
Soil Survey

Cattaraugus County New York

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In cooperation with the
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SOIL SURVEY OF CATTARAUGUS COUNTY, NEW YORK

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Area Inspected by W. J. Latimer, Inspector, District 1

United States Department of Agriculture in cooperation with the
Cornell University Agricultural Experiment Station

COUNTY SURVEYED

Cattaraugus County is in the southwestern part of New York (fig. 1). The southern boundary is formed by the Pennsylvania-New York State line. The shape of the county is nearly square. The distance from east to west is about 39 miles, and from north to south, 35 miles. The approximate land area is 1,314 square miles, or 840,960 acres.

Little Valley, the county seat, situated near the geographical center of the county, is 63 miles south of Buffalo by State highways and 422 miles from New York City via the Erie Railroad.

Physiographically the area is composed of maturely dissected plateaus designated as the Northwestern Appalachian Plateau Border and the Allegheny Plateau (6).² The latter is set off because of more rugged topography and considerably higher general elevation. The extreme northwestern corner of the county lies on the escarpment between the plateau area on the south and the Erie plain on the north. The county as a whole is part of the Southwestern Plateau section of New York.

The southern part of the county includes the Allegheny Plateau, the northern boundary of which follows the trend of the Allegheny River

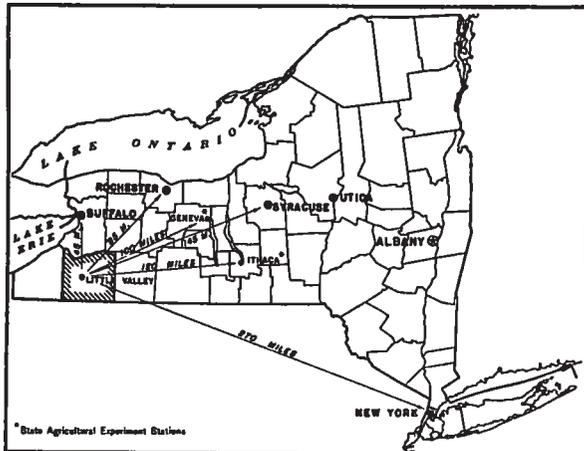


FIGURE 1.—Sketch map showing location of Cattaraugus County, N. Y.

¹ The Soil Survey Division was transferred to the Bureau of Plant Industry July 1, 1930.

² Italic numbers in parentheses refer to Literature Cited, p. 65.

but is from 4 to 6 miles north of the river. This physiographic region is practically coextensive with the unglaciated portion of the area and represents the only part of the State that was not covered with ice during some part of the glacial period.

The contrast in relief between the glaciated and unglaciated parts is striking. The Allegheny Plateau is more rugged with longer and steeper slopes, is mountainous, and lacks the irregular hilly characteristics of much of the glaciated northern part of the county. The elevation ranges from about 2,400 feet at the top of the plateau to 1,284 feet at the point where the Allegheny River enters Pennsylvania. The maximum elevation of 2,440 feet occurs in the town of Great Valley, about 6 miles east-southeast of Salamanca, but many of the plateau remnants, especially in the western part of the plateau, have elevations of 2,300 feet or more. A striking feature of this section is the even sky line visible from any high summit.

The Allegheny River rises in Pennsylvania, enters the county at the eastern boundary, swings north a few miles, and reenters Pennsylvania near the western boundary of Cattaraugus County. The valley through which the river flows ranges from one-half to 2 miles in width throughout its course in this county. The valley walls are abrupt and steep, a feature characteristic of a country in which the rock formations are somewhat resistant. Some of the high elevations on the plateau are less than a mile back from the valley floor.

From Steamburg south the river occupies a postglacial channel. Previous to the last glacial age the course of this river was past Steamburg to Randolph and through the Conewango Valley to Gowanda, whence it followed the present course of Cattaraugus Creek northward. Choking of the valley with glacial drift near Steamburg caused the river to seek a southern outlet. Another example of drainage reversal, due to the effects of glaciation, is that of Ischua Creek. A glance at the map will show this valley considerably wider at its source than in its lower reaches.

That part of the county lying north of the Allegheny Plateau is not so deeply dissected, and the relief has been changed considerably by the effects of glaciation. This area consists of a rolling upland with a maximum elevation of 2,276 feet in the southeastern part 2 miles south of Fitch, from which point there is a gradual reduction in height above sea level to the north and west. The elevation of slightly more than 600 feet at the point where Cattaraugus Creek leaves the county is the lowest in the entire county.

With the exception of the lower Ischua Creek Valley and the gorge along Cattaraugus Creek east of Gowanda, which resemble the southern part of the county in depth of dissection and steepness of slope, this part of the area has long, less abrupt slopes that are in many places cultivated all the way to the summits of the plateau.

The wide valley of Conewango Creek along the western side was not formed by action of the present stream but is a preglacial river channel deeply filled with glacial, lacustrine, and alluvial sediments.

About three-fourths of the county is drained by the Allegheny River, a part of the Mississippi drainage system. The northern part and a small section of the western part lie in the Great Lakes drainage system.

When first known by white men, the area comprising Cattaraugus County was covered by magnificent forests of white pine and hardwoods and comprised a part of the original northeastern hardwood forest. Both the original and the present second- and third-growth forests were and are composed principally of yellow birch, beech, and hard maple. With these dominant species are associated hemlock, white pine, red maple, sweet birch (locally called black birch), black cherry, white ash, cucumbertree, tuliptree (locally called yellow poplar), hickory, elm, and American linden (locally called basswood). The beech-birch-maple wood lots are, for the most part, kept free of underbrush by grazing animals.

Through the Allegheny Valley and on the slopes bordering it, the beech-birch-maple forest is replaced by an oak-hickory association, species that require less moisture and will tolerate a lower level of fertility. The dominant trees of this section are white oak, white pine, chestnut, shagbark and pignut hickory, sassafras, and black oak. Hemlock bark was an important item of export when the virgin forests were being exploited, and hemlock lumber was produced in great quantity on the high plateau from about 1870 to 1890.

Chestnut, formerly an important and rather widely distributed species, has practically disappeared. Sprouts frequently are noticed coming up from the bases of dead trees but are able to survive only a few years before they too fall victims to the oriental chestnut blight.

White pine was the first species of tree to be intensively harvested by the early lumbermen. The principal areas where this was dominant were on the flats along the Allegheny River and through the Conewango Valley. Besides other species enumerated, elm, hemlock, and black ash were prevalent in the wetter situations, with some balsam growing in the swamps.

In the beech-birch-maple forests the following shrubs are listed by Taylor (15) in order of the frequency with which they occur: Hobblebush (*Viburnum alnifolium*), European red elder or red-berried elder (*Sambucus racemosa*), Canada yew or ground yew (*Taxus canadensis*), mountain maple (*Acer spicatum*), striped maple or moosewood (*A. pennsylvanicum*), pagoda dogwood or alternate-leaved dogwood (*Cornus alternifolia*), mapleleaf viburnum (*Viburnum acerfolium*), arrowwood (*V. dentatum*), and American fly honeysuckle (*Lonicera canadensis*).

The shrubs under oak-hickory forest in the approximate order of the frequency of their occurrence are: Tall shrubs—arrowwood, pinxter-bloom (*Azalea nudiflora*), American elder (*Sambucus canadensis*), deerberry (*Vaccinium stamineum*), smooth sumac (*Rhus glabra*), dwarf pussy willow or sage willow (*Salix tristis*), beak willow (*S. bebbiana*), beaked hazelnut (*Corylus cornuta*), common witch-hazel (*Hamamelis virginiana*), poison-ivy (*Toxicodendron radicans*), and pasture rose or wild rose (*Rosa humilis*); lower shrubs—lowbush blueberry (*Vaccinium pennsylvanicum*), dryland blueberry or late upland blueberry (*V. vacillans*), prairie willow (*Salix humilis*), sweetfern (*Comptonia asplenifolia*), dwarf bush-honeysuckle (*Dier-villa lonicera*), Jersey-tea (*Ceanothus americanus*), trailing-arbutus (*Epigaea repens*), and wintergreen (*Gaultheria procumbens*).

The encroachment of hawthorn in pastures is more or less serious over most of the county. Infestation varies from a few scattered

clumps that grazing cattle keep under control to areas that have been completely taken over by the trees.

