown as are oats and corn. It is used as grain feed for hogs and cattle and is an ideal nurse crop for clover and alfalfa.

The acreage of rye is very small. This is a sandy soil crop and is the best adapted of all grain crops to such soils. It is used as feed, particularly for hogs.

Of the cash crops, tobacco is by far the most important. It ranks fifth in acreage of all farm crops and second in farm value. The center of production of this crop is in the vicinity of Viroqua and Westby, and in this part of the county most of the farmers devote from 8 to 12 acres to tobacco each year. Eastward and westward from this locality, the tobacco acreage diminishes and fewer farmers grow it. Tama, Waukesha, Clinton, and Bertrand silt loams are probably the soils best adapted to this crop. Tobacco is sold either to local buyers or is handled by the tobacco pool, a farmers' cooperative association. The best tobacco grown in Vernon County is used for cigar binders and wrappers.

Wheat ranks sixth in acreage of crops and seventh in farm value. Although it is to be considered a cash crop, part of it is used for household consumption and the poorest-quality grain is used as feed for livestock. It is grown throughout the county but not on all farms, commonly on the light-colored well-drained silt loam soils.

Potatoes rank eighth in acreage and sixth in farm value. Most of the potatoes are grown for home consumption, but a few are marketed in years when the production is heavy. Potatoes are grown on the smooth well-drained soils, such as Waukesha silt loam, Bertrand silt loam, and Clinton silt loam.

Clover seed (medium red and mammoth) is produced throughout most of the county, mainly in the western quarter and the remainder in the eastern half. A total of 2,400 bushels, valued at $42,480, was produced in 1927. The best yields are obtained on the light-colored soils of the high ridges, such as Clinton and Dubuque silt loams. Clover seed does not produce well on the dark-colored soils, such as Tama, Dodgeville, Waukesha, and Bates silt loams. The yields vary widely from one year to another, depending to a large extent on climatic conditions during the development of the blossoms.

A few cucumbers are produced in the vicinity of La Farge, where the only salting station in the county is located. In 1925, 690 bushels valued at $545 were produced, according to the Biennial Crop and Livestock Review of the Wisconsin State Department of Agriculture. Cucumbers are grown on the valley soils mainly, preferably on loams and fine sandy loams.

Maple sirup and maple sugar are derived from the sugar-maple trees. Most of these products are produced in the central part of the Kickapoo Valley. Owing to the continuous removal of the timber, the quantity of these products is diminishing each year.

Other crops grown in the county in 1927, which were reported by the Wisconsin Department of Agriculture, included 80 acres of dry peas and 70 acres of canning peas. Strawberries, cabbage, sweet corn, apples, and grapes are commonly and widely grown products

which are used almost wholly on the farms where produced, but an occasional surplus is placed on the market. Red raspberries and blackberries, both wild and cultivated, keep the local markets well supplied during the season.

The use of commercial fertilizers, although not very common, is becoming more widespread from year to year. Complete fertilizers for corn and tobacco are probably those most commonly used. A considerable amount of crushed limestone, either obtained from local quarries or shipped into the county by rail from large commercial quarries, is being used throughout the county in starting alfalfa. The United States census states that $13,283 was spent for fertilizer, including lime, on 241 farms reporting such expenditure in 1924. The amount of fertilizer used annually has increased considerably since that year.

The well-operated dairy farms in Vernon County demand rather extensive and complete supplies of equipment. Good barns for housing all livestock and feed are prime requisites, and housing facilities for machinery are needed. During the last 10 years the silo has become a necessary accessory to the best dairy farms, and according to Bulletin 90 of the Wisconsin Department of Agriculture, one-half the farms were equipped with silos in 1927. This same authority gives the average valuation of farm buildings at about $3,100 a farm. Horses furnish most of the draft power, although a few farmers use mules, the average number of work animals on a farm being three. Many farmers own tractors, and 457 were used in the county in 1927.

Farm machinery on the average farm consists of single and gang plows, disk and other harrows, grain drill, corn planter, cultivators, mower, reaper, corn binder, manure spreader, wagons, and a small stationary gas engine. Practically every farm is equipped with a good well and either a windmill or gas engine for pumping. Many farms are equipped with light trucks, milking machines, and feed grinders, and some are furnished with electricity for light and power, supplied either from an individual plant or from a power line. Most of the creamery patrons own their own cream separators. Silo fillers, grain separators, and corn huskers are operated and owned either by individuals or cooperatively by a small group of farmers.

Practically all the farms are supplied with fair or good fences. All pasture land is fenced and most cropped fields are separated by cattle-proof fences. In some localities, where the farms include sufficient nontillable land to furnish grazing throughout the summer, the cropped fields are not separated by fences, because the cattle are allowed to run on these fields only late in the fall after all the crops have been harvested.

Farm labor is almost wholly American and is fairly efficient. During recent years the tendency has been to operate the farms with less labor, either by using more machinery or by cultivating less land. Although the supply of farm labor, as a rule, is not plentiful, it seems sufficient to satisfy the demand except during the busiest seasons. Most of the laborers are hired by the month during the busiest five or six months of the growing and harvesting season, and on some of the larger farms some laborers are hired by the year. On such farms, day laborers are employed during the busiest seasons, or for specific

purposes, such as fence building and wood cutting. Farm wages range from $40 to $50 a month. The total amount expended for labor during the year 1924, according to the United States census, was $463,200 on the 2,204 farms reporting such expenditure.

The average size of the farms in 1924, according to the United States census, was 117.6 acres. The largest farms are located in the more rolling parts of the county where they include considerable rough nontillable land, and in these localities many farms range from 200 to 350 acres in size. In the vicinity of Westby and Viroqua, where from 70 to 95 per cent of the farm land is tillable, the size of the farms ranges from 60 to 100 acres.

Farm tenancy has gradually increased during each decade since 1880. At that time only 7.6 per cent of the farms were operated by tenants, but in 1925 farm tenancy had increased to 18 per cent. Farm tenancy is either under a cash-rent or share-rent system, the last being the most common. Under the cash-rent system the renter pays a stipulated cash sum for the use of the farm, furnishes all equipment and labor, and receives all the farm income. The usual rental period is one year. The share-rent system is somewhat variable. Under a common arrangement, the renter furnishes the labor, horses, machinery, and part of the productive livestock, the owner furnishes the farm and part of the productive livestock, and the farm income is equally divided between owner and renter. Under another agreement the productive livestock is furnished by the owner and the income is divided equally.

Prices of farm land in Vernon County vary widely, and are, of course, subject to change from time to time. The value of the best land in 1928, according to actual sales, is from $150 to $200 an acre including buildings. Farms in the hilly sections, made up for the most part of the rolling silt loam soils and rough nontillable land, are valued at prices ranging from $50 to $90 an acre. Owing to the fact that farms are sold under various conditions and that most farms include two or more soils, it is impossible to establish with any degree of accuracy an actual monetary value for each soil type. A relative value, however, can be established with some degree of accuracy by a comparative rating of the soils according to their productivity and range of usefulness. If the best soil is given a rating of approximately 100, the comparative values of the other soils can be indicated by numbers ranging from 100 downward. For such a rating comparative numerical values may be given to the soils of the county as follows: Tama silt loam, Waukesha silt loam, and Bates silt loam, from 95 to 100 per cent; Clinton silt loam and Bertrand silt loam, from 93 to 98 per cent; Dubuque silt loam, deep phase, and Dodgeville silt loam, from 85 to 95 per cent; Boone silt loam, Dubuque silt loam, Tama silt loam, steep phase, and Bertrand loam, from 75 to 90 per cent; Bertrand fine sandy loam, from 70 to 80 per cent; Clinton silt loam, steep phase, Dodgeville silt loam, steep phase, and Bates silt loam, steep phase, from 55 to 75 per cent; Boone silt loam, steep phase, Dubuque silt loam, steep phase, and Sparta sand, brown phase, from 35 to 60 per cent; Boone loam, steep phase, Boone fine sandy loam, steep phase, and Ray silt loam, from 25 to 40 per cent; Wabash silt loam and Genesee fine sandy loam, from 10 to 30 per cent; and meadow, rough broken land, and peat, from 3 to 12 per cent.

SOIL SERIES AND TYPES

The aim of the soil survey is to study and classify the soils, to construct a map showing the various soils and their location, to describe their characteristics, and to show their relation to agriculture. The soil classification is based on the evident characteristics of the soils. There are two categories, or divisions, of the soil classification scheme which have local significance. The major of these two categories is based on variation in the structure, color, and relative arrangement and thickness of the natural soil layers and on the chemical composition of the several layers. A soil group or division based on these characteristics is called a soil series. The second grouping, or minor subdivision, is based on the relative amount of sand, silt, and clay in the surface soil. This characteristic of the soil is called texture, and a subdivision based on the texture of the surface soil is called a soil type and is the unit of classification used in soil survey work.

In basic construction, the soil map differs little from an ordinary map except that it distinguishes the soils of the area surveyed. The scale of the map is 1 inch to 1 mile. The various culture symbols are explained in the map legend. The soil areas are outlined with solid black lines, and each soil is represented on the map by a distinct and separate color and letter symbol. In referring to the soil report for information regarding the soils in any particular part of the area surveyed, by noting the soil boundaries and the soil symbols and colors that appear on the map, and by referring these to the soil legend, the name or names of the soils that occur within the particular part can be readily ascertained. The text of the report explains the characteristics of the soils and gives general information in regard to crops, yields, and methods of farming.

The Clinton series includes the soils of the high ridges that have a deep light-colored silty soil profile. The 8-inch surface layer is grayish-brown friable silt loam, below which is a heavier-textured more compact yellowish-brown layer. The underlying soil material is soft friable lighter-colored silt that extends to a depth of more than 4 feet below the surface. One type, Clinton silt loam, with a steep phase, is mapped in Vernon County.

The Dubuque series comprises the light-colored soils of the high ridges that are similar to the Clinton soils with the exception that cherty silt or cherty clay is reached at a depth ranging from 28 to 40 inches below the surface. One type, Dubuque silt loam, with a steep phase and a deep phase, is mapped.

Included in the Tama series are the deep silt loam prairie soils of the high ridges. The surface layer to a depth of 10 or 12 inches is very dark brown or nearly black silt loam. This layer is underlain by lighter-brown silt loam that becomes still lighter colored with depth. The silty material extends to a depth of 4 feet or more below the surface. Tama silt loam, with a steep phase, is mapped.

The shallow prairie soils of the high ridges have been grouped in the Dodgeville series. The surface soil resembles that of the Tama soils. At a depth of about 20 inches, however, cherty dark reddish-brown clay is present. One type, Dodgeville silt loam, with a steep phase, is mapped.

The Boone series includes the light-colored soils on the valley slopes. They are underlain at a depth ranging from 2 to 10 feet by sandstone or shale. Three soils of the Boone series, the fine sandy loam, loam, and silt loam, each with a steep phase, are mapped.

Included in the Bates series are the prairie, or dark-colored, soils on the valley slopes. The surface soil is nearly black, but the subsoil is lighter. Sandstone or shale is reached at a depth ranging from 2½ to 4 feet. Bates silt loam, with a steep phase, is mapped in Vernon County.

The Bertrand series is characterized by light-colored well-drained heavier-textured soils occurring on the smooth or nearly level benches, or terraces, bordering the larger streams. Three soils of this series, the fine sandy loam, loam, and silt loam, are mapped in this county.

The dark or nearly black soils, which occur on the smooth or nearly level benches or terraces bordering the larger streams, are grouped in the Waukesha series. Waukesha silt loam is mapped in Vernon County.

The Sparta series includes the brown or dark-brown sandy soils occurring on the smooth or nearly level benches or terraces bordering the larger streams. Sparta sand, brown phase, is mapped.