Cattaraugus County is a part of the original Holland purchase, and those parts of it now incorporated in Allegany State Park never were held privately. This county was set off as a distinct unit from Genesee County in 1808 and was organized in 1817, with 500 taxable voters residing within its limits. The first settlement was made in 1798 at Oldtown, near the site of Oldtown School, by three men from the Society of Friends of Philadelphia. In 1803 this society purchased 692 acres near Tunesassa, now known as Quaker Bridge, as a site for a school for Indians, and this school is still maintained.

Settlement began at Olean about 1804, and this place early became a thriving village. It is situated at the head of navigation on the Allegheny River and therefore was the gateway to the western country. Many immigrants embarked here for the trip down the Allegheny to Pittsburgh, thence down the Ohio. In 1807 the first raft that made the trip to Pittsburgh marked the beginning of an immense lumber industry. At the peak of this industry as much as 300,000,000 feet of lumber annually were sent to market over this river. Early accounts state that it cost 12½ cents to send 100 pounds of freight from Olean to Pittsburgh and \$1.25 for the same quantity to be sent from Pittsburgh to Olean.

When the Erie Canal was opened to traffic in 1825, immigrant travel by way of Olean ceased. This caused a decided slump in business and resulted in the departure of many of the people. When the Erie Railroad reached Olean in 1851 it gave a great impetus to agricultural development.

The Genesee Valley Canal, which was to connect this county with Lake Ontario and Rochester, was surveyed in 1835 and completed in 1856. It was not a success and was abandoned in 1878.

The Allegany Indian Reservation, established in 1797, occupies the territory on both sides of the river from the State line to Vandalia and includes 30,469 acres. The number of Indians in the county in 1930 was 966, and most of them live on the Allegany Indian Reservation. The rest live on that part of the Cattaraugus Indian Reservation that lies in the extreme northwestern part of the county.

In 1930 there were 72,398 people in the county, according to the census, of whom 33,454 were classed as urban and 38,944 as rural. The rural farm population was 17,650. The present inhabitants are predominantly descendants of the early settlers, most of whom came from Pennsylvania, eastern New York, and the New England States. The foreign-born white population in 1930 was 6,194, and the number of people of foreign parentage but born in this country was 10,398.

Olean, the largest city, has a population of 21,790, and Salamanca has 9,577 inhabitants. Important villages are Gowanda, with 3,042 inhabitants, 955 of whom live in Erie County; Franklinville, with 2,021; and Little Valley, with 1,196.

The county is well supplied with direct rail transportation to such industrial centers as Buffalo, Rochester, Pittsburgh, and New York City. The main line of the Erie Railroad crosses the southern part, and a branch line extends to the north. Lines of the Pennsylvania, Baltimore & Ohio, and Pittsburgh, Shawmut & Northern Railroads also pass through the county.

According to the 1930 census there are 3,999 farms, 563 of which are located on concrete roads, 642 on macadam roads, 229 on gravel roads, 39 on brick, asphalt, and sand-clay roads, 374 on improved dirt roads, 2,015 on unimproved dirt roads, and 137 on all other roads, including those not reported. Farms with telephones numbered 1,782, and those wired for electricity numbered 1,346.

Some consolidation of rural schools has taken place, but there are still a large number of one-room rural schoolhouses.

Lumbering was the earliest and for many years the most important industry. Pittsburgh, in a region where white pine was not common, furnished an excellent market for lumber from the vast pine forests of the Allegheny and Conewango Valleys. As early as 1840 this industry reached its maximum development. White pine and hemlock were the first species lumbered, the latter mainly for its bark, a product in demand by the tanning industry.

After most of the valuable timber had been removed, the chemical industry moved in and cut much of what was left for the production of destructive-distillation products of wood. No representative trees of the once great forests remain, and all the present forests are composed of second- and third-growth trees. The area south of the Allegheny River and west of Tunungwant Creek, set aside as a State park in 1921, is protected from both cutting and fire. In years to come this area may furnish an example of the kind of forest that once covered this section.

The first oil well in this county was drilled in 1864. The industry was on a paying basis by 1878, when there were 250 producing wells. The product is a high-grade paraffin-base oil that commands a premium on the market. The refining of this oil is the industry responsible for the development of Olean as a city. Many of the wells have been producing for 30 years or more, and by recently developed methods of flooding with water it is probable that the life of the field will be extended for many years (?).

Other important industries are the manufacturing of furniture, tanning, gluemaking, cutlery manufacturing, weaving, canning, and milk processing. The 1930 census records the total value of manufactured products as \$42,849,974.

CLIMATE

The climate is continental and is characterized by wide extremes between summer and winter temperatures. The absolute maximum and minimum temperatures recorded at Franklinville are 99° and -45° F., respectively. The southern and eastern parts of the county, with their more rugged character and higher elevation, experience even greater extremes than the northwestern part. The total annual precipitation varies from 5 to 10 inches between these two sections.

The average length of the frost-free season ranges from 99 days at Allegany State Park to 171 days at Perrysburg. The longer growing season at Perrysburg is due to its proximity to Lake Erie, which lies 14 miles to the northwest. The average frost-free season as recorded at Franklinville extends from May 21 to September 25, a period of 127 days. Frost has been recorded, however, as late as June 12 and as early as August 30.

Precipitation is well distributed through the year in all sections. Approximately 50 percent of the total falls during the growing season, from May 1 to September 30. Long-continued droughts are rare, but it is not uncommon for short periods of dry weather to occur during the year.

In a section like Cattaraugus County, where the difference in elevation between the valleys and uplands ranges from 100 to 1,800 feet, there are many local differences in length of growing season, temperature, and other features of the climate, which are significant from the point of view of crop production. The areas of higher elevation are limited to a system of agriculture in which the production of forage is most important, although local elevations may have somewhat longer frost-free seasons than local depressions. Many local "frost pockets" exist where cold air settles at night during spring and fall.

Table 1 gives detailed climatic data taken from the records of the United States Weather Bureau station at Franklinville, and table 2 summarizes data for other stations in the county.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Franklinville, Cattaraugus County, N. Y.

[Elevation 1,600 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1934)	Total amount for the wettest year (1905)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December.....	25.3	62	-27	2.56	2.07	3.32	17.2
January.....	23.1	68	-34	3.08	1.99	5.05	20.6
February.....	19.5	66	-45	2.49	1.10	1.66	15.0
Winter.....	22.6	68	-45	8.13	5.16	10.03	52.8
March.....	32.2	80	-16	2.84	2.19	2.77	8.9
April.....	42.4	85	-1	3.49	2.25	3.80	5.8
May.....	54.0	92	19	3.62	.72	2.88	.6
Spring.....	42.9	92	-16	9.95	5.16	9.45	15.3
June.....	63.0	97	30	4.26	2.08	8.89	.0
July.....	67.8	99	32	3.91	2.10	5.82	.0
August.....	65.2	95	26	3.85	5.21	4.09	.0
Summer.....	65.3	99	26	12.02	9.39	18.80	.0
September.....	60.2	91	21	3.54	4.02	2.10	(¹)
October.....	48.9	86	13	3.87	2.46	4.87	1.5
November.....	37.1	78	-24	2.78	2.68	4.35	7.0
Fall.....	48.7	91	-24	10.19	9.06	11.32	8.5
Year.....	44.9	99	-45	40.29	28.77	49.60	76.6

¹ Trace.

TABLE 2.—*Summarized climatological data for Cattaraugus County,¹ N. Y.*

Station	Elevation	Growing season May 1 to Sept. 30								
		Precipitation			Length			Temperature		
		Mean	Heaviest	Lightest	Average	Longest	Shortest	Mean	Highest	Lowest
	<i>Feet</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Days</i>	<i>Days</i>	<i>Days</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>
Allegany.....	1,440	19.89	25.84	14.29	127	156	89	62.6	64.8	61.1
Allegany State Park.....	1,346	19.31	22.21	14.61	99	123	65	69.7	61.5	58.8
Humphrey.....	1,951	22.30	30.61	12.63	134	155	109	62.8	65.4	60.2
Otto.....	1,280	16.79	18.18	13.01	146	175	111	64.3	64.4	63.5
Perryburg.....	4,500	17.46	20.11	14.48	171	184	155	63.6	65.3	61.0

Station	Annual					
	Precipitation			Temperature		
	Mean	Heaviest	Lightest	Mean	Absolute maximum	Absolute minimum
	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>° F.</i>	<i>° F.</i>	<i>° F.</i>
Allegany.....	43.17	49.57	35.51	46.4	98	-37
Allegany State Park.....	44.10	52.17	36.21	44.4	95	-25
Humphrey.....	44.45	59.49	30.70	45.4	93	-17
Otto.....	33.09	36.24	33.02	46.8	99	-24
Perryburg.....	38.90	44.95	33.25	46.0	95	-18

¹ Taken from Mordorff (9).

AGRICULTURAL HISTORY AND STATISTICS

The early agriculture of Cattaraugus County was primarily of a subsistence type. The first products grown were those necessary to sustain life in a wilderness. Fields were cleared and the timberland burned over, the ashes being converted into black salts. The sale of these salts eked out the small cash income the early settlers had from the sale of honey, beeswax, cheese, butter, furs, cattle, and wheat.

Cereals, such as corn, wheat, and oats, were planted in the patches of cleared land. The surplus products, principally corn and oats, were disposed of at the lumber camps in the southern part of the county. Agricultural development was slow at first, because there was no outlet for the surpluses grown. After the construction of the Erie Railroad, advances in agriculture were rapid.

Before 1850 most of the cattle were raised principally for beef and were driven overland to eastern markets. After the railroads were built the production of cattle for beef was superseded by the dairy industry, which has remained the most important phase of agriculture. The United States census of 1850 records the number of cattle as 50,893, of which 19,949 were milk cows and 4,843 work oxen. During 1855, 1,957,183 pounds of butter and 1,717,484 pounds of cheese were produced. It is only recently that dairy products have been marketed as fluid milk rather than in the form of butter and cheese.

It was early recognized that the hill soils of Cattaraugus County were better adapted to hay and pasture than to grain. Agriculture always has been based on raising livestock and producing crops to supplement a livestock type of farming. The acreages of the principal crops in stated years are given in table 3.

TABLE 3.—Acreages of the principal crops in Cattaraugus County, N. Y., in stated years

Crop	1879	1889	1899 ¹	1909	1919	1929 ¹	1934 ¹
Oats:							
Threshed.....	Acres 29,064	Acres 41,880	Acres 29,679	Acres 31,058	Acres 29,714	Acres 15,207	Acres 15,471
Out and fed unthreshed.....						3,603	3,182
Corn:							
For grain.....	8,930	3,564	7,049	5,665	2,211	244	1,016
For silage, fodder, and hogging down.....					5,277	11,413	13,899
Buckwheat.....	2,091	5,783	7,157	9,592	7,504	5,115	
Mixed grains threshed.....					1,107	8,394	5,403
Barley.....	1,421	2,368	1,130	835	982	901	596
Wheat.....	4,589	1,731	1,438	390	1,731	300	562
Potatoes.....	5,230	6,215	6,805	7,392	5,067	3,511	4,819
Vegetables harvested for sale.....					531	700	920
Hay.....	117,002	131,113	143,253	132,349	135,584	105,984	121,535
Timothy and clover, alone or mixed.....				129,103	130,510	101,061	108,240
Alfalfa.....			41	392	110	1,338	1,435
Small grains cut for hay.....			2,667	1,828	3,678	1,420	5,234
Other hay.....			140,545	1,308	1,006	2,165	6,626
Apples.....	Trees	Trees	Trees	Trees	Trees	Trees	Trees
Maple trees tapped.....	366,536	434,319	434,319	287,788	197,246	114,259	86,158
Grapes.....	Vines	Vines	Vines	Vines	Vines	Vines	Vines
			96,318	180,292	349,327	472,848	336,074

¹ The numbers of apple trees and grapevines are for the years 1900, 1930, and 1935.

² For forage only.

Hay is the most important crop both from the point of view of acreage and value. The 121,535 acres devoted to hay in 1934 produced 83,049 tons, which was a low yield, owing to the serious lack of precipitation during the early summer of that year. Normally the average yield is slightly more than 1 ton an acre. The most important hay crops—timothy and timothy and clover mixed—were grown on 108,240 acres and produced 72,898 tons of hay. Alfalfa is grown on a comparatively small scale, although the acre yield is about twice that of timothy or timothy and clover. The 1,435 acres devoted to alfalfa in 1934 yielded 2,029 tons of hay.

Most of the corn is utilized as fodder or silage, especially the latter. The acreage of corn in 1934 was 14,915 acres, and corn from only 1,016 acres was harvested for grain. Corn was one of the most important crops in the early agriculture, when it was harvested principally as grain, a practice that has largely ceased during recent years.

Oats are the leading grain crop, with an acreage of 15,471 in 1934. The area devoted to this crop has been steadily declining, however, since the peak year of 1889, when 41,880 acres were devoted to it. Other crops of minor importance are buckwheat, potatoes, barley, and wheat.

The production of fruit is of little importance. The number of apple trees of bearing age declined to 86,158 in 1934 and represents mainly the small orchards of the farmsteads. Little or no attempt

is made to spray and prune the trees properly, so that the fruit produced is of poor quality. Most of it is used by the farm families. In 1934, 1,575,890 pounds of grapes were produced from 336,074 vines. Grapes are grown almost exclusively near Perrysburg, where the growing season is considerably lengthened by the proximity of Lake Erie.

The total value of field and orchard crops, vegetables, and farm gardens, in 1929, as reported in the United States census of 1930, was \$3,477,564, of which the principal item was hay and forage, valued at \$2,141,459. The value of forest products cut on farms, for home use and for sale, was \$500,092.

Livestock products greatly exceed field crops in value. In 1929, 27,138,695 gallons of milk was produced, of which 24,150,363 gallons was sold for \$5,313,080; 291,971 pounds of butter was churned, of which 200,421 pounds was sold for \$100,211; 137,205 pounds of cream was sold as butterfat, and 23,359 gallons of fluid cream was sold for \$67,230 and \$46,718, respectively. The total value of dairy products sold in 1929 was \$5,527,239. The production of milk and butter in 1934 was 26,481,155 gallons and 264,468 pounds, respectively.

The value of the 402,998 chickens raised in 1929 was \$435,238, and the value of other poultry \$21,628. Of these, 198,279 chickens were sold alive or dressed for \$220,090. The value of the 2,280,388 dozens of eggs produced in 1929 was \$798,136, of which 1,727,200 dozens were sold for \$604,520. The number of chickens raised was 328,885, and the number of eggs produced was 2,108,197 dozens in 1934.

A State census (11) reports the number of dairy cattle of milking age in 1935 as 50,000, with an average production of 5,185 pounds of milk a cow. The total milk production in 1933 amounted to 262,890,000 pounds, which was disposed of as follows: 10,177,000 pounds was used on the farm as milk or for cream, 6,379,000 pounds for making butter, and 28,838,000 pounds for feeding calves. Large plants and large retail dealers received 206,621,000 pounds, and 10,875,000 pounds was sold by the farmers direct to consumers or to small retailers.

There were 39 plants receiving milk and cream from the farmers in 1933. Nineteen of these were taking milk for fluid use, 12 were receiving milk for manufacture, and 6 were obtaining cream for fluid use. There were 17 plants making American cheese, 6 plants condensing and evaporating milk, 2 plants making creamery butter, 12 plants making ice cream, and 1 plant engaged in the production of powdered milk and cream. Cottage, pot, and bakers' cheeses also are manufactured. The average butterfat test of the milk during the year was 3.71 percent. A large proportion of the milk is shipped as fluid milk, mostly to markets in New York City and Buffalo.

The number and value of domestic animals on farms are given in table 4.

TABLE 4.—*Number and value of domestic animals on farms in Cattaraugus County, N. Y., in stated years*

Kind of animal	1880 ¹	1890 ¹	1900 ¹	1910	
	Number	Number	Number	Number	Value
Cattle.....	82,638	80,067	109,694	101,504	\$2,873,749
Horses.....	12,890	15,752	14,647	13,888	1,792,192
Sheep.....	26,745	22,179	27,012	9,709	54,164
Swine.....	10,435	16,631	14,708	17,854	169,018

Kind of animal	1920		1930		1935 ¹
	Number	Value	Number	Value	Number
Cattle.....	81,673	\$6,874,221	83,379	\$5,043,222	67,757
Horses.....	13,208	1,890,637	7,507	879,929	7,770
Sheep.....	4,481	59,512	8,042	70,922	4,455
Swine.....	14,377	279,011	5,239	77,218	4,497

¹ Value not reported.

Practically all of the cattle now on farms are dairy cattle, the number of which has remained fairly constant for a great number of years. The number of cows and heifers kept mainly for beef production on farms in April 1930 was only 264. Holstein-Friesian is the most common breed of dairy cattle, followed by Guernsey, Ayrshire, and Jersey in the order named.

Very few sheep were raised by the first settlers, because of depredations by wolves. After the extermination of wolves, sheep raising attained a notable level for a period of about 15 years, then again declined.