The lighter-colored poorly drained first-bottom soils along the streams and drainage ways are included in the Ray series. The grayish-brown material of the surface soil is underlain in most places by a darker or nearly black layer. Invariably the subsoil is mottled. One type, Ray silt loam, is mapped.

The Genesee series includes the light-colored better-drained first-bottom soils. Genesee fine sandy loam is mapped.

Grouped in the Wabash series are the dark or nearly black poorly drained first-bottom soils along the streams and drainage ways. The subsoil is invariably mottled. One type, the silt loam, is mapped.

Meadow includes the unclassified soils of the Mississippi first-bottom land. Its characteristics are too variable to allow exact defining.

The poorly drained organic soils, which occur for the most part in small areas on the first bottoms of the streams, are classified as peat and muck.

Rough broken land includes the shallow, stony, rocky, and steep areas that have little or no agricultural value.

In the following pages of this report the soils of Vernon County are described in detail and their agricultural relations are discussed; their distribution and location are shown on the accompanying soil map; and their acreage and proportionate extent are shown in Table 4.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Vernon County, Wis.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Clinton silt loam	64,896	14.8	Bates silt loam	704	0.2
Steep phase	12,160		Steep phase	64	
Dubuque silt loam	21,760	26.8	Bertrand silt loam	3,136	.6
Deep phase	29,824		Bertrand fine sandy loam	704	.1
Steep phase	86,720		Bertrand loam	768	.2
Tama silt loam	30,912	6.1	Waukesha silt loam	2,240	.4
Steep phase	512		Sparta sand, brown phase	512	.1
Dodgeville silt loam	2,048	1.5	Ray silt loam	19,008	3.7
Steep phase	5,440		Genesee fine sandy loam	3,136	.6
Boone silt loam	8,064	9.8	Wabash silt loam	19,520	3.8
Steep phase	42,560		Meadow	14,272	2.7
Boone loam	960	2.8	Peat and muck	128	.1
Steep phase	13,376		Rough broken land	131,584	25.4
Boone fine sandy loam	768	.3			
Steep phase	704		Total	516,480	

CLINTON SILT LOAM

Clinton silt loam is the deep light-colored soil occurring on the high ridges in the western half of the county. The cultivated surface soil to a depth of about 9 inches is light grayish-brown floury soft silt loam which is underlain to a depth of about 18 inches by yellowish-brown friable silt loam. Below this layer, the subsoil is heavier and more compact silt loam or silty clay loam that crumbles readily into firm subangular pieces when the mass is broken or crushed. Below a depth of about 32 inches, the soil material is yellowish-brown soft velvety silt loam slightly lighter in color than the material of the overlying layer. This silty material extends to a depth ranging from 45 inches to as much as 100 inches.

The surface soil, to a depth of about 16 inches, is medium or strongly acid, and the heavy subsoil is strongly or very strongly acid. Below a depth of 60 inches, the acidity diminishes, a medium acid reaction resulting at a depth of 65 or 75 inches.

The aggregate area of Clinton silt loam is about 101 square miles. It occurs on the high ridges and is associated with Dubuque and Tama silt loams. Most of it lies west of Kickapoo River, the largest area occurring north and west of the village of Westby. West of the large prairie area in the vicinity of Viroqua and Westby, practically all the ridges having a width of one-fifth mile or more are occupied by Clinton silt loam, but the outer edges of many of the ridges are occupied by the steep phase of Dubuque silt loam. Only a few small isolated areas of Clinton silt loam occur east of Kickapoo River.

Areas of this soil are undulating or gently rolling, even the broadest ridges having ample relief to afford good surface drainage. The deep silty character of the soil gives it a comparatively good water-absorptive capacity and a good water-holding capacity, both of which are of great advantage to growing crops in times of scanty rainfall.

The natural vegetation on Clinton silt loam is similar to that on Dubuque silt loam. Between 80 and 90 per cent of the land is cleared and used either for general farm crops or as improved grazing land, probably about 35 per cent of the total area being grazing land which includes practically all the forested land. Small grain, mainly

oats, occupies from 20 to 25 per cent of the land; hay crops (timothy, mixed timothy and clover, alsike clover, and alfalfa) occupy from 20 to 25 per cent; and corn from 10 to 15 per cent. Tobacco occupies a possible 4 per cent, but in some localities the proportion of tobacco land is higher. Much of the clover seed produced in the county is grown on areas of this soil in the extreme western part.

Clinton silt loam is a productive soil, all general-farm crops yielding comparatively well when grown on it. Under good farm practices, oats yield from 40 to 45 bushels an acre, although with heavy fertilization and a favorable season, 60 bushels an acre are possible; corn yields from 40 to 45 bushels; barley, from 30 to 35 bushels; and wheat, from 20 to 25 bushels. Acre yields of 35 bushels of wheat and 60 bushels of corn have been reported. The most common hay crop, mixed timothy and clover, yields from 2 to 2½ tons an acre, and alfalfa, when properly limed, yields from 3 to 3½ tons, although higher yields are not uncommon. Tobacco is successfully grown on this soil. Acre yields ranging from 1,300 to 1,500 pounds are common, and occasionally yields exceeding 1,700 pounds are obtained. Medium red clover yields about 2 bushels of seed an acre, and occasionally yields of nearly 3 bushels have been reported.

This soil lends itself well to a regular crop rotation because of its ability to grow all general farm crops successfully and because of the fact that, for the most part, it occurs in more extensive smooth tracts than do many of the soils of the county, and as a result, much of it is farmed under a crop-rotation system. The growing of leguminous hay crops is in general practice, and barnyard manure is used either as a top-dressing on new seeding or plowed under for corn or tobacco. On some farms the tobacco crop receives the greater part of the barnyard manure produced on the farm, but some farmers are abandoning this method of farming by either cutting down the acreage of tobacco or supplementing the manure with commercial fertilizer. Commercial fertilizers, particularly superphosphate (acid phosphate) and potash, are being more extensively used for the tobacco and corn crops and to a small extent for the improvement of the alfalfa crop. Commercial fertilizers, when broadcast for corn or tobacco, are applied at the rate of about 300 pounds an acre, and when distributed with the planter, at the rate of about 125 pounds. A common mixture that is broadcast is 0–12–12,[3] and when applied with a planter a 4–8–6 mixture is used. Crushed limestone, applied at the rate of 2 to 3 tons an acre, is used in preparing the soil for alfalfa.

Clinton silt loam, steep phase.—The steep phase of Clinton silt loam does not differ essentially from typical Clinton silt loam except that its surface is rolling or steep rather than undulating or gently rolling. The slope ranges from about 14 per cent to 30 per cent, and such a steep gradient makes the soil susceptible to erosion when tilled.

The aggregate area of soil of this phase is 19 square miles. It is associated with the smoother typical Clinton silt loam and occurs almost wholly in the western quarter of the county, the most extensive areas lying in the vicinity of Bad Axe River, particularly immediately south of the river. Like the steep phase of Dubuque

[3] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

silt loam, this steep soil occurs along the edges of the high ridges and in some places occupies the entire ridge tops of the narrower ridges. Drainage is good. Although the depth of this soil is markedly greater than that of Dubuque silt loam, deep phase, the present system of farming and the methods of improvement are similar for the two soils. Its greater depth allows this soil to withstand more severe surface erosion than Dubuque silt loam, but, at the same time, the surface soil is carried away just as quickly as is the surface soil of Dubuque silt loam, and the deep silt of the subsoil allows gully erosion to be even more destructive on this soil than it is on Dubuque silt loam.

Table 5 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of typical Clinton silt loam.

TABLE 5.—*Mechanical analyses of Clinton silt loam.*[1]

No.	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*
312987	Surface soil, 0 to 2½ inches	0.0	0.6	0.4	1.1	3.4	75.0	19.5
312988	Subsurface soil, 2½ to 7 inches	.0	.2	.1	.5	3.5	78.7	17.0
312989	Subsoil, 7 to 14 inches	.0	.1	.1	.4	3.8	75.4	20.0
312990	Subsoil, 14 to 33 inches	.1	.2	.2	.4	3.3	66.9	28.8
312991	Subsoil, 33 to 37 inches	.0	.0	.1	.3	2.7	64.8	32.1
312992	Subsoil, 37 to 48 inches	.0	.1	.0	.1	3.7	67.3	28.7
312993	Subsoil, 48 to 70+ inches	.0	.0	.0	.1	1.8	74.2	23.8

[1] After treatment with hydrogen peroxide.

DUBUQUE SILT LOAM

Dubuque silt loam is the shallow soil occurring on the high ridges. It occupies the narrower ridges and the edges of some of the larger ones.

The surface layer of Dubuque silt loam to a depth of about 7 inches is brown or grayish-brown friable soft silt loam. The next lower layer is yellowish-brown friable silt loam. A variable amount of chert occurs throughout these two layers of the surface soil. Below a depth of about 15 inches, the material is yellowish-brown silty clay loam that grades within 3 or 4 inches into deep-brown or reddish-brown plastic cherty clay. The clay layer becomes heavier, more plastic, and more cherty with depth, and when dry has a brick-like hardness. Cherty beds of limestone occur at a depth ranging from 20 inches to 4 feet below the surface, but in some places the cherty beds lie within 14 or 16 inches of the surface, and in such places the surface soil contains an abundance of chert. In some places the chert is so abundant over the surface of the ground as to make it necessary or advisable to remove it when the soil is to be used for crops. The entire soil, with the exception of the thin organic surface layer, is strongly or very strongly acid. The outstanding difference between typical Dubuque silt loam and its deep phase is that the typical soil is markedly shallow, that is, the depth to the heavy reddish-brown clay is much less than in the deep phase.

The aggregate area of Dubuque silt loam is 34 square miles. The greater part of it and the most extensive areas occur within the

drainage basin of Kickapoo River in the eastern part of the county. It occurs to less extent and in smaller areas in the western quarter.

The natural vegetation on this soil is similar to that on the deep phase. Drainage also is similar to that of the deep phase, but, owing to its shallowness, the typical soil is probably more susceptible to drought than the deep phase.

About 75 per cent of the land is cleared. Between 40 and 50 per cent is used for grazing, the entire area of uncleared land being included in the area of grazing land. Small grains, such as oats, barley, and a small acreage of wheat and hay are the most important crops grown. Corn occupies about 5 per cent of the total area of this soil. Tobacco is not grown so extensively as on the deep phase. Crop yields probably vary more and average yields are somewhat lower on Dubuque silt loam than on its deep phase. Under good farm practices, oats yield from 30 to 40 bushels an acre, and on a few farms 50 bushels have been reported. During exceptionally dry seasons, yields as low as 15 bushels have been reported on some of the shallower areas of this soil. Barley averages about 30 bushels, corn about 35 bushels, mixed timothy and clover between 1½ and 2 tons, and alfalfa on many farms has yielded 3 tons an acre without the use of lime. Medium and mammoth clover seed yield about the same as on the deep phase. Potatoes and tobacco are not extensively grown.

Fertilization on this soil is practiced in about the same manner as it is on the deep phase. Even though alfalfa produces from fair to good yields without the use of lime, it is generally conceded that an application ranging from 2 to 3 tons of lime an acre gives profitable returns.

Dubuque silt loam, deep phase.—The deep phase of Dubuque silt loam is one of the most important and one of the predominant soils of the county. The cultivated surface soil to a depth of about 9 inches is light grayish-brown floury soft silt loam which is underlain to a depth of about 18 inches by yellowish-brown friable silt loam. Below this layer the subsoil is heavier and more compact silt loam or silty clay loam that crumbles into firm subangular chunks when broken or crushed. At a depth of about 30 inches, the tendency to crumble diminishes. The substratum material is rather variable. In some places this lower material is heavy yellowish-brown clay loam that contains a variable amount of chert and grades into reddish-brown cherty clay at a depth of about 40 inches; in other places the material is yellowish-brown friable silt loam that contains a variable amount of chert; but cherty or stony material underlies all this soil at a depth of less than 42 inches. Limestone occurs in most places at a depth ranging from 4 to 8 feet, although there are several areas in which the limestone has been weathered completely away, leaving the soil resting on the underlying sandstone or shale.

In a few localities in the southwestern part of the county, Dubuque silt loam, deep phase, occurs over the Galena-Trenton formation of limestone, and in such places the entire soil is free from chert and the plastic clay subsoil in many places ranges from cream colored to greenish gray. The most extensive area of this variation is in sections 9 and 10 of T. 11 N., R. 6 W. A large part of it lies within the village limits of Retreat.

The aggregate area of Dubuque silt loam, deep phase, is 46.6 square miles. It occurs on undulating or gently rolling ridge tops. On the highest part of the ridges the surface relief is nearly level, but toward the edges a perceptible and almost invariably increasing gradient begins within a short distance. The outer edges of the ridges have a gradient of 14 per cent or more, and where these steep outer borders are wide enough to be mapped separately they have been designated as a steep phase of Dubuque silt loam.

Due to the topographic position and relief of Dubuque silt loam, deep phase, the soil is well drained despite the fact that the substratum is very impervious.

The natural vegetation on Dubuque silt loam, deep phase, consists of hardwood trees. West of Viroqua the natural tree growth is largely red oak, white oak, and some hickory, and east of Viroqua the tree growth is predominantly hard maple and basswood, with some small areas in which the growth is largely red oak. A small amount of butternut, poplar, elm, and cherry grows throughout the county. Between 80 and 90 per cent of the total area of this soil is cleared and devoted largely to general farm crops, but only a small acreage is devoted to the cash crops, tobacco and wheat. Hay and small grains, particularly oats, are the most common crops. Of the hay crops, mixed timothy and clover lead in acreage, but, with the increasing use of crushed limestone and fertilizers, the alfalfa acreage is increasing.

About 40 per cent of the total area of this soil (including practically all of the forested parts) is used for grazing. Small grains, mainly oats, occupy from 20 to 25 per cent of the land; hay crops, such as timothy, timothy and medium red clover, mammoth clover, alsike clover, and alfalfa, occupy about 25 per cent; and corn occupies about 10 per cent. Tobacco is commonly grown on this soil but not so extensively as on the prairie soils. Clover seed, particularly medium red and mammoth clover seed, is more commonly grown on this than on any other soil, with the possible exception of Clinton silt loam.

On the deep phase of Dubuque silt loam, under good farm practices oats may be expected to yield from 35 to 45 bushels an acre; corn, from 35 to 45 bushels; barley, from 30 to 40 bushels; wheat, about 25 bushels; and mixed timothy and clover hay, from 2 to 2½ tons. Under the best farm practices and in favorable seasons, yields of more than 60 bushels of oats and of corn and 50 bushels of barley have been reported by farmers. Alfalfa ordinarily yields nearly 3 tons an acre, with some yields of nearly 5 tons having been reported. The yield of medium red clover seed ranges from 1 to nearly 3 bushels an acre, the average being about 1½ bushels; mammoth clover seed yields somewhat more. Tobacco, the most important cash crop grown on this soil, yields, under good conditions, about 1,200 pounds an acre, with yields exceeding 1,600 pounds being frequently obtained. The average yield of potatoes is about 150 bushels, and yields of 200 bushels are obtained under favorable weather conditions and good management.

Fertilization of this soil is largely through the use of barnyard manure, supplemented by the growing of nitrogen-fixing legumes, particularly clover and alfalfa. On the whole, barnyard manure is well conserved but is not always evenly distributed over the crop-

producing fields of the farms. The soils of the high ridges on farms with the farm buildings in the valleys frequently suffer for want of manure because of their isolated location.

The use of crushed limestone, obtained from local quarries or shipped by rail from commercial quarries, is increasing. It is applied almost wholly as a soil amendment in preparing the soil for alfalfa seeding. Complete fertilizers and superphosphate are coming into common use for the purpose of supplementing barnyard manure on tobacco and corn land and to some extent in preparing the soil for alfalfa.

Dubuque silt loam, steep phase.—The steep phase of Dubuque silt loam does not differ essentially from the typical soil except in topographic features. Its surface has a slope that ranges from 14 to 30 per cent, and such a steep gradient makes the soil susceptible to erosion, and as a consequence, more shallow stony spots occur in cultivated fields of the phase than in fields of typical Dubuque silt loam. This steep soil occurs along the outer edges of the ridges and in a few places occupies narrow ridge tops. It is distributed throughout the county wherever Dubuque silt loam and Clinton silt loam occur. The aggregate area is 135.5 square miles.

This steep soil is not so well adapted to cropping because of its susceptibility to erosion and to the greater difficulty of tilling the soil and of harvesting the crops. A larger part of it is forested, and the proportion of hay and pasture land is greater than on the smooth areas. The proportion of cultivated crops is less and the practice of crop rotation is not so systematically followed as on the typical soil. It is advisable to avoid tilling the steep areas as much as possible in order to conserve the soil material, particularly the surface soil. Pasture and hay crops, particularly alfalfa, should be grown as much as possible, and cultivated crops should not be grown more than one year in succession.

Average crop yields are lower than on typical Dubuque silt loam, particularly during dry seasons, as the exposed, steeper areas lose their moisture more readily, making it more difficult for crops to obtain the necessary plant food from the soil. Owing to the greater amount of erosion on the steep areas, more of the plant food is removed by surface run-off and much of the beneficial effect of manure applied to the soil is lost. As a consequence, the fertility of this steep soil, particularly those areas that are regularly farmed, may be expected to be lower than that of the smoother areas of Dubuque silt loam.

TAMA SILT LOAM

Tama silt loam is the deep silty prairie soil that occurs on the high ridges in the vicinity of Westby and Viroqua. The surface soil to a depth of about 12 inches is dark-brown or nearly black smooth friable silt loam. Below the surface layer and extending to a depth of about 20 inches is a silty layer having a deep-brown color that grades with depth into brownish yellow. The material below a depth of 20 inches is brownish-yellow heavy silt loam or silty clay loam that grades into soft friable silt loam at a depth of about 40 inches. The soil material below 40 inches is brownish yellow, slightly mottled with gray, light yellow, and reddish yellow, and it extends to a depth ranging from 4 to 12 feet. It is underlain in most places by lime-

stone but in some places by loose, thin-bedded sandstone. The topmost 6 inches of this soil is medium or strongly acid, and the rest of the soil ranges from strongly acid to very strongly acid.

There are a few small areas of Tama silt loam in which, owing to poor drainage, the subsoil, below a depth of about 15 inches, is light-gray, mottled with reddish brown, silt loam and below a depth of 20 inches is silty clay loam containing a few black iron concretions.

The aggregate area of Tama silt loam is 48.3 square miles. It occurs on the high broad ridges in the west-central part of the county, the main body extending from the vicinity of Westby south to the vicinity of Liberty Pole. Small areas and irregular but connected extensions of the main body extend west, southwest, and south of Liberty Pole.

The surface relief ranges from undulating on the crests or highest parts of the ridges to gently rolling in the areas sloping toward the drainage ways. Drainage of this soil is good, with the exception of a few inextensive poorly drained depressions which must be artificially drained before such crops as alfalfa can be successfully grown. The water-absorptive and moisture-holding capacity of this soil is probably better than that of any other well-drained soil of the county, owing to the deep silty character of the soil material and to the high organic-matter content of the surface soil.

The areas of Tama silt loam in their virgin condition were dominantly and typically grasslands. Statements of the early settlers in this section are that in places there was a scattered growth of very small trees and brush, small enough at the time of settlement to be turned under with breaking plows. At the present time, practically all this soil is tilled. The systems of farming practiced are dairying or general farming, supplemented largely by tobacco growing. About 20 per cent of the acreage of the soil is devoted to small grain, from 20 to 25 per cent to hay crops, from 14 to 18 per cent to corn, from 20 to 25 per cent to pasture crops, and between 10 and 15 per cent to tobacco. This soil is better adapted to tobacco and corn than any other soil in the county. On the other hand, most small grains are grown more successfully on Clinton silt loam and Dubuque silt loam, deep phase. Tama silt loam is also well adapted to the production of hay and pasture crops.

The average acre yield of oats, under good farm practices, is about 40 bushels; of corn, between 40 and 45 bushels; and of mixed timothy hay, about 2½ tons. Acre yields of 60 bushels of corn have been reported. From 1,300 to 1,500 pounds an acre of tobacco is a good yield, but yields of 1,800 pounds are occasionally obtained. The average acre yield of tobacco for the county, all soils included, for the period 1918 to 1926, according to the Wisconsin Department of Agriculture Crop Reporting Service Bulletin 90, was 1,141 pounds. For the year 1925, according to the Biennial Crop and Livestock Review for 1924–25 of the Wisconsin Department of Agriculture, the average acre yield for the county was 1,350 pounds. Potatoes, though not extensively grown, yield well, but clover seed is not successfully produced on this soil.

Fertilization of this soil is largely through the use of barnyard manure. Hay crops, composed wholly or in part of legumes, are grown on practically all farms, and the acreage of alfalfa is in-

creasing from year to year. Commercial fertilizer is used as a supplement to barnyard manure for corn and tobacco. It is distributed with fertilizer attachments on the planters, and some is broadcast on alfalfa fields. When distributed broadcast with the manure, fertilizer is applied at the rate of about 300 pounds an acre, and about 125 pounds are applied when a planter attachment is used. Most of the commercial fertilizers used carry a high percentage of phosphate and some have also a high percentage of potash, but as a rule they have a low nitrogen content, this constituent being supplied to the soil largely through leguminous crops and barnyard manure. Commercial fertilizer applied with the planter attachment, however, carries a small amount of nitrogen, generally about 4 per cent. Considerable crushed limestone is used on land seeded to alfalfa and is applied at the rate of about 2½ tons an acre. The use of superphosphate for alfalfa is profitable.

Tama silt loam, steep phase.—The steep phase of Tama silt loam differs from the typical soil only in that it occurs on steeper slopes, the gradient of which ranges from 14 to 30 per cent. The average depth of soil of this phase may be less than that of typical Tama silt loam, but its depth to stony or cherty material is 40 or more inches.

This steep soil is of very small extent, the total area being only 0.8 square mile. The main areas occur in the NE. ¼ sec. 32, T. 13 N., R. 5 W.; N. ½ sec. 2, T. 13 N., R. 4 W.; SE. ¼ sec. 2 and SW. ¼ sec. 1, T. 11 N., R. 5 W.; and SW. ¼ sec. 24, T. 12 N., R. 5 W.

Although the steep phase of Tama silt loam is slightly more desirable than the steep phase of Dodgeville silt loam, the yields, crops, methods of fertilization, and general farm practices are similar.

DODGEVILLE SILT LOAM

Dodgeville silt loam is the shallow prairie soil associated with Tama silt loam. The surface soil to a depth of 12 inches is dark-brown or nearly black smooth friable silt loam. This layer is underlain by dark yellowish-brown heavy silt loam or silty clay loam which becomes lighter colored with depth. Below a depth of about 25 inches, the material is yellowish-brown or reddish-brown cherty heavy clay. Limestone is generally reached at a depth ranging from 3 to 7 feet. Like Tama silt loam, this soil is strongly acid in both surface soil and subsoil.

The aggregate area of this soil is 3.2 square miles. It occurs on the broad ridge in the vicinities of Westby, Viroqua, and Liberty Pole. It differs from the associated Tama silt loam in that it is a shallower soil. Drainage of Dodgeville silt loam is good, but the water-holding capacity is probably less than in Tama silt loam due to the thinner solum, or true soil, of Dodgeville silt loam.