The number of horses decreased between 1920 and 1930, since which time there has been little change. Many of the horses are large well-bred animals. Very few are raised in the county, as evidenced by the fact that only 227 of the 7,770 horses reported in 1935 were colts under 2 years of age.

Raising swine never has been very important. The peak in numbers, 17,854, was reached in 1910, but the 1935 census reports only 4,497.

Poultry and poultry products have been increasing steadily in importance as sources of farm income ever since the early establishment of agriculture. Practically all of the farmers raise poultry as a side line and trade the surplus eggs and chickens locally. There were 178 farms classed as poultry farms by the 1930 census, on the basis of the fact that more than 40 percent of the income was derived from the sale of poultry and poultry products.

The sale of forest products is now of secondary importance. All the first-growth timber has been cut, but a considerable amount of the second growth is being utilized. During 1929, 3,660,000 board feet of saw and veneer logs, 333,875 fence posts, and 6,806 cross ties were cut. The production of maple sugar and sirup, which reached its maximum in 1889, with 687,934 pounds of sugar and 30,068 gallons of sirup, has steadily declined as the mature trees were cut for lumber. Maple trees yielded only 20,725 pounds of sugar and 36,895 gallons of sirup in 1929.

In 1934, 593,743 acres, or 69.1 percent of the area of the county, were in farms, of which 57.3 percent is utilized as pasture, 20.5 percent is devoted to hay, 12.1 percent is devoted to oats, corn, and other cul-

tivated crops, and 10.1 percent is occupied by wood lots, farmsteads, or roads.

Most of the farms range from 50 to 219 acres in size. Some of those near the cities and villages contain less than 20 acres, and in the rougher parts farms of 500 acres are not uncommon. The number of farms decreased from 6,017 in 1910 to 3,999 in 1930, then increased to 4,760 in 1935. The average size for the years mentioned above was 111.3, 136.2, and 124.7 acres, respectively.

The average value a farm for land and buildings in 1930 was \$5,989, or \$43.97 an acre. Corresponding values for 1935 were \$4,021 a farm or \$32.24 an acre. Many of the buildings, especially in the upland sections, are badly in need of repairs and paint.

Most of the farms are well supplied with the necessary farm machinery and equipment. The average value of machinery of a farm amounted to \$964.20 in 1930. In the same year 3,384 automobiles were reported on 2,834 farms, 1,258 trucks on 1,191 farms, and 806 tractors on 790 farms.

According to the 1935 census, owners operate 83.7 percent of the farms, tenants 15.9 percent, and managers 0.4 percent. Tenancy has not varied significantly in the last 50 years. Most of the rentals are on a share basis. The owners generally furnish the seed and fertilizers and receive in return one-half of the farm produce.

Fertilizer, including lime, was purchased in the amount of \$178,353 during 1929, an average expenditure of \$68.44 for each of the 2,606 farms reporting its use. Very little complete fertilizer is used by the farmers. Most of the fertilizer used is 16-percent superphosphate. The use of lime has decreased considerably during recent years, largely because of the prevailingly low prices received for milk. The meadows would be greatly improved by the use of more lime.

The common practice is for neighbors to exchange labor during harvesting and when the silos are filled. The census reports an expenditure for wages during 1929 of \$543,007 on 2,106 farms, an average of \$257.83 a farm reporting the hire of labor. The daily wage ranges from \$1 to \$3. Some of the larger farms employ extra labor on a year-long basis at a monthly wage ranging from \$30 to \$50.

Feed was purchased on 3,535 farms in 1929 at a total expense of \$2,237,709, or \$633.02 a farm reporting.

Dairying is the principal source of income on most farms. The 1930 census classes the farms as follows: 2,552 dairy farms, 445 general farms, 178 poultry farms, 141 self-sufficing farms, 74 crop-specialty farms, 45 animal-specialty farms, 26 fruit farms, 16 truck farms, and the rest abnormal or unclassified.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence,

texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil³ and its content of lime and salts are determined by simple tests.⁴ Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. Areas of land, such as coastal beach or bare rocky mountainsides that have no true soil, are called (4) miscellaneous land types.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus Wooster, Chenango, and Volusia are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Chenango gravelly silt loam and Chenango gravelly sandy loam are soil types within the Chenango series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is generally the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, which differs from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion frequently are shown as phases. For example, within the normal range of relief for a soil type, there may be areas that are adapted to the use of machinery and the growth of cultivated crops and others that are not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such instances the more sloping parts of the soil type may be segregated on the map as a sloping or hilly phase. Similarly, soils

³The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

⁴The total content of readily soluble salts is determined by the use of the electrolytic bridge. Phenolphthalein solution is used to detect a strong alkaline reaction.

having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS AND CROPS

Cattaraugus County lies wholly within the Southwestern Plateau section of New York State. The land has been so maturely dissected that the relief is characterized by flat-topped hills and ridges with nearly uniform elevations. Slopes are steep and rather smooth. The southern part of the county is the most rugged and remains largely in forest.

The soils vary considerably in their characteristics. The texture of the surface soil ranges from gravelly loam to clay but in most places is silt loam. The color in general is light, the predominant colors being yellow, brown, and gray, which are characteristic of soils developed under a predominantly deciduous forest cover in a temperate humid section such as this. In such an environment little organic matter is incorporated in the soil. The litter that falls is lost rapidly through decomposition and leaching. Approximately 50 percent of the total area consists of well-drained soils, 13 percent of imperfectly drained soils, and 37 percent of poorly drained soils. A comparatively small acreage of the soils classed as poorly drained are nonagricultural because of a permanent excess of water. Poor drainage of the rest indicates a lowering of the agricultural value and productiveness, owing to temporarily excessive moisture, generally in the spring, when seedbeds are under preparation.

The agriculture of this county has been determined by a combination of economic, climatic, and soil factors. There are no large local markets within the county. Buffalo, 60 miles to the north, is furnished with agricultural products from the intensively farmed areas close to that city. The elevation above sea level throughout most of the county exceeds 1,200 feet, and the growing season is correspondingly short. Therefore, the range of crops that can be successfully produced is limited. Poor or imperfect drainage of a large proportion of the soils also limits the range of crops that can be grown. Besides deficient drainage, many of the upland soils have hard compact subsoils, locally known as hardpan. This impervious layer retards the downward movement of water and prevents the penetration of plant roots. These hardpanlike soils dry slowly in the spring, causing delay in seeding, and later in the season they become dry and hard because of the low storage capacity and exhaustion of moisture in the surface soil. The compact layers effectively stop the rise of water by capillary action.

Such a combination of economic, climatic, and soil factors directs agriculture toward the production of concentrated products that can be transported to distant markets with profit.

The first settlers soon recognized that the soils of this section were better adapted to the production of forage crops and hay than to grain and vegetable crops; consequently dairying and the manufacture of butter and cheese became the dominant enterprises.

The characteristics of the upland soils effectively limit their successful utilization to forage crops, such as timothy, red clover, alsike clover, and oats. Grasses tolerate these characteristics; moreover, the rainfall along with the cool growing-season temperature is favorable to grasses. The soils have a low natural fertility level, but with additions of phosphates and lime, excellent pastures can be developed, a factor of great significance in this county with its 50,000 dairy cows (5).

The agriculture practiced on the rather large area of well-drained soils with good physical properties throughout the valleys is the same as that practiced on the uplands, but larger yields are obtained. The farms have larger herds of cattle and are more prosperous in general than those of the uplands.

To facilitate the detailed discussion of the relationships between soils and agriculture, the soils are placed in groups, on the basis of their topographic position, as soils of the uplands and soils of the lowlands. The soils are further subdivided on the basis of their drainage characteristics into well-drained, imperfectly drained, and poorly drained soils, and the soils of the lowlands are also subdivided on the basis of their age into those developed from older outwash and lake deposits and those developed on present flood plains.

In the following pages the characteristics and agricultural relationships of the soils are discussed in detail, their distribution is indicated on the accompanying soil map, and their acreage and proportionate extent are given in table 5.