The natural vegetation is similar to that on Tama silt loam. Practically all the land is tilled, and it is farmed in much the same way as is Tama silt loam, the proportionate acreage of crops being about the same. Yields on the whole may be slightly lower than on Tama silt loam, but Dodgeville silt loam is considered a fertile and productive soil.

Dodgeville silt loam, steep phase.—The steep phase of Dodgeville silt loam has a slope ranging from 14 to 30 per cent. Although the

profile characteristics are similar to those of the typical soil, in many places a larger amount of cherty material is present in the surface soil, and the surface soil is shallower. This more stony and shallower soil is particularly noticeable in areas that have been under cultivation for a long period of years and have consequently had a considerable amount of the surface soil removed by erosion.

The steep phase of Dodgeville silt loam has an aggregate area of 8.5 square miles. It is much more extensive than typical Dodgeville silt loam. It occupies steep slopes of the prairie ridges in the vicinities of Westby, Viroqua, Liberty Pole, and West Prairie and is closely associated with Tama silt loam. Most of the Dodgeville soil that occurs on the broad ridge on which Westby and Viroqua are located lies on the west slope.

Probably 90 per cent of this steep soil is now or has at some time been under cultivation. As compared with typical Dodgeville silt loam or Tama silt loam, a larger proportion of this soil is devoted to grazing and hay crops. General farm crops and tobacco are grown but not so extensively as on the smoother prairie soils.

Crop yields are not so high as on Tama silt loam, although it is possible for some of the best areas of this steep land to produce as good yields as some of the Tama silt loam is now producing. Fertilization is mostly through the use of barnyard manure. Owing to the fact that a greater proportion of this soil is devoted to grazing and a smaller proportion to cultivated crops, the amount of manure used is less than on typical Dodgeville silt loam. Leguminous hay crops are regularly grown, and the acreage of alfalfa is increasing from year to year. As with the steep phases of other soils, grazing and hay crops should be grown as much as possible in order to prevent washing away of the surface soil.

BOONE SILT LOAM

Boone silt loam is the light-colored comparatively shallow soil, overlying shale and sandstone, on the low ridges and valley slopes. The grayish-brown silt loam surface soil extends to a depth of about 8 inches, and the subsoil to a depth of about 28 inches is yellowish-brown silty clay loam or heavy silt loam. The substratum is, in most places, composed of partly disintegrated sandstone or shale. The soil is strongly acid throughout. The surface relief is undulating or gently rolling, and drainage is good.

The aggregate area of this soil is 12.6 square miles. It occurs for the most part as small isolated areas within the more extensive areas of the steep phase of Boone silt loam. Although it is a more desirable soil than the steep phase, its small extent and scattered occurrence renders a discussion of the agricultural relationships of this soil separately from its steep phase difficult.

Boone silt loam, steep phase.—The distinctive feature of the steep phase of Boone silt loam is its occurrence on rougher land, with slopes ranging between 14 and 30 per cent. Stony, shallow, and sandy patches are included in the steep phase, but such areas do not occur in the more typical Boone silt loam. Drainage of the steep phase ranges from good to excessive, except in a few spots where seepage water comes to the surface.

The aggregate area of the steep phase of Boone silt loam is 66.5 square miles. The soil occurs on the low ridges and valley slopes.

The most extensive areas are in the northeast quarter of the county in the vicinity of Hillsboro, and in the Kickapoo Valley. Strips of this soil also occur on both sides of the valleys in the western part of the county.

About 65 per cent of Boone silt loam, including the steep phase, is cleared. General farm crops and small acreages of tobacco, wheat, potatoes, and cucumbers are the principal crops grown. Pasture land, including practically all the forested land, occupies about 45 per cent of these soils, hay crops about 25 per cent, small grain about 20 per cent, and corn from 5 to 7 per cent. Land in cucumbers and tobacco seldom amounts to more than 1½ or 2 acres on such farms of Boone silt loam that produce these crops.

The average yield of oats is about 35 bushels an acre, of corn about 40 bushels, and of mixed timothy and clover hay about 2 tons. It is generally conceded that small grain yields better on the high ridge soils than on the valley soils, but in dry seasons the yield of small grain on the valley soils practically equals the yield on the best-adapted high ridge soils. Corn grown on Boone silt loam is about as productive and in many years more productive than corn grown on Dubuque silt loam and Clinton silt loam. Owing to the predominantly rolling surface of the Boone soils and their consequent susceptibility to erosion, proper measures must be taken to minimize soil washing when growing corn or other cultivated crops.

Fertilization is almost wholly through the use of barnyard manure and the growing of leguminous hay crops. Some crushed limestone is used in starting alfalfa, but only a small amount of commercial fertilizer has been used on this soil. A crop rotation should be planned with crops that require a minimum of plowing and cultivation. Hay, particularly leguminous hay, small grain, and pasture crops are the most satisfactory crops for this soil. Alfalfa, because it generally yields well for several years in succession, is a desirable crop. Lime in some form should be used in preparing the soil for alfalfa, and phosphatic fertilizer has proved of value to this crop. Phosphatic fertilizer can be profitably used for corn and small grain as well as for alfalfa. An application of 300 pounds an acre broadcast with manure is the best method of building up and maintaining the fertility of this soil. When fertilizer is applied at the time of planting a cultivated crop, an acre application of 125 pounds of commercial fertilizer containing a small percentage of nitrogen and a relatively high percentage of phosphate is recommended.

BOONE LOAM

Boone loam has a brown or grayish-brown loam surface soil 6 or 8 inches deep. The subsoil is yellowish-brown silt loam or silty clay loam that is underlain at a depth of about 40 inches by shaly silt loam, silty clay loam, or loose sandy material which may be somewhat mottled.

This soil occupies undulating ridge tops and the more gentle slopes associated with Boone loam, steep phase, and Boone fine sandy loam. Further discussion of this soil is included with that of Boone fine sandy loam, steep phase.

Boone loam, steep phase.—Boone loam, steep phase, differs from typical Boone loam in its rougher relief, having slopes of a maximum

of 30 per cent. Further discussion of this soil is included with that of Boone fine sandy loam, steep phase.

BOONE FINE SANDY LOAM

Boone fine sandy loam, to a depth of about 10 inches, is brown or dark-brown fine sandy loam. The subsoil, to a depth of about 40 inches, is heavier textured, ranging from heavy loam to silty clay loam. The material below this layer is sandy and contains a variable amount of sandstone fragments. As with Boone loam, the subsoil of some of the areas is mottled. Only a very small total area of Boone fine sandy loam is mapped.

Several small areas, scattered along the east side of the river valley in secs. 24, 25, 26, and 35 of T. 12 N., R. 3 W., south of the village of Viola, have a sandier subsoil than typical, and the more sandy areas are subject to some blowing of the sand, especially in early spring before the crops have partly covered the surface.

Boone fine sandy loam, steep phase.—The steep phase of Boone fine sandy loam, except in its occurrence on more steeply sloping lands, is similar to typical Boone fine sandy loam.

Except for the difference in texture, Boone loam and Boone fine sandy loam are nearly identical. These two soils occur for the most part on steep valley slopes just below rough broken land, and the steep phases are much more extensive than the typical soils. The surface of these steep phases have slopes ranging from 14 to 30 per cent. Drainage ranges from fair to good. The poorer drainage evident in some areas is due to seepage water, but this condition is not sufficiently pronounced to interfere with crop production, inasmuch as the slope is steep enough to provide surface drainage. The areas not affected by seepage water are apt to be droughty during extended dry periods. Erosion is a serious menace to these soils because of their loose texture and consequent easy washing by surface water.

The aggregate area of Boone loam, including its steep phase, is 22.4 square miles, and the aggregate area of Boone fine sandy loam, including its steep phase, is 2.3 square miles. About 50 per cent of the area of these soils is cleared and cropped. Owing to their occurrence in small areas, they are farmed under practically the same system as is the more predominant Boone silt loam with which they are everywhere associated. Crop yields generally range from 5 to 15 bushels an acre less than on Boone silt loam.

Fertilization is almost wholly through the use of barnyard manure and the growing of leguminous hay crops. Lime and commercial fertilizers high in phosphorus are recommended in addition to barnyard manure and the growing and turning under of legumes.

Because of their looser consistence and coarser texture, these soils are well adapted to the production of truck crops, of which cucumbers and potatoes are the most important. Most of the areas of these soils are not well adapted to pasture crops because of their low water-holding capacity and susceptibility to drought.

BATES SILT LOAM

Bates silt loam includes the dark-colored soils, underlain by shale and sandstone, occurring on the valley slopes. The surface soil, to

a depth of about 12 inches, is nearly black silt loam, and the subsoil, to a depth of about 34 inches, is yellowish-brown heavy silt loam. Below this layer, the soil material differs in different localities. In most places the underlying material is buff-colored slightly mottled silt loam to a depth of more than 65 inches, and in other places sandy or shaly material occurs at a depth of about 48 inches. This soil everywhere is strongly acid. The aggregate area of Bates silt loam is small. The largest areas and probably 90 per cent of the total acreage are in secs. 17, 20, and 21, T. 14 N., R. 6 W., and sec. 20, T. 13 N., R. 6 W. The surface relief is undulating or gently rolling, and drainage is good. Crop acreages, yields, fertilization, and farming methods are practically the same as for Waukesha silt loam.

Bates silt loam, steep phase.—The slope of the steep phase of Bates silt loam, which is the essential difference between the phase and the typical soil, ranges from 14 to 30 per cent. As a whole, the depth of the steep soil is somewhat less than that of the typical soil. Most of the land of the steep phase is cleared and is devoted to general farming. It produces good yields, particularly of hay and corn, but crop yields as a rule are slightly lower than those obtained on typical Bates silt loam and Waukesha silt loam. Care must be taken to prevent washing when growing cultivated crops, owing to the tendency of this soil to erode wherever the surface soil is left unprotected.

The fertility of this soil is maintained and improved largely through the use of barnyard manure and the growing of leguminous hay crops, but commercial fertilizer (particularly superphosphate) and lime can be profitably used as supplements to the manure. The growing of cultivated crops should be somewhat restricted and the production of legumes for hay and pasture increased, both as a means of increasing the fertility and of preserving the soil.

BERTRAND SILT LOAM

Bertrand silt loam is the light-colored heavy-textured soil that occurs on the nearly level benches along the larger streams. The surface soil, to a depth of about 10 inches, is friable grayish-brown or brown silt loam, and the subsoil, to a depth of about 36 inches, is yellowish-brown silty clay loam. The deeper part of the subsoil is smooth friable silt loam lighter in color than the upper part and slightly mottled with gray.

A few areas, particularly in Kickapoo Valley, are underlain by cherty gravel at a depth of about 36 inches. Another variation occurs in Bad Axe Valley, particularly in sec. 15, T. 12 N., R. 7 W., where the subsoil below a depth of about 8 inches is yellowish-red clay, somewhat mottled with gray below a depth of about 18 inches, and the surface soil has a silty clay loam texture. The areas of Bertrand silt loam that occur in the valley of Baraboo River and in the valleys of its branches are only a few feet above the first-bottom land, consequently they are not so well drained as the areas in other places and, as a result of poor drainage, the subsoil is mottled yellowish-brown, gray, and bright-yellow silty clay loam.

Bertrand silt loam is strongly acid to a depth of at least 70 inches. Where the silty material extends to a greater depth, the material is only slightly acid or alkaline below a depth of 8 feet.

Bertrand silt loam occurs on the benches or terraces along the main streams of the county and lies at an elevation ranging from 3 to as much as 35 feet above the adjoining bottom land. The most extensive and most typical areas are along Coon Creek, and smaller and more scattered areas are along Bad Axe, Kickapoo, and Baraboo Rivers.

Areas of Bertrand silt loam are nearly level or gently undulating. With the exception of the poorly drained areas along Baraboo River, the soil is well drained.

Practically all of the land is cleared and under cultivation. This is one of the most desirable soils of the county and is devoted to general farming and tobacco growing. Corn probably occupies 18 per cent of the land, small grain (mostly oats) about 25 per cent, hay 25 or 30 per cent, tobacco and other cash crops about 10 per cent, and pasture the remainder.

This soil is well adapted to the production of corn, tobacco, and hay and pasture crops, although alfalfa can not be grown successfully on the more poorly drained areas. Farmers are of the general opinion that the small grain grown on the valley soils is more severely affected by rust than that grown on the high ridge lands of Dubuque and Clinton silt loams, but small-grain crops hold an important place in the crop rotation and are regularly and fairly successfully grown.

Oats yield from 35 to 40 bushels an acre, corn yields from 40 to 45 bushels, and mixed timothy and clover from 2 to 2½ tons. Alfalfa, where the land has been well limed, is a very successful crop. Of the cash crops, tobacco and potatoes yield well, tobacco under reasonably good conditions producing from 1,300 to 1,500 pounds an acre, but much higher yields are frequently obtained.

Barnyard manure and the growing of leguminous hay crops are the main sources of fertility for this soil. A small amount of commercial fertilizer is being used for corn and tobacco, and crushed limestone is generally applied where alfalfa is to be grown. Crop rotation, including corn, small grain, and one or two years of hay, is the general practice.

To improve the fertility of this soil, commercial fertilizer should be used as a supplement to barnyard manure. An acre application of 250 or 300 pounds of commercial fertilizer, especially that with a high phosphate content, broadcast with manure and plowed under to a slight depth for corn or other cultivated crops, is recommended. In addition to this, a leguminous crop should be grown on at least one-third of the acreage of the tillable land, and for the best results with these crops, particularly alfalfa, from 2 to 3 tons of crushed limestone an acre should be applied once in a period of six or eight years.

BERTRAND FINE SANDY LOAM

The surface soil of Bertrand fine sandy loam, to a depth of about 8 inches, is light-brown fine sandy loam. This is underlain by brownish-yellow slightly heavier and more compact soil material to a depth of about 17 inches. Below this depth, the material gradually becomes more sandy, and at a depth ranging from 22 to 26 inches it consists of yellow fine sand. The entire soil is medium acid. The surface relief of this soil is similar to that of Bertrand silt loam.

The land is well drained, some of the sandier areas being excessively drained because of the light-textured porous subsoil.

The principal areas of Bertrand fine sandy loam occur along Coon Creek and along Kickapoo River in the vicinities of La Farge and Viola. A few small areas are in the valley of Bad Axe River.

Probably 85 per cent of Bertrand fine sandy loam is cleared. This soil is farmed in much the same way as is Bertrand silt loam, but owing to its sandier character, it is more easily tilled and warms up earlier in the spring than does the heavier silt loam soil. It is not so well adapted to hay and pasture crops, especially the shallow-rooted grasses, because of its lower moisture-holding capacity and its consequent greater susceptibility to drought. The supply of organic matter and plant food is lower, but, on the other hand, crops respond more quickly and markedly to fertilization on this soil than they do on Bertrand silt loam.

Crop yields are in general lower than on Bertrand silt loam. Oats yield from 30 to 40 bushels an acre, corn yields about the same, mixed timothy and clover hay from 1½ to 2 tons, and tobacco about 1,200 pounds.

Fertilization practices are about the same as on Bertrand silt loam, but because of the sandier and more porous character of the subsoil, top-dressing with manure is more commonly recommended on this soil than on the silt loam. Green-manure crops are of great value in maintaining the organic-matter content and the consequent increased moisture-holding capacity of the soil. It should be planned to maintain and build up the nitrogen supply through the use of barnyard manure and by growing legumes; to increase the phosphate content by supplementing barnyard manure with high phosphatic fertilizers; and to make the soil better adapted to leguminous hay crops by applying from 2 to 2½ tons of crushed limestone an acre.

BERTRAND LOAM

The surface soil of Bertrand loam is light-brown friable loam. The subsoil, between depths of about 9 and about 18 inches is heavier and firmer yellowish-brown loam. The soil material gradually becomes lighter textured below this depth until at a depth of about 40 inches it consists of yellow fine sand. The entire soil is medium or strongly acid. The surface relief is similar to that of Bertrand silt loam.

The largest area of Bertrand loam is at Readstown, and a few smaller areas are along Bad Axe River and Coon Creek. This soil is heavier textured than Bertrand fine sandy loam and, as a consequence, is a little stronger and has greater moisture-holding capacity. The acreage devoted to crops, the yields, and the methods of handling the soil are similar to those practiced on Bertrand fine sandy loam.

WAUKESHA SILT LOAM

Waukesha silt loam is the dark-colored heavy-textured soil that occurs on the benches or terraces along the main streams. The surface soil, to a depth of about 10 inches, is very dark brown or nearly black friable silt loam. The subsoil, to a depth of about 36 inches, is heavier dark yellowish-brown silt loam, and below this layer the

material is floury light-brown silt loam. Gravelly or sandy material lies at a depth ranging from 4 to 12 feet. A few areas of this soil lie only a few feet above the adjoining stream-bottom land, and in such areas the poorer drainage has resulted in the development of a highly mottled yellow, gray, and brown silty clay loam subsoil. The entire soil of Waukesha silt loam ranges from medium to strongly acid, except where the silty material extends to a depth of 12 or more feet, in which places the reaction is alkaline at and below this depth.

Areas of this soil are nearly level or gently undulating except at the edges of the benches or terraces, where the slopes are steep and the descent ranges from 2 to as much as 35 feet to the adjoining stream bottoms. As is true of the Bertrand soils, the Waukesha soils are typically well drained, except in the few areas lying only a few feet above the stream bottoms.

Most of this soil occurs in the valley of Coon Creek and in the vicinity of Hillsboro along Baraboo River. A very few areas are in the valley of Bad Axe River. Most of the more poorly drained areas occur along the branches of Baraboo River, but a few such areas are in the valley of Coon Creek.

Waukesha silt loam is one of the most fertile and productive soils of the county. The relative crop acreages are about the same as on Bertrand silt loam. The higher organic-matter content of this soil gives it better tilth and greater water-holding capacity as well as making it more fertile than the lighter-colored silt loams. Corn, tobacco, hay, and pasture crops yield slightly heavier on this soil than they do on Bertrand silt loam, but small grain is more apt to lodge, with a consequent lower yield.

Methods of fertilization and recommendations for the improvement of this soil are practically the same as for Bertrand silt loam. It may be said, however, that in using complete commercial fertilizers, the necessity for, or value of, the nitrogen is not so great on this soil as it is on Bertrand silt loam or the other light-colored soils.

SPARTA SAND, BROWN PHASE

Sparta sand, brown phase, includes the brown sandy soils on the river terraces. The surface soil, to a depth of 9 inches, is dark grayish-brown loamy sand or loamy fine sand. Below this layer, the material becomes lighter brown in color, and at a depth of about 30 inches it grades into yellow fine sand that may contain a small amount of gravel. The material of the entire soil is strongly acid.

The surface relief of this soil is nearly level or gently undulating. Because of its porous sandy subsoil, drainage is excessive.

Very nearly all of Sparta sand, brown phase, occurs in the Mississippi Valley. The largest areas are in secs. 4 and 5, and secs. 28 and 33, T. 14 N., R. 7 W. A very few small areas occur in other parts of the county, within areas of other terrace soils.

About 70 per cent of Sparta sand, brown phase, is cleared, and the remainder is covered with a thin growth of scrub oak and is used as grazing land. General farm crops, tobacco, and buckwheat are grown on the tilled land. Corn and oats yield about 25 bushels an acre, hay from 1 to 1½ tons, and tobacco, under good care, has produced as high as 1,200 or 1,300 pounds.

Fertilization is mostly through the use of barnyard manure and the growth, to some extent, of leguminous hay crops. Because of its sandy character, this soil is well adapted to the growing of such special truck crops as melons, cucumbers, and early potatoes.

A crop rotation, including a legume such as red clover, mammoth clover, or alfalfa, should be practiced. It has been demonstrated that even though the fertility and water-holding capacity of the soil are low, fair crops of alfalfa can be grown on very sandy soils if care is taken in getting the crop started. A common rotation used on this soil is corn, small grain, and hay. If the hay crop is alfalfa, it may well be left from year to year, or as long as the yield is profitable. Barnyard manure is especially valuable on this soil because of its great need for organic matter as well as for plant food. As with Bertrand fine sandy loam, light but frequent applications of manure are advisable. Top-dressing or plowing under to a very slight depth is preferable to turning manure under to a depth of 6 or 7 inches. Green-manure crops, such as rye, mammoth clover, or medium red clover (preferably the clovers), are of great value in increasing the fertility and organic-matter content of the soil. Commercial fertilizer, especially phosphatic fertilizers, can be profitably used as a supplement to barnyard manure. For truck crops, nitrogenous fertilizers may be desirable to stimulate early rapid growth. When alfalfa is to be grown, both phosphatic fertilizer and crushed limestone should be applied, the fertilizer at the rate of about 250 pounds of 16 per cent superphosphate to the acre and the lime at the rate of about 2 tons. It is advisable in starting alfalfa, to give the land a light application of barnyard manure in addition to the commercial fertilizer.

RAY SILT LOAM

Ray silt loam is the light-colored first-bottom land occurring along the streams and drainage ways. The surface soil, to a depth ranging from 5 to 24 inches, is grayish-brown smooth friable silt loam. Below this material is a very dark brown or nearly black layer, from 5 to 10 inches thick, which ranges in texture from silt loam to silty clay loam. The soil material below this layer is mottled dark-gray, yellow, and reddish-yellow clay loam which in most places grades into sandy material at a depth ranging from 3 to 5 feet below the surface. In a few areas the black layer is absent, and in such places the subsoil, at a depth of 6 or 8 inches below the surface of the ground, is brownish-yellow, mottled with gray and different shades of yellow and brown, silt loam or silty clay loam. The acidity of this soil ranges from slightly to strongly acid.

Ray silt loam is widely distributed over the county, occurring along most of the streams and drainage ways. Drainage of this soil is deficient but not to such an extent that most crops, with the exception of alfalfa, can not be grown. Much of the soil is subject to overflow during periods of heavy precipitation. Many of the areas of Ray silt loam can be improved by tile drainage and the straightening of the stream channels, the cost of such improvements being the limiting factor.

Probably 75 per cent of this soil is cleared, and about 35 per cent of the cleared land is cropped. The uncleared areas are covered by

a scattered growth of elm, soft maple, willow, hoary alder, haw, and some oak, but there is practically no merchantable timber. The 60 or 65 per cent of the cleared land that is not cropped is used as permanent pasture. Corn and hay occupy a great part of the cropped land, with small grain ranking third in acreage. Some tobacco is commonly grown on this soil.

Corn, when not injured by early frosts, yields heavily of both grain and fodder, yielding from 40 to 45 bushels of grain an acre in favorable seasons. Yields of 50 or more bushels have been reported. Mixed timothy and clover hay averages 2½ tons an acre and tobacco about 1,300 pounds, although yields of 1,800 pounds have been reported. Oat yields vary widely, depending on the rust infection and the extent to which the grain lodges. As permanent pasture land, this soil is about the best in the county and when cleared will probably support more livestock to the acre than any other soil.

Ray silt loam is one of the strongest and most fertile soils in the county, owing to the fact that it is composed of the fine silt washed from the soils of the adjoining uplands and to the fact that much of it is subject to occasional flooding and consequent deposition of more fine silty material.