TABLE 5.—*Acreage and proportionate extent of the soils mapped in Cattaraugus County, N. Y.*

Soil type	Acres	Per cent	Soil type	Acres	Per cent
Wooster gravelly silt loam.....	19,264	2.2	Fromont silt loam.....	24,960	3.0
Wooster gravelly silt loam, rolling phase.....	1,472	.2	Erie silt loam.....	37,824	4.5
Wooster gravelly silt loam, steep phase.....	3,648	.4	Erie silt loam, steep phase.....	1,472	.2
Wooster gravelly loam.....	11,968	1.4	Hornell silty clay loam.....	6,976	.8
Wooster gravelly loam, rolling phase.....	832	.1	Aurora silty clay loam.....	6,592	.8
Wooster gravelly loam, steep phase.....	2,752	.3	Aurora silt loam.....	3,072	.4
Wooster silt loam.....	10,496	1.2	Ernest silty clay loam.....	13,056	1.6
Wooster silt loam, steep phase.....	896	.1	Ernest silty clay loam, steep phase.....	640	.1
Lordstown silt loam.....	28,288	3.4	Ernest silt loam.....	13,440	1.6
Bath gravelly silt loam.....	3,392	.4	Chippewa silty clay loam.....	5,184	.6
Bath gravelly silt loam, rolling phase.....	1,984	.2	Mardin silt loam.....	21,632	2.6
Bath gravelly silt loam, steep phase.....	1,836	.2	Mardin silt loam, steep phase.....	9,728	1.1
Lordstown stony silt loam.....	5,760	.7	Canfield silt loam.....	81,744	3.8
Lordstown stony silt loam, steep phase.....	61,504	7.3	Canfield silt loam, steep phase.....	4,608	.5
Dekalb silt loam.....	27,840	3.3	Langford silt loam.....	17,472	2.1
Dekalb silt loam, steep phase.....	100,864	12.0	Chenango gravelly loam.....	19,840	2.4
Dekalb stony silt loam.....	12,480	1.5	Chenango gravelly silt loam.....	13,056	1.6
Leontonia coarse sandy loam.....	6,272	.7	Chenango gravelly silt loam, alluvial fan phase.....	8,960	1.1
Cattaraugus silt loam.....	2,240	.3	Chenango gravelly sandy loam.....	2,752	.3
Cattaraugus silt loam, steep phase.....	2,112	.3	Chenango gravelly loamy sand.....	832	.1
Volusia silt loam.....	81,920	9.7	Chenango silt loam.....	8,064	1.0
Volusia silt loam, steep phase.....	6,976	.8	Unadilla silt loam.....	15,852	1.8
			Unadilla fine sandy loam.....	2,304	.3
			Otisville gravelly loam.....	9,664	1.1
			Mentor fine sandy loam.....	896	.1
			Braceville silt loam.....	2,816	.3

TABLE 5.—*Acres and proportionate extent of the soils mapped in Cattaraugus County, N. Y.—Continued*

Soil type	Acres	Per-cent	Soil type	Acres	Per-cent
Mahoning silty clay loam.....	5,440	0.6	Genesee fine sandy loam, high-bot- tom phase.....	1,038	0.1
Mahoning silty clay loam, rolling phase.....	3,328	4	Genesee silt loam.....	256	(1)
Mahoning silty clay loam, steep phase.....	6,144	7	Genesee silt loam, high-bottom phase.....	64	(1)
Mahoning silt loam.....	17,472	2.1	Pope silt loam.....	2,048	.2
Mahoning silt loam, rolling phase..	2,112	.3	Chagrin silt loam.....	64	(1)
Caneadea silt loam.....	1,472	.2	Middlebury silt loam.....	6,272	.7
Lorain silty clay loam.....	10,496	1.2	Holly silty clay loam.....	7,808	.9
Lorain silt loam.....	3,008	.4	Wayland silty clay loam.....	1,344	.2
Lorain fine sandy loam.....	1,280	.2	Atkins silt loam.....	1,408	.2
Tyler silty clay loam.....	3,328	.4	Alluvial soils, undifferentiated.....	22,848	2.7
Tyler silt loam.....	3,136	.4	Muck.....	4,672	.6
Tioga silt loam.....	4,928	.6	Muck, shallow phase.....	5,824	.7
Tioga silt loam, high-bottom phase.	3,200	.4	Rough stony land.....	37,440	4.5
Tioga fine sandy loam.....	1,984	.2	Quarries.....	64	(1)
Tioga fine sandy loam, high-bottom phase.....	2,688	.3			
Genesee fine sandy loam.....	2,112	.3	Total.....	840,960	

¹ Less than 0.1 percent.

SOILS OF THE UPLANDS

WELL-DRAINED SOILS OF THE UPLANDS

The group of well-drained soils of the uplands comprises members of the Wooster, Lordstown, Bath, Dekalb, Leetonia, and Cattaraugus series.

The Wooster, Bath, and Lordstown soils are characterized by their brown color, friability throughout, and good drainage of both surface soil and subsoil. The first two soils are deep, but the last is shallow—in few places more than 36 inches deep. The Lordstown soils occupy the hilltops and slopes, where they are developed from a thin mantle of glacial till derived almost entirely from local sandstone material. Although the flat, rolling, or moderately sloping relief in general is favorable for agriculture, the high elevation at which they occur and the consequently short growing season, together with the comparative inaccessibility of these areas, are limiting factors. The Bath soils are formed from moderately thick glacial till deposits of the higher plateau levels. Agriculture, as practiced on these soils, consists of the production of crops, such as timothy, clover, oats, and silage corn, in support of dairying.

Members of the Dekalb, Leetonia, and Cattaraugus series occur only in the southern half of the county, entirely within the unglaciated section. The Dekalb soils occupy a strip 4 or 5 miles north of the Allegheny River and continuing south to the Pennsylvania State line. They lie south of the terminal moraine and have developed in place through soil-forming processes acting directly on the underlying rocks, which include shales, thin-bedded and massive sandstones, and quartz conglomerates. All the area west of Tunungwant Creek is incorporated in a State park. The Dekalb, Leetonia, and Cattaraugus soils occupy flat or rolling uplands and steep rugged slopes that never have been used extensively for agriculture. The numerous large conglomerate boulders and ledges further reduce the agricultural value of these soils. Very few areas ever were cleared and used for farming, and most of the cleared areas subsequently were abandoned because of the low productivity of the soil.

Wooster gravelly silt loam.—The cultivated surface soil of Wooster gravelly silt loam is brown or yellowish-brown loose gravelly silt loam to a depth of 8 inches. The subsurface material, continuing to a depth of 24 inches, is yellowish-brown or brownish-yellow gritty silt loam and is somewhat firm in place. The subsoil, between depths of 24 and 36 or more inches, is slightly compact but friable pale-yellow gravelly or stony loam with a brown cast in many places. The lower part of the subsoil and the substratum are light grayish-yellow moderately compact gravelly or stony loam till. The degree of compactness increases with depth but does not reach a point where it interferes with the movement of water or the penetration of plant roots.

The natural organic-matter content is low, and the reaction is strongly acid. The gravel present consists of rounded and angular fragments of shales and sandstones, with variable quantities of crystalline materials carried in from the north. In some places the surface gravel, particularly the shale and sandstone fragments, is so large that the soil approaches a stony silt loam.

Wooster gravelly silt loam is rather widely distributed throughout the county except in the unglaciated section in the southern part and in the higher parts of the plateau, where it grades into Bath gravelly silt loam. Probably the largest areas are in the vicinity of Randolph and north of Machias. From Randolph northeastward to Little Valley along the line of the terminal moraine the Bath soils become important. The total area of the Wooster soil is 30.1 square miles, approximately 60 percent of which is cleared and under cultivation, 10 percent cleared and idle, and 30 percent in second-growth forest.

In most places the relief is distinctly rolling to hilly, although in some areas it is relatively level. In many places this soil represents moraines and has the relief typical of such land forms. The soil has developed from glacial till made up of mixed foreign and local rocks, with the latter predominant. Evidence of considerable water action is manifested in many places by the amount of rounded gravel and stratification in the parent material.

The native vegetation was a mixed conifer and hardwood forest. The present stands on the uncleared land are mainly a beech, hard maple, and yellow birch association, with some ash, hickory, and basswood.

Wooster gravelly silt loam is one of the most productive upland soils in the county and is well adapted to the crops commonly grown. The loose mellow surface soil and porous only slightly compact subsoil are conducive to good crop yields under proper management. The natural fertility is not high, because the soil is easily leached, but good response is made to fertilization. Yields of the important crops grown under the prevailing system of fertilization are 1½ to 2 tons of hay, 40 bushels of oats, and 8 to 10 tons of silage corn an acre. The hay crops are principally timothy and medium-red clover. Alfalfa does well on the Wooster soils but requires more lime than is commonly applied to the new seedings of clover. The physical properties of this soil are favorable for the production of potatoes, but the acreage devoted to this crop is small. Buckwheat is grown to some extent.