Fertilization is not so regularly practiced on this soil as it is on some of the upland soils. Barnyard manure is the main source of fertilization and is generally applied for the benefit of the corn and tobacco crops. The soil is best adapted to permanent pasture, cultivated crops, and hay. Many of the areas are so irregular in shape that they can not be economically used except for grazing. Where the land is tilled, tile drainage will prove profitable if the expense of installation is not too great. Care must be taken to prevent ditches from developing on the tilled land, as gully erosion, when once started, develops rapidly and is difficult to arrest.

GENESEE FINE SANDY LOAM

The surface soil of Genesee fine sandy loam, to a depth of about 10 inches, is brown or light-brown fine sandy loam. Below this depth, the texture of the soil material is slightly heavier, and at a depth of about 18 inches it becomes more sandy. At a depth ranging from 28 to 32 inches, light-yellow or grayish-yellow sand or gravelly material occurs. The soil ranges from neutral to acid, the degree of acidity differing in different localities.

Genesee fine sandy loam, as mapped in this county, is variable. In many places layers of dark-colored and heavy-textured material occur in the profile. An included variation, or phase, of Genesee fine sandy loam occurs in which the surface soil, to a depth of about 18 inches, is dark-brown or nearly black loam or fine sandy loam. Below this depth, the color is a lighter shade of brown and the texture is slightly heavier. Below a depth ranging from 28 to 32 inches, the material is mottled gray, yellowish brown, and bright yellow, and the texture ranges from fine sandy loam to silty clay loam. Below a depth of 48 inches, the texture is fine sandy loam or fine sand. This variation is widely distributed over the county, the largest areas occurring in the northern parts of T. 14 N., Rs. 3 and 5 W., and T. 11 N., R. 3 W.

Genesee fine sandy loam occurs on the first bottoms of streams and drainage ways. The most extensive area is along Coon Creek, extending from the vicinity of the village of Coon Valley down the valley to within about 2½ miles of the village of Stoddard. A few small areas occur along the upper reaches of some of the smaller streams, as along West Fork of Kickapoo River in T. 14 N., R. 3 W. The surface relief is similar to that of Ray silt loam. The land is subject to overflow, and drainage is imperfect, but, owing to the sandy character of the soil, drainage is better than in the heavier soils. Some of the higher sandy areas of this soil dry out rather quickly during dry periods.

Most of the land is used as permanent pasture, and probably 70 per cent of it is uncleared. Some of the cleared areas also are used for grazing. This soil is poorly adapted to cropping because of its occurrence in small irregular areas and because most of it lies close to the stream channels. With the exception of a few areas, the land is best adapted to grazing crops. The areas that can be farmed are very productive, and good yields of tobacco and corn are commonly produced. Some of the land is fertilized with barnyard manure.

WABASH SILT LOAM

Wabash silt loam is the dark-colored soil that occurs on the first-bottom lands along the streams and drainage ways. The surface soil, extending to a depth ranging from 14 to 20 inches, is very dark brown or nearly black silt loam. The subsoil is mottled yellow and gray heavy silt loam or silty clay loam. Sandy material occurs at a depth ranging from 3 to 5 feet. As with all first-bottom soils, the texture and color characteristics are not uniform, and many variations occur. The acidity of this soil ranges from neutral to medium or strongly acid in different areas.

Slightly more extensive than Ray silt loam, Wabash silt loam is widely distributed over the county. Many of the areas of Ray silt loam extend for considerable distances along the streams, but the areas of Wabash silt loam are less continuous and occur as smaller more irregular-shaped areas.

The surface relief of this soil is nearly level, except for irregularities due to old stream channels and erosion by flood waters and some boggy depressions. Drainage is deficient, in places being distinctly poor as compared with drainage in Ray silt loam. Many areas of Wabash silt loam could be markedly improved by tile drainage and by straightening and deepening the stream channels.

Although drainage of Wabash silt loam is more deficient than that of Ray silt loam, many areas of this soil are producing good yields of corn, hay, potatoes, and tobacco. Probably 45 per cent of the land is cleared, and 25 per cent is cropped. The 75 per cent of uncropped land, with the exception of the most poorly drained or boggy areas, affords fair to excellent grazing. Crop yields, fertilization practices, and recommendations for the improvement of this soil are similar to those given for Ray silt loam.

MEADOW

Meadow includes the variable and unclassified soil comprising the first-bottom lands along Mississippi River. The characteristics of

this soil vary widely particularly as regards organic-matter content and texture. The surface soil ranges from sandy material to heavy silt loam or silty clay loam, the lower areas generally having the heavier-textured surface soil. At a depth of 16 inches, the material in most places is mottled sandy loam or sand.

Areas of this soil are nearly level or gently undulating and are broken or cut to a considerable extent by sloughs and wet boggy depressions. Drainage is generally deficient, and the land is subject to overflow.

Practically none of this land has been cleared. The natural vegetation consists of soft maple, birch, willow, and other lowland and deciduous trees, and the wetter depressions are covered with sedges. Some of the land classed as meadow is used for grazing, parts of it furnishing fair or good pasture, but none of it can be classed as improved agricultural land.

PEAT AND MUCK

Peat and muck include the organic soils of the county. Most of this material is composed of partly or almost completely disintegrated sedges. The surface material, to a depth of about 18 inches, is nearly black in color and is fine in texture. Below this layer the material is a light-brown coarse felty mass, mostly of sedge origin. Mineral soil material lies at a depth ranging from 2 to 5 feet below the surface, but very little mineral material is mixed with the layers of organic material.

The natural vegetation on peat and muck is principally sedges, and no forest growth occurs on it in Vernon County. The sedges do not afford good grazing.

Peat and muck occur in first-bottom lands along streams. Drainage is very deficient, and the water table lies about 2 feet below the surface. The few small areas mapped are in the eastern part of the county, principally in the S. ½ sec. 9, T. 14 N., R. 1 E., in the NE. ¼ sec. 25, T. 14 N., R. 1 E., in the NE. ¼ sec. 15, T. 13 N., R. 1 E., and in the SW. ¼ sec. 31, T. 14 N., R. 1 W.

ROUGH BROKEN LAND

Rough broken land includes rock exposures, cliffs, and land which is too steep and rough to plow or cultivate in any way. It may be considered nonagricultural land, as it is of value only for the forest growth and small amount of grazing it affords. On the precipitous stony slopes the soil material has practically all been washed away, but in places where the slope is less steep 8 or 10 inches of soil, ranging in texture from sand to silt loam, has accumulated. The material is invariably stony and underlain by rock at a depth of 12 inches.

Rough broken land occupies a large part of the steep valley walls, forming a boundary between the valley bottoms and the ridge tops. The slopes are the longest and most precipitous in the western quarter of the county, where many of them are as steep as 70 per cent and rise from 300 to 500 feet above the valley bottoms. The slope of rough broken land along the Kickapoo Valley is not quite so steep or

so extensive, and in the northeastern part of the county the area of steep land is even less than in the Kickapoo Valley.

The natural vegetation on rough broken land is similar to that on the adjoining ridge land. In the western part of the county red oak, white oak, and hickory predominate, with a small amount of butternut, elm, cherry, and poplar intermixed. East of Viroqua the predominating forest growth is hard or sugar maple and basswood, with small areas dominated by oaks, and some elm, butternut, cherry, and poplar occur in this part of the county. White and red oak displace the maple and basswood in the extreme eastern part of the county. Some white pine and hemlock grow along the main valley of Kickapoo River.

Probably 10 per cent of rough broken land is cleared, but practically none of it is tillable. The object in clearing the land has been to obtain the timber, to improve the grazing, or both. Probably 10 per cent of rough broken land is not grazed. Inasmuch as grazing injures the growth of tree seedlings, it is advisable that livestock be fenced out of the areas where reforestation is being attempted, as the animals practically prohibit natural reforestation by seedlings and do an inestimable amount of damage to the older trees, particularly the saplings.

The value of this land for grazing is low on account of the sparse covering of grass and because dry weather stops the growth of grass in early summer. The north-facing slopes afford the best grazing and forest growth. Reforestation is recommended for most of this rough land.

SOILS AND THEIR INTERPRETATION

Vernon County is located in the driftless area of southwestern Wisconsin. The underlying rock formations are, from the lower to the upper: Potsdam sandstone, lower magnesian limestone, St. Peter's sandstone, and Galena-Trenton limestone. Loessial deposits of variable thickness may cover a large part of the county, the thickness decreasing eastward from Mississippi River.

Vernon County lies in two soil regions, the gray-brown podsolic soil region and the humid prairie region. As indicated by the temperature and precipitation data, this county has a climate typical of these two broad groups of soils, that is, the mean annual rainfall is within the range of 30 to 45 inches, the mean annual temperature approaches 50° F., and the frost-free period ranges from 120 to 150 days. The region of the gray-brown podsolic soils has, or did have previous to settlement, a dense forest growth of deciduous hardwoods comprised of oaks, hickory, maple, and basswood. The prairie area of the county supported a grass vegetation. Statements from the first settlers are to the effect that sapling trees were not infrequent on the prairie area, which fact might be construed as an indication that the deciduous forest was encroaching on the prairie area.

Owing to the amount of rainfall over this region, leaching of soluble salts has progressed to a marked degree, which is evidenced by the degree of acidity indicated in the profile descriptions of the different soils.

Characteristic soils of the gray-brown podsolic soil group are the Clinton, Dubuque, Boone, Bertrand, and Sparta soils. Humid

prairie soils are the Tama, Dodgeville, Bates, and Waukesha. The distinguishing features common to the first group are as follows: (1) Deciduous hardwood vegetation; (2) relatively low content of organic matter in the surface soil; (3) an acid reaction and marked absence of the soluble salts throughout the main layers of the solum; and (4) an accumulation of iron and aluminum oxides at a depth of about 20 inches. The outstanding characteristics of the humid prairie soils in Vernon County are as follows: (1) Grass or prairie vegetation; (2) high content of organic matter to a depth of 12 or 14 inches; and (3) an acid reaction and marked absence of the soluble salts throughout the main layers of the solum.

A typical profile of the gray-brown podsolic soil group is that of Clinton silt loam. The surface 1½ or 2 inches is a mixture of leaf mold, other partly disintegrated organic material, and some mineral matter, matted or bound together by a network of grass and tree rootlets. The immediate surface soil is brown, but the lower part of the layer is very dark brown or nearly black, is more disintegrated, contains a greater amount of mineral material, and is somewhat granular. The reaction of the surface layer is generally slightly acid. Under cultivation, the color effect of this layer can be perceived for the first year or two, but it rapidly disappears under continuous cropping and cultivation.

Below this layer and extending to a depth of about 10 inches is the distinctly eluviated layer. A distinct and abrupt change occurs in passing from the surface organic layer into this layer consisting of grayish-brown friable smooth silt loam, the upper part of which is darker brown owing to a higher organic-matter content. The soil mass breaks and crumbles readily into weak-structured crumbs. Close examination of a clod of this material shows that the fine soil aggregates, or crumbs, lie in a horizontal position, and when a clod is broken horizontally the mass separates into thin irregular plates but when broken vertically the breakage surface is rough or more jagged. Close examination also shows that, although the color of the mass is apparently grayish brown, it is not uniform, the main body of a soil aggregate being pale yellowish brown and the outer part having a coating or film of whitish gray. This layer contains some rootlets and a small amount of earthworm casts. The reaction of the material of this layer ranges from medium to strongly acid.

Below this layer the material gradually becomes heavier textured and richer in color. To a depth of about 17 inches, the soil material is brown or brownish-yellow friable smooth silt loam which breaks into subangular fragments from one-fourth to one-half inch in diameter, the fragments being slightly firm but easily crushed. The surface of the soil fragments is covered by a thin irregular gray film. A great many capillaries, or minute tubes, occur throughout this soil layer, the inner walls of which appear to be the same color as the soil mass. Very few rootlets occur in this layer. The reaction of the soil material is strongly acid.

Below a depth of approximately 17 inches and extending to a depth of about 32 inches, is deep yellowish-brown friable but firm silty clay loam that breaks or falls apart readily into subangular fragments ranging in size from one-fourth inch to 1½ inches in diameter. Many of these fragments, as in the material of the layer

above, have an irregular thin gray film on their surfaces, but the vesicles, or capillaries, are much less numerous and only a few roots and rootlets occur. The reaction of the material in this layer ranges from strongly to very strongly acid.

Below a depth of about 32 inches, the texture and color of the soil gradually become lighter. To a depth ranging from 36 to 40 inches, the material is brownish-yellow friable silty clay loam which breaks under pressure into massive subangular chunks, with no tendency to crumble or break apart except when subjected to pressure. The material is sufficiently compact to show brittleness when a chunk is broken or crushed apart. A slight gray film is generally in evidence on the breakage or cleavage surfaces. The reaction of the material in this layer is strongly acid.

At a depth of about 40 inches, the soil material becomes brownish yellow, mottled with gray and limonite yellow, and the texture is that of a heavy smooth silt loam. The structure is the same as that of the layer above. There are some very fine air channels, or capillaries, but only a few roots. The reaction is strongly acid.

Below a depth of about 50 inches the soil material is brownish-yellow smooth softer silt loam, having very little or no structure. Under pressure the mass pushes apart with no definite breakage surfaces into an almost single-grain mass. The reaction at a depth ranging from 70 to 80 inches is medium or slightly acid. Bedrock is reached at a depth ranging from 50 to 120 inches.

The soils of the Dubuque series differ primarily from typical Clinton silt loam in that they are shallower. Heavy clay or cherty material lies at a depth ranging from 15 to 45 inches. The Clinton soils are free from cherty or stony material, but the Dubuque soils generally contain a small amount of chert throughout the soil profile, particularly below a depth of 20 inches.

The surface soil to a depth of about 8 inches is similar to that of the Clinton soil, except that in many areas it may be somewhat browner. Below a depth of about 10 inches in most places an illuviated layer from 6 to 10 inches thick occurs, in which the soil material is yellowish-brown heavy silt loam grading into silty clay loam that breaks or falls apart easily into subangular firm chunks similar in all respects to the material of the heavy layer occurring at a depth of about 15 inches in the Clinton soils. At an average depth of about 15 inches residual cherty reddish-brown clay is reached. This material, when carefully handled, readily falls apart into definitely shaped cubelike fragments from one-fourth to one-half inch in diameter. When subjected to pressure while in a moist condition, the fragments crush together into a stiff plastic mass, and when dried they have a bricklike hardness. The amount of chert in the clay increases with depth, and at a depth of about 30 inches, the material is an impenetrable mass of chert and stiff resistant clay. Bedrock of limestone occurs at a depth of about 45 inches, but in a few places, the parent limestone rock has completely weathered, leaving the soil material resting on sandstone or shale. In many places the surface is strewn with a considerable amount of chert fragments ranging from one-half inch to 8 inches in diameter. The entire profile of Dubuque silt loam, with the exception of the thin surface layer, is strongly acid, the heavy reddish-brown clay being very strongly acid.

The deep phase of Dubuque silt loam differs from the shallower soil chiefly in the greater thickness of the yellowish-brown silty clay subsoil layer which lies between the surface silt loam and the reddish-brown clay of the substratum, resulting in a greater total thickness of the soil mantle. The reddish-brown clay may lie at a depth ranging from 2 to 4 feet below the surface. This soil is also less cherty on the surface and in the upper soil layers than is the shallower Dubuque silt loam.

The Clinton and Dubuque soils occur on the high ridges and are underlain in most places by limestone. The Clinton soils occupy practically all the high ridges in the vicinity of and west of the prairie area. Very little Clinton soil occurs east of the West Fork Kickapoo River. A comparatively small total area of Dubuque silt loam occurs in the western part of the county. The deep phase of this soil predominates on the broader high ridges in that part of the county east of the West Fork Kickapoo River. The typical location of the shallower Dubuque soil is on the narrower high ridges east of West Fork Kickapoo River, and this soil is more extensive in the eastern part of the county than in the central part. This relation of these soils plainly indicates that the depth of the silt gradually diminishes from the western part of the county to the east.

The Boone soils occur on the low ridges and valley slopes and are all underlain by sandstone or shale. Typical Boone silt loam is shallow, the residual shale or sandstone material occurring at a depth ranging from 20 to 40 inches.

The 1 or 1½ inch surface layer of Boone silt loam is a dark-brown or nearly black mixture of leaf mold, other partly disintegrated organic matter, and mineral soil material bound together by grass and tree rootlets. Below this layer the material is brown or dark-brown smooth floury friable silt loam that crumbles easily into weak-structured crumbs, or soil aggregates. The soil material immediately below this layer and extending to a depth of about 10 inches is similar except that the color is a lighter shade of grayish brown. As with the upper 10 or 12 inches in Clinton silt loam, the upper soil material of Boone silt loam has a noticeable horizontal structure, or arrangement of the soil aggregates. Below a depth of about 10 inches, the soil material is more yellowish brown and the texture gradually becomes heavier. With increasing depth, the mass breaks more definitely into slightly angular fragments rather than into soft aggregates. At a depth of about 18 inches, the material is dark yellowish-brown or slightly red yellowish-brown heavy silt loam or silty clay loam, that breaks apart readily into definitely shaped subangular fragments ranging from one-fourth inch to 1½ inches in diameter. The gray film, similar to that on the surface of the fragments of the subsoil of the Clinton soils, occurs on the surface of the soil fragments of this layer of Boone silt loam. To this depth the profile of Boone silt loam is similar to that of the Clinton soils, except that sandstone or shale fragments occur in many places in variable amounts throughout much of the profile of the Boone soil.

Below a depth of about 24 inches, the soil material varies widely. In most places the material grades into a mixture of greenish-gray disintegrated shaly material, mixed with yellowish-brown silt loam or loam, that contains a variable amount of very fine sand. In

such places bedrock of fragmentary shale occurs at a depth ranging from 26 to 40 inches below the surface. In other places sandy material, containing sandstone fragments, lies at a depth comparable to the depth at which the shaly material is commonly reached. In some locations the soil material grades at a depth of about 30 inches into a heavy sandy clay substratum that contains a large amount of shale fragments. In practically all areas of typical Boone silt loam, partly disintegrated bedrock of sandstone or shale is present at a depth not greater than 60 inches.

The steep phases of Clinton, Dubuque, and Boone silt loams are differentiated from their respective typical soils on the one characteristic of degree of slope of the land surface. Under virgin conditions, the profiles of these steep phases correspond closely to their respective soil types. Under cultivation, however, the surface soil in many places is partly or wholly removed, leaving the heavier darker-brown subsoil exposed. Fields that have been under cultivation for a considerable period of time have a spotted appearance when freshly plowed, owing to the uneven erosion, or washing away, of the grayish-brown surface soil.

Boone fine sandy loam and Boone loam, although belonging to the same series as Boone silt loam and being essentially soils residual from sandstone and shale, are not exactly similar in profile characteristics to Boone silt loam. They consist to a great extent of colluvial material, and their characteristics other than surface texture have a wide range. They occur for the most part immediately below the strips of rough broken land that occupy the steep slopes of the high ridges. These areas, or strips, of rough land consist mostly of sandstone material. As a result of the disintegrated sandy material moving down the slopes as colluvial matter, fine sandy loam and loam soils have developed where this material has come to rest.

The surface soils of Boone fine sandy loam and Boone loam, to a depth of about 8 inches, range from light brown to very dark brown in color, and the texture is fine sandy loam or loam according to the soil type to which it belongs. The subsoils, to a depth of about 30 inches, are heavier textured and more yellowish brown. The subsoil material breaks into subangular fragments from one-fourth to three-fourths inch in diameter. Below this depth, the material may be mottled sandy clay that grades into shaly or sandstone material at a variable depth, or it may grade into yellow sand or rotten sandstone at a depth of about 30 inches. In some places, the subsoil at a depth of 18 or 20 inches is silt loam. Such a condition is the result of the sandy colluvial material having come to rest on the surface of the silt loam soil of the valley slope, thus changing the soil type from Boone silt loam to Boone loam or Boone fine sandy loam, as the case may be. In such places, the depth to the sandy or shaly substratum is considerably more than 30 inches, in some places being as great as 5 feet.

The reaction of Boone fine sandy loam and Boone loam is medium to strongly acid. Most areas of Boone loam and Boone fine sandy loam in Vernon County have a gradient greater than 14 per cent, and hence the greater part of the areas of these soils have been mapped as steep phases of their respective types.

Two series of gray-brown podsolic soils, the Bertrand and Sparta, occur on the stream terraces, or second bottoms, of the county.

The parent material of the Bertrand soils ranges from silt loam to fine sandy loam. The characteristics of the main soil type, Bertrand silt loam, are similar to those of the regional soil type, Clinton silt loam. The lighter-textured soils, Bertrand loam and Bertrand fine sandy loam, though not so nearly similar, show a definite relation to the regional soil type also.

The surface soil of Bertrand fine sandy loam to a depth of about 5 inches is light-brown friable fine sandy loam. No opportunity was afforded during the course of this survey to examine the soil under virgin conditions, but it is probable that under virgin conditions it has a thin surface layer of nearly black material composed of leaf mold, other partly disintegrated organic matter, and mineral soil. Between depths of about 5 inches and about 10 inches the material is brownish-yellow fine sandy loam which below this layer is compacted or weakly cemented together. The mass breaks easily into subangular blocks 2 or 3 inches in diameter, which, if crushed, lose their cemented character very easily. Below a depth of about 18 inches the material rapidly grades into yellow fine sand. This lower material is generally markedly stratified, and many well-defined changes occur both in color and texture. The entire solum and substratum are strongly acid.

The profile of Bertrand loam is similar to that of Bertrand fine sandy loam, except that the upper layers are loam rather than fine sandy loam in texture.

The few areas of Bertrand loam and Bertrand fine sandy loam that occur along Mississippi River contain a variable amount of gravel in the stratified material below the soil profile proper. In a few places, gravel occurs throughout the soil profile in such amounts that the areas might well be designated as gravelly loam or gravelly fine sandy loam.

The Sparta series is represented in Vernon County by a brown phase of Sparta sand. The most typical areas of this soil occur on the Mississippi River terraces. The few small sandy areas (too sandy to be classified as Bertrand fine sandy loam), occurring on the terraces of the inland streams, are included with this soil in mapping.

The Sparta soil does not conform exactly to the description of the gray-brown forest soils, nor is it a true prairie soil. It does, however, have a uniform, though small, accumulation of organic matter throughout the surface soil to a depth of 10 or 12 inches. Areas of Sparta sand, brown phase, have 8 or 10 inches of surface soil ranging from brown to very dark brown loose loamy sand or loamy fine sand. Below this layer, the distinct dark shade gradually disappears, the color in most places being dark reddish brown. Below a depth of 18 inches, the reddish-brown color grades into light reddish brown, reddish yellow, or yellow. The loaminess invariably disappears at a depth of 16 or 18 inches. Below a depth of 32 inches, the material is yellow fine sand or sand, and some gravel may occur intermixed with the sand. The material below a depth of 2½ or 3 feet is distinctly stratified sand and more gravelly sand. This soil is strongly acid throughout. The underlying strata, below a depth of 3 or 4 feet, range in acidity from medium to strongly acid.

Areas of Sparta sand on the terraces of the smaller streams are small and isolated, and they occur as slight rises of sandy material

above the adjoining terrace soils or bottom lands. The color is more distinctly yellow, and the texture in most places is fine sand. The material comprising the Sparta sand of the inland stream terraces is invariably composed of quartz grains, whereas the sand of the Mississippi River terraces contains a small quantity of silicate minerals.