The common system of management calls for a 4- or 5-year rotation of corn, oats, and hay, with the land remaining in meadows for

2 or 3 years. Where alfalfa replaces clover and timothy, it is left until the plants run out. About 200 pounds of superphosphate is applied to the land for corn and oats, and manure is applied to the meadows and cornland. Applications, ranging from 1,500 to 3,000 pounds an acre, of lime, most frequently in the form of ground limestone, are made to the new seedings of clover or alfalfa. This system of management is the common one used throughout the county regardless of the type of soil farmed. About the only change is the substitution of alsike for medium-red clover on the poorly drained soils.

Wooster gravelly silt loam, rolling phase.—The rolling phase of Wooster gravelly silt loam has the brown or yellowish-brown surface soil and the lighter colored open subsoil characteristic of typical Wooster gravelly silt loam, from which it is distinguished by its more sharply rolling, hummocky, and pitted relief, which, in places, is characterized by alternating kames and kettles. The rougher surface materially reduces the agricultural value of the more rolling soil, as compared with the typical soil, because of the difficulty experienced in tillage. Where this rolling soil is farmed, the cropping system is essentially the same as that practiced on the typical gravelly silt loam, but yields are somewhat lower. Even though this soil is porous, erosion on the steeper parts may be serious if care is not exercised in managing the land.

Most of this soil has been cleared of its original forest. A larger proportion of it is idle or abandoned than of the typical soil. The principal areas are in Randolph Town and from there northeastward to Little Valley along the line of the terminal moraine. This soil is similar to and grades into areas of Bath gravelly silt loam, rolling phase.

Wooster gravelly silt loam, steep phase.—The steep phase of Wooster gravelly silt loam, to a depth of 5 or 6 inches, consists of brown or yellowish-brown loose gravelly silt loam. This is underlain, to a depth of 18 or 20 inches, by brownish-yellow firm gravelly silt loam. The parent material consists of pale-yellow or brownish-yellow slightly compact but friable gravelly or stony loam deep glacial till. This steep soil resembles the typical soil except that all horizons average somewhat thinner, and the land is very steep. Most of it remains in forest, but a small total area is used for pasture.

Wooster gravelly loam.—Wooster gravelly loam has an 8-inch surface layer of brown mellow gravelly loam overlying a subsurface layer of yellowish-brown open gravelly silt loam. The subsoil, beginning at a depth of 24 inches and continuing to a depth of 36 inches, is composed of pale-yellow or gray coarse gravelly or stony loam. The unaltered material, or substratum, consists mostly of mixed gravel and angular stone fragments, with only a small proportion of fine material (silt, clay, and very fine sand). The profile of Wooster gravelly loam is not greatly different from that of Wooster gravelly silt loam, except that the surface layer is lighter textured and rounded gravel and stratification in the substratum are more common. This soil consistently has more sharply rolling relief than the gravelly silt loam, and in places it resembles that of Otisville gravelly loam. Like all members of the Wooster series, this soil is strongly acid and is excellently drained.

The agriculture and the methods of management are similar to those practiced on the gravelly silt loam, but yields on the rougher areas of the gravelly loam are slightly less. Wooster gravelly loam occurs in the principal valleys of the county but is most typically developed in the valley from Franklinville northward to the county line. The total area is 18.7 square miles.

Wooster gravelly loam, rolling phase.—Wooster gravelly loam, rolling phase, has a 4- to 8-inch brown mellow gravelly loam surface soil. This overlies yellowish-brown loose friable gravelly silt loam that continues to a depth ranging from 18 to 30 inches. The parent material consists of loose gravelly glacial till composed largely of sandstone and shale fragments, together with small quantities of many other rocks. This soil differs from typical Wooster gravelly loam chiefly in its rolling or kettle-kame topography and in its somewhat slighter depth. It is used for the same crops as the typical soil, but yields on it are somewhat less. A larger proportion of the land is devoted to hay, pasture, and woodland. Only a small area is mapped.

Wooster gravelly loam, steep phase.—The steep phase of Wooster gravelly loam includes some areas of all types of Wooster soils occupying steep slopes. On such slopes the texture is not uniform and ranges from silt loam to light gravelly loam, but gravelly loam predominates. The agricultural value of these areas is low, as many of the slopes are too steep for cultivation and are subject to severe erosion if plowed.

The soil profile is not noticeably different from that of other types of the Wooster series, except where erosion has been sufficiently active to remove the surface soil.

Some of the cleared areas are used as pasture, but, unless the land is fertilized, the grasses are of poor quality. The total area of this soil is small, and a large proportion of it remains in forest.

Wooster silt loam.—Wooster silt loam has a 6- to 10-inch surface layer of rich-brown, brown, or yellowish-brown mellow silt loam or very fine sandy loam. Little or no gravel is present. Below this is a subsurface layer of yellowish-brown firm silt loam. The subsoil is composed of bedded sands and silt or mixed gravel and sand, which, in places, are sorted into layers of the various materials.

In many places the materials from which the soil has developed were deposited as lateral moraines along the edges of the ice lobes and as deltas in temporary glacial lakes. The relief ranges from level and benchlike to rolling or hummocky.

The less rough areas of this soil are excellent cropland, and yields may be from 5 to 10 percent greater than on either Wooster gravelly silt loam or Wooster gravelly loam. The silt loam occurs mainly in the western and northern parts of the county through Conewango and Cattaraugus Creek Valleys, where it is developed on the lower slopes just above the valley floors. Several areas are in the vicinity of Maples in Mansfield and East Otto Towns. In common with other Wooster soils, this soil has excellent drainage and generally is acid in reaction, although in some areas liberal quantities of limestone gravel are present at a depth ranging from 6 to 8 feet. The total area mapped is 16.4 square miles.

Agricultural practices are similar to those followed on other Wooster soils, and timothy and clover, oats, and silage corn are the leading crops. Many pastures are better than those on other Wooster soils, because this soil has more body and greater water-holding capacity in the upper layers. With sufficient use of lime, alfalfa would give good results.

Wooster silt loam, steep phase.—Wooster silt loam, steep phase, consists of rich-brown, brown, or yellowish-brown silt loam to a depth of 6 to 8 inches. This is underlain by yellowish-brown or pale brownish-yellow firm but friable somewhat gravelly silt loam that continues to a depth ranging from 20 to 30 inches where it rests on gravelly glacial till or bedded sands and gravel. The gravel is composed largely of sandstone fragments, together with some hard shale and pieces of many different kinds of rocks that were brought in by the glacier that invaded the area in Pleistocene times.

The steep slopes characteristic of this soil have forced most farmers to leave the land in forest, although a few areas are cleared and furnish a poor grade of pasturage for livestock. The total area is small.

Lordstown silt loam.—Lordstown silt loam is developed extensively on the high hilltops and gentle upper slopes of the area lying north of the terminal moraine and is characterized by a light-brown or grayish-brown mellow silt loam surface soil that in most places contains some angular shale and sandstone fragments. The subsurface material is grayish-yellow or brown firm silt loam. The subsoil is light-gray or yellow friable and incompact material and rests on thin-bedded shales and sandstone bedrock at a depth ranging from 24 to 36 inches. The organic-matter content is rather low in places where the soil has been cultivated for some time. Drainage is good, and the reaction is strongly acid.

Agriculture consists of the production of forage crops in support of dairying. The important crops grown are timothy and clover, oats, some corn for silage, and buckwheat. Meadows are planted mostly to timothy and yield from $\frac{3}{4}$ to 1 ton an acre. The acid reaction necessitates the application of lime for the successful production of legumes. Oats and silage corn yield about 30 bushels and from 6 to 8 tons an acre, respectively. Probably less commercial fertilizer and lime are used by the farmers on the Lordstown soils than on any other important soils, because of the cost of labor involved in transportation. Both lime and phosphate produce good results, however, when used on this soil. Pastures generally are poor and consist mainly of poverty grass.

Lordstown silt loam has a total area of 44.2 square miles. About 50 percent of the land has been cleared, of which approximately 25 percent is abandoned; the rest remains in forest of second- and third-growth hardwoods, mainly beech, hard maple, basswood, and yellow birch.

Bath gravelly silt loam.—Under cultivated conditions the surface soil of Bath gravelly silt loam consists of a 10-inch layer of rich-brown or yellowish-brown friable gravelly silt loam containing many small fragments of shale and sandstone that are more or less rounded as a result of glacial action. Under virgin conditions the surface soil consists of a 2- or 3-inch layer of very light gray silt

loam covered by a thin mat of partly decayed leaves and underlain by dark-brown silt loam or gravelly silt loam. The subsoil, beginning at a depth of 10 inches and continuing to a depth of about 24 inches, is rust-brown friable silt loam grading into light yellowish brown in the lower part. The color becomes considerably lighter and the material more and more gravelly with depth. The parent material consists of more or less gravelly glacial till somewhat mixed with water-assorted gravel like that under the Wooster soils.

Bath gravelly silt loam occurs on strongly undulating land at high elevations on the terminal moraine just north of the Allegheny Plateau. It is used for the same crops as Wooster gravelly silt loam, and yields are very similar, but those on the Bath soil are limited by a somewhat shorter growing season.

This soil differs somewhat from Bath gravelly silt loam, as originally established in Steuben County, where the parent material is composed of somewhat heavier textured yellowish-gray slightly compact silt loam containing stone fragments. From an agricultural point of view, however, the two soils are essentially the same.

Bath gravelly silt loam, rolling phase.—Bath gravelly silt loam, rolling phase, is much like typical Bath gravelly silt loam except that the relief is much more irregular. This rolling soil occupies smoothly rolling to fairly steep irregularly shaped hills interspersed with rather steep-sided depressions. This type of relief is very similar to the kettle-kame relief characteristic of water-deposited glacial border materials. Cleared areas of this soil are used for the same crops as those grown on the typical soil, but it produces somewhat lower yields and is more subject to erosion because of rapid run-off of water during rainy periods.

Bath gravelly silt loam, steep phase.—The profile characteristics of Bath gravelly silt loam, steep phase, are like those of the typical soil and the rolling phase except that the horizons in general are somewhat thinner. It occupies steeper slopes than the rolling soil and is devoted chiefly to forestry—the best use to which it can be put. Like the other Bath soils, it lies at high altitudes.

Lordstown stony silt loam.—Lordstown stony silt loam is rather unproductive. It differs from Lordstown silt loam only in the greater content of thin, angular stone fragments throughout the soil mantle, which are sufficiently abundant in places to interfere with cultivation. Where cultivated, the soil produces smaller yields than the silt loam.

This soil is developed mainly in the towns of Ellicottville, Franklinville, Mansfield, and East Otto, in the central part of the county, and Portville along the eastern boundary. The total extent is 9 square miles, 80 percent of which is forested. Much of the cleared land is abandoned.

Lordstown stony silt loam, steep phase.—The steep phase of Lordstown stony silt loam includes steep slopes that are nonagricultural. The soil profile, where erosion has not removed the surface layer, is like that of the typical Lordstown soil, except that bedrock is closer to the surface and ledges and outcrops of underlying rock are more common. Practically all of the land remains in forest. The few cleared areas furnish poor pasturage. The total area is 96.1 square miles.

Dekalb silt loam.—Dekalb silt loam, which is largely nonagricultural, has a yellow or yellowish-brown silt loam surface layer overlying a bright-yellow smooth incompact heavy silt loam or silty clay loam subsurface layer. The subsoil is yellow moderately dense silty clay loam mottled with gray and brown in places. Numerous angular sandstone fragments, ranging in size from gravel to slabs, occur in the subsoil down to bedrock, which lies from 24 to 48 inches below the surface. The organic-matter content is low, and the reaction is strongly acid.

Many areas, indicated on the map by stone symbols, have a considerable number of conglomerate boulders scattered over the surface. The two formations that contribute most of these boulders are the Salamanca and Olean conglomerates. The boulders occur below the outcrops of these rocks, as the less resistant formations below weather and erode, leaving the conglomerate to break off in boulders and move down the slopes. Many rock outcrops also are shown on the map by symbol in areas of Dekalb soils.

Dekalb silt loam occupies flatter hilltops and more gentle slopes than do the other members of the Dekalb series. Surface drainage is good, and subsoil drainage ranges from imperfect to good.

The native vegetation consists mainly of hard maple, beech, and birch, with basswood, black cherry, and tuliptree; and on the drier, thinner areas oak, hickory, and ash predominate. Chestnut formerly was prevalent, but only dead snags and sprouts are left.

Dekalb silt loam occupies a total area of 43.5 square miles, 85 percent of which is forested. Of the remaining 15 percent, which is cleared, possibly 5 percent is under cultivation; most of the rest is being reforested or is abandoned. The agriculture on the cleared areas never was very satisfactory or prosperous. The soil is naturally low in fertility, and after dissipation of the original organic matter and fertility it was rapidly abandoned. The few areas under cultivation are devoted to forage crops and pasture, in support of dairying. The crops grown and approximate yields are: Timothy hay from $\frac{1}{2}$ to 1 ton, oats 25 bushels, and silage corn from 5 to 7 tons an acre. Numerous oil wells located through the areas of Dekalb soil produce a small quantity of high-grade crude oil, which is refined at Olean.

Dekalb silt loam, steep phase.—The steep phase of Dekalb silt loam is entirely nonagricultural and is largely forested. Large conglomerate boulders and sandstone blocks are scattered over the surface in many places. Where erosion is not too severe the profile is essentially like that of the typical soil. This is the most extensive soil in the county and covers 12 percent of the total area. Aside from the forest products and petroleum deposits, the value of this land lies largely in its use for recreational purposes.

Dekalb stony silt loam.—Dekalb stony silt loam is developed only on narrow, flat ridge tops and smooth slopes in the rough southern part of the county. It differs from Dekalb silt loam in that it has numerous sandstone slabs and large stones scattered over the surface and mixed through the soil. The depth to bedrock is consistently less, in most places ranging from only 12 to 24 inches from the surface. It has the typical yellow, bright-yellow, or brownish-yellow color of the Dekalb soils, and, aside from the quantity of stone fragments and the thickness of the soil material, the profiles are similar.

Even though this soil represents nonagricultural land, parts of it, like Dekalb silt loam, are valuable because of the petroleum deposits underlying it. The land is entirely in second- and third-growth forests, which furnish a certain amount of fuel, fence posts, and railroad cross ties.

Leetonia coarse sandy loam.—Leetonia coarse sandy loam has a 2-inch surface layer of forest litter and partly decomposed organic matter underlain to a depth of 8 inches by an ash-gray layer of highly leached coarse sandy loam, or mixed quartz sand and pebbles. Between depths of 8 and 18 inches the material consists of rust-brown or reddish-brown slightly compact mixed sand and quartz pebbles, the color fading to yellowish brown at the lower level. Considerable quantities of finer materials have been deposited in this layer, but not enough to give it a significantly heavier texture than that of the surface soil. Below this and continuing to a depth of 30 inches is a pale-yellow slightly mottled and partly cemented mixture of sand and gravel. The above-described profile is typical of those areas that have been derived from the conglomerate rocks, for instance, the areas in the towns of Allegany, Olean, and Little Valley. The influence of conglomerate rocks is much less in the area in the town of Red House, which is included in Allegany State Park. Here the texture is heavier and the soil has more body.

In general the land is flat, but the microrelief is rough in places, owing to outcrops and exposures of the underlying rocks. The total area of Leetonia coarse sandy loam is 9.8 square miles. The only areas that do not lie along the New York-Pennsylvania State line are in the town of Little Valley. The land, which has no value for cultivated crops or pasture, is all in forest.

Cattaraugus silt loam.—Cattaraugus silt loam is readily distinguished by its reddish-brown color. The surface layer in a cultivated field is dark-brown or reddish-brown mellow silt loam, in which fragments of red sandstone and shale are numerous in places. The subsurface material is reddish-brown friable smooth silt loam. It overlies purplish-red slightly compact heavy silt loam with an irregular small-blocky structure. The lower part of the subsoil is dark purplish-red dense, compact heavy silt loam or silty clay loam, with a massive-blocky structure.

In areas of this soil occurring on the lower slopes in the small valley just north of Portville, drainage is only fair. The surface soil is dark, and the subsoil is compact and distinctly mottled. The soil colors here are not so red as they are on the hilltops or steep slopes.

Cattaraugus silt loam covers a small total area in the towns of Humphrey, Allegany, and Portville, where it is developed mainly on the high hilltops. A few outcrops of red shale and red spots of soil occur along the roads in the section of Dekalb soils, but they are too small and scattered to be indicated on the soil map. The soils of this series are largely residual and have developed from the reddish-brown shales and sandstones of the Cattaraugus formations. Drainage in most places is good, and the soils are noncalcareous throughout. The comparatively few acres under cultivation are devoted to timothy, oats, buckwheat, and silage corn. Yields are approximately the same as those obtained on the Lordstown soils.