A typical profile of the humid prairie soils is that of Tama silt loam. The surface soil, extending to a depth ranging from 12 to 15 inches, is very dark brown or nearly black soft friable almost feathery silt loam. This layer is distinctly granular, and the soil mass falls apart readily into buckshot or pea-sized granules which are definite in form but are easily crushed between the fingers. Earthworm casts are noticeable throughout the layer. The upper 3 inches of this layer is sod bound, and the lower part contains many rootlets. The organic-matter coloring is very persistent even after several decades of cultivation. The surface of Tama silt loam tends to become lighter in color or to be spotted where this soil borders, or lies in the vicinity of, the lighter-colored soils, such as Dubuque silt loam and Clinton silt loam. The reaction of the surface soil ranges from medium to strongly acid.

The soil material below this layer is heavier in texture. It extends to a depth of about 22 inches and ranges in color from deep medium brown to brownish yellow. Streaks of darker-colored material extend from the layer above into this layer. The material is friable, but the granulation is less distinct than in the layer above. The reaction of the material of this layer is strongly acid.

Between depths of about 22 and about 32 inches the soil material is yellowish-brown or dark brownish-yellow heavy silt loam that breaks up readily into subangular fragments. The structure of this layer is very similar to that of the illuviated layer of Clinton silt loam previously described. The reaction of the material of this layer is strongly acid.

The material below this layer is lighter brownish yellow, finely mottled with yellow, gray, and light and dark shades of brown and yellow. The texture is about the same as that of the layer above, but the structure is not so pronounced; that is, the mass does not fall apart readily into as distinct subangular fragments as does the material of the layer above. The reaction of the material of this layer is strongly acid.

The material below a depth of 40 inches is heavy silt loam somewhat more mottled than in the layer above. In addition to the yellow and gray shades, are specks of dark rust brown. The structure is similar to that of the lower layer of Clinton silt loam. The mass does not crumble or break readily into fragments but rather crushes under pressure to practically a single-grain mass. The mottling of this lower layer diminishes below a depth of about 65 inches, brownish yellow becoming predominant. Also the silt becomes softer and more floury in the lower part of this layer. At a depth of 70 inches, the acidity diminishes to medium acid. Limestone or sandstone bedrock lies at a depth ranging from 50 to 140 inches below the surface.

Tama silt loam is the predominant soil of the prairie area of the county. Associated with it is Dodgeville silt loam which differs

from Tama silt loam in being shallower. Dodgeville silt loam is underlain by cherty red clay at a depth of about 22 inches. The surface soil and upper subsoil layer are similar to the corresponding layers of Tama silt loam. In some locations, the soil is deep enough to allow the development of an illuviated layer, but in most places the cherty red clay lies at such slight depth that this layer has not developed. The red clay layer is similar to the clay material composing the subsoil of Dubuque silt loam. Dodgeville silt loam is strongly acid throughout.

Both the Tama and Dodgeville soils have steep phases. The steep phase of Tama silt loam is very inextensive, whereas the steep phase of Dodgeville silt loam is more extensive than the typical soil. It can be readily concluded, therefore, that most of the smooth prairie land has a deep silty solum, whereas most of the steep prairie land is comparatively shallow.

Bates silt loam, the third of the prairie soils, is associated with the Boone soils. It occurs in small areas on the lower edges of the valley slopes. In profile it is similar to Tama silt loam except that some of the areas are underlain by sandstone or shale at a depth of about 40 inches or less. The position of this soil would indicate that the dark color might be the result of a higher moisture content due to seepage water, but the subsoil has no more indication of poor drainage than does the subsoil of Tama silt loam. Moreover, the areas of Bates silt loam extend up steep slopes where surface drainage is good and no indication of seepage water is present. The reaction of this soil is strongly acid. A steep phase is associated with Bates silt loam, which is similar to the typical soil except that the average depth of silt is less.

Waukesha silt loam resembles Tama silt loam in soil characteristics, but it occurs on stream terraces instead of on the uplands. The parent material of Waukesha silt loam is mainly silt, only a small part of this soil having an appreciable quantity of sand in the upper 30 inches of soil. In many places, particularly near the edges of the terraces, substrata of sandy material lie within 3 feet of the surface. This sandy material is not properly the parent material of Waukesha silt loam, but it is stratified sand deposited previous to the time the overlying silt was laid down. The reaction of Waukesha silt loam is strongly acid throughout except in places where the silt extends to a depth of more than 10 feet. In such places, the acidity diminishes to medium or slightly acid, or even alkaline, below a depth of 10 feet.

The soils of the first, or overflow, bottoms, being recently deposited material, have not developed the regional profile characteristic of the soils of the two groups described. This alluvial material, with the exception of the soils of the Mississippi River bottoms, is derived from the sandstone, shale, limestone, and loess of the drainage basins of the local streams. The soils of the Mississippi River alluvial plain are composed mainly of foreign material. The soils derived from local material include the soils of the Wabash, Ray, and Genesee series, and the undifferentiated alluvium of the Mississippi bottoms is mapped as meadow.

SUMMARY

Vernon County is in the southwestern part of Wisconsin and includes a total area of 807 square miles. The greater part of the county is deeply and well dissected by stream valleys and drainage ways, and drainage, on the whole, is good. Settlement of the county was started in 1844 by American-born pioneers. At the present time, people of northern European descent, particularly Norwegians, Bohemians, and Germans, predominate. The entire county is well served by both railroad and highway transportation facilities to the large market centers. Chicago and Milwaukee are the principal livestock markets.

Vernon County has a humid, temperate climate that is well suited to dairying, livestock production, and the growing of general farm crops. The average frost-free period in the vicinity of Viroqua is about 150 days and in the vicinity of Hillsboro about 130 days.

Fifteen soil types and 10 phases, in addition to peat and muck, meadow, and rough broken land, are included in the soil classification of this county.

The prairie soils, including Tama silt loam, Dodgeville silt loam, Waukesha silt loam, and Bates silt loam, are probably the most fertile soils of the county. They are particularly well adapted to the production of hay and corn and other cultivated crops.

The light-colored silt loam soils, including Clinton, Dubuque, Bertrand, and Boone silt loams, are productive soils but have a much lower organic-matter content than the prairie soils. These light-colored soils, particularly the Clinton, Dubuque, and Bertrand silt loams, are best adapted to the production of hay and small grain.

The steep phases of these soils should not be tilled more than is necessary because of the ease with which they erode when the surface soil is not protected against the action of run-off water.

The first-bottom soils, including the Wabash, Ray, and Genesee soils, are well adapted to grazing. Many areas of these soils are sufficiently well drained to produce good yields of cultivated crops and hay.

The wheat acreage of Vernon County in 1879 was equal to 49 per cent of the total grain acreage, but in 1927 the acreage of this crop was estimated to have dropped to 3.8 per cent of the total grain acreage.

Dairy farming, supplemented by hog or sheep raising and, on some farms, by a cash crop, is the prevalent type of farming. It is common practice to produce nearly all the feed required by the livestock.

Hay, principally mixed timothy and clover, oats, and corn are the principal feed crops grown. The combined acreage of these three crops is about 88 per cent of the total crop acreage of the county.

Tobacco is the main cash crop. The farm value of the tobacco crop in 1927 was estimated at $1,537,860. It was outranked in value only by hay, the farm value of which in 1927 was estimated at $2,120,718.

Crop rotation including a legume-hay crop, the careful conservation and use of barnyard manure, the use of commercial fertilizer, especially phosphatic fertilizer, as a supplement to barnyard manure,

and the use of crushed limestone in starting alfalfa are highly recommended practices for building up and maintaining the fertility of Vernon County soils.

Farm tenancy, though increasing yearly, is low as compared with farm tenancy in many sections of the United States. About 82 per cent of the Vernon County farms were operated by their owners in 1925.

The best agricultural soils of the county range in value from $150 to $200 an acre, including buildings and other improvements. Topography and depth of the soil are two of the prime factors in determining the value of farm land in Vernon County.

Two regional soil groups are represented in Vernon County, the gray-brown podsolic soils and the humid prairie soils. Soils of the Clinton, Dubuque, Boone, and Bertrand series are representative of the gray-brown podsolic group, and soils of the Tama, Dodgeville, Bates, and Waukesha series are representative of the prairie group.

The alluvial soils are inextensive.

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U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
HENRY G. KNIGHT, CHIEF
A. G. McCALL, CHIEF SOIL INVESTIGATIONS
CURTIS F MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP
VERNON COUNTY
WISCONSIN

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
ERNEST F. BEAN, DIRECTOR
UNIVERSITY OF WISCONSIN COLLEGE OF AGRICULTURE
H. L. RUSSELL, DEAN
A. R. WHITSON, IN CHARGE SOIL SURVEY

Mark Baldwin, Inspector, District 1.
Soils surveyed by M. J. Edwards, in charge, and A. C. Anderson,
U. S. Department of Agriculture, and A. H. Meyer, J. A. Chucka, and
D. E. Wilcox, Wisconsin Geological and Natural History Survey.

BASE MAP FROM
U. S. GEOLOGICAL SURVEY SHEETS

Scale $\frac{1}{62500}$

Field Operations
Bureau of Chemistry and Soils
1928

[PUBLIC RESOLUTION—No. 9]

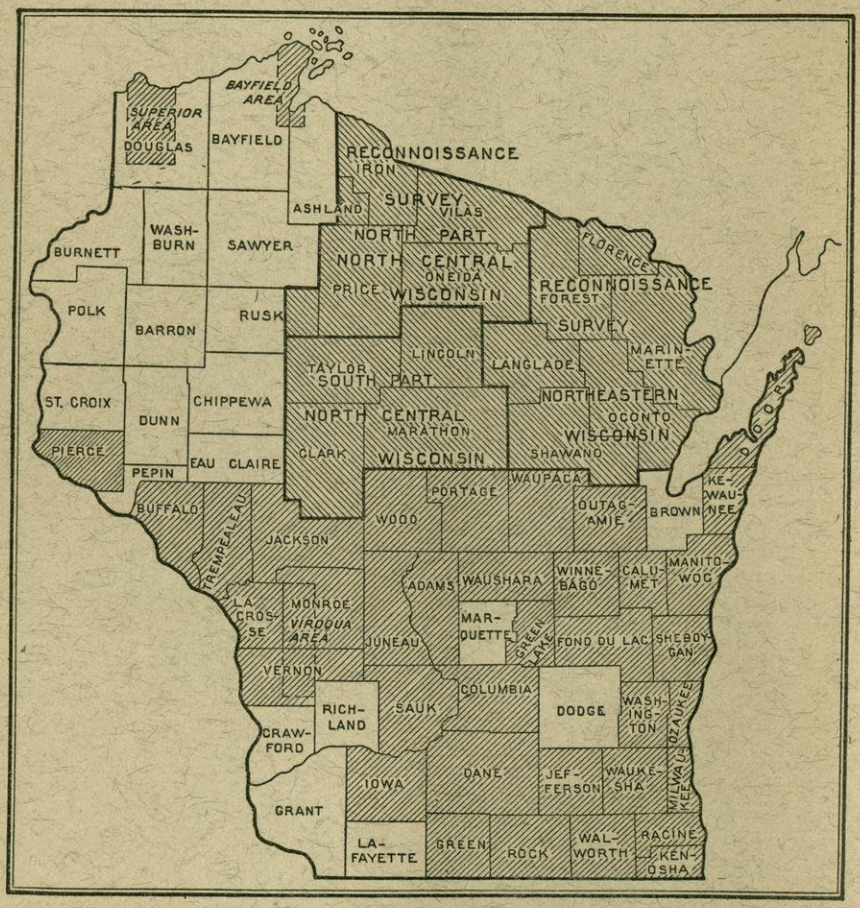
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Wisconsin, shown by shading

U. S. GOVERNMENT PRINTING OFFICE: 1932