Cattaraugus silt loam, steep phase.—The steep phase of Cattaraugus silt loam, which is entirely in the town of Portville, is not

suiting to agriculture because of the excessive slope. Profile characteristics are not markedly different from those of the typical soil, except that bedrock lies closer to the surface and outcrops are more common. This steep soil is about as extensive as the typical soil, and all the land is forested.

POORLY AND IMPERFECTLY DRAINED SOILS OF THE UPLANDS

All the poorly and imperfectly drained soils of the uplands, with the exception of Chippewa silty clay loam, are agricultural soils but have low productive capacity. They are known as cold soils because their slowness to dry in spring retards the preparation of seedbeds and planting. The relief, except of the steep phases, is favorable to cultivation. These soils have gray or grayish-brown surface soils and gray compact impervious subsoils that impede the penetration of water and roots. These unfavorable physical properties limit the crops that can be grown successfully to forage crops and grains, such as oats and buckwheat. Dairying is the principal type of agriculture on farms situated on these soils.

There is more abandoned land among the soils of this group than of any other group. Much of the idle land has been purchased by the State and planted to red pine, Scotch pine, white pine, and spruce. Additional areas are being purchased annually in blocks of 500 acres.

Volusia silt loam.—Volusia silt loam, in a moist condition, has an 8-inch gray heavy silt loam surface layer that tends to puddle badly if worked when moisture conditions are not optimum, even though it has a moderate supply of organic matter. When dry, the soil has a characteristic light-gray or almost white color. The surface layer is underlain, to an average depth of 12 inches, by pale-yellow or brownish-yellow moderately dense heavy silt loam mottled with shades of yellow, brown, and gray. The subsoil, between depths of 12 and 30 inches, is very hard and compact in place, but the structural aggregates, which consist of irregular medium-sized lumps, are brittle when broken. The material in this layer is very highly mottled in the upper part, but the mottles fade toward the lower part. This layer is impervious to both water and roots, and in spring, when the soils are saturated, water moves laterally above the hardpan layer even though that layer may be dry. Practically all excess moisture is lost by surface run-off or evaporation. Later in the season the soil dries rapidly, because of the low moisture-storage capacity; moreover, little if any water rises through the soil by capillary action, because of the impervious subsoil layer.

Volusia silt loam is fairly uniform except in the areas north of Olean and west of Farmersville Station. The first-mentioned areas are rolling and hummocky and represent a part of the terminal moraine. Drainage, however, is poor. The last-mentioned areas are characterized by a greater content of gravel, a more brown color in the surface soil, and a less compact subsoil, compared with the typical soil. In a few areas bedrock lies from only 24 to 30 inches below the surface. This soil occurs in all parts of the county except in the section of the Dekalb soils, but the most typically developed and largest areas are in the northeastern part in the towns of Franklinville, Farmersville, Lyndon, and Ischua. This is one of the most extensive soils, totaling an area of 128 square miles. Approximately

70 percent of the land is cleared, and the remaining 30 percent is in wood lots and forest.

Volusia silt loam has developed from materials deposited as glacial till, which were derived largely from local materials, although in the deeper deposits on the lower slopes crystalline erratics are present. Various quantities of stone and gravel fragments are mixed with the soil. The relief is smoothly rolling or moderately sloping and is favorable for agriculture. Both surface and subsoil drainage, however, are poor. The soil is noncalcareous throughout.

The agriculture consists almost entirely of dairying, as the unfavorable physical and drainage properties limit the range of crops grown to those that are used in the support of livestock. The common system of crop rotation is silage corn, oats, and hay. The latter crop is mainly timothy, although clover, either medium red or alsike, is commonly used in the new seedings. The strongly acid reaction and the poorly drained condition of the soil are unfavorable for the growth of legumes.

The most common form of fertilization practiced consists of a rather light application of superphosphate on the land for corn and oats. Lime is used to some extent on the new seedings, but meadows could be greatly improved by a more extensive use of this soil amendment. In areas where the soil can be adequately drained, good response may be expected from the use of lime and fertilizer (8).

Crop yields are less than on the Wooster soils. Oats return from 25 to 35 bushels, silage corn 6 to 8 tons, and hay $\frac{3}{4}$ to 1 ton an acre. A considerable acreage of buckwheat is grown on the Volusia soils, as this crop can be planted at a late date and still mature. Pastures as a general rule are poor. Many are badly infested with hawthorn; in fact, some have been completely taken over by encroachment of this shrub. Large areas of this soil have been abandoned and are growing up to weeds and brush, whereas other areas, where it has been possible to acquire blocks of 500 acres or more, have been purchased by the State and reforested.

Volusia silt loam, steep phase.—The steep phase of Volusia silt loam has the same general profile as the more extensive typical soil, but it occupies slopes steep enough to interfere seriously with the use of machinery. Many seepy spots and springs occur on the slopes and frequently flow the year round. Very few of these steep areas are cultivated, but where the timber has been removed the land furnishes some poor pasture.

Fremont silt loam.—Fremont silt loam is a rather unproductive soil closely associated with the Volusia and Lordstown soils, generally occupying a higher position on smooth slopes and flat, poorly drained hilltops. It has a pale yellowish-brown mellow silt loam surface layer underlain to a depth of 15 inches by light yellowish-brown firm silt loam mottled with rust brown and various shades of gray. The subsoil, between depths of 15 and 32 inches, is compact heavy silt loam highly mottled with gray, yellow, and brown. The material breaks into hard irregular lumps that show definite lines of cleavage. Below this is drab or olive-drab heavy silt loam faintly mottled and closely splotched with iron staining. The parent material is glacial till derived almost exclusively from the local

shale and sandstone rocks, and it shows little evidence of weathering. The depth to bedrock ranges from 4 to 6 feet. Considerable quantities of angular rock fragments are mixed through the soil. The reaction is acid throughout.

Although the profile resembles that of Volusia silt loam, the surface soil is more brown and the compact subsoil lies at a greater depth. Moreover, the compaction is not so pronounced, nor, in general, is drainage so poor as in the Volusia soil.

The Fremont soil is as widely but not so extensively developed as the Volusia. The largest and most typical areas are in the towns of Humphrey, Lyndon, and Farmersville. About 70 percent of the land is cleared, of which probably 50 percent is abandoned.

The relief is flat, gently sloping, or slightly depressed. Drainage, both surface and internal, is not good, and, like many other poorly drained upland soils, artificial drainage is not feasible because of the slow lateral movement of water through the soil. Moreover, under present conditions, the agricultural value of the land does not warrant the expense of installing tile drains.

Agricultural practices and crop yields are essentially the same as on the Volusia soils. At one time large areas of the Fremont soil were used as pasture for sheep, but the enterprise never was profitable and was soon abandoned, as it was impossible adequately to protect the flocks from the depredations of dogs.

Erie silt loam.—Erie silt loam might be briefly described as Volusia silt loam with an alkaline subsoil, because the profiles of the two soils are otherwise similar. Erie silt loam under average conditions has a 6-inch surface layer of grayish-brown or brownish-gray heavy silt loam moderately supplied with organic matter. It frequently is in a lumpy or puddled condition. It is underlain by a thin subsurface layer of yellowish-brown or pale-yellow smooth firm silt loam mottled with gray and brown. The upper subsoil layer, which begins at a depth of 10 inches and continues to a depth of 24 inches, is hard, compact, brittle, heavy silt loam highly mottled with various shades of yellow, brown, and gray. This is the so-called hardpan layer that greatly impedes the penetration of roots and effectively retards the movement of water through the soil. The lower part of the subsoil is somewhat less compact than the indurated layer and is only faintly mottled. The texture ranges from silt loam to silty clay loam. Fragments of angular gravel and stones are numerous throughout the soil, but the quantity of this material in the surface soil in few places is sufficient to interfere seriously with cultivation.

The reaction of the surface and subsurface layers is acid, but the subsoil between depths of 30 and 36 inches is everywhere alkaline and in some places contains carbonate of lime. The effect of lime below the hardpan layer on plant growth is problematical. Although some areas of Erie silt loam support better stands of grasses than does Volusia silt loam, in general little difference can be noted.

The Erie soils have developed from glacial till derived from local shales—some of them calcareous—fine-grained dense sandstones, some crystalline materials, and here and there a piece of limestone. The relief ranges from rolling to moderately sloping. The soil is developed principally in the towns of Leon, Dayton, and Perrysburg in

the extreme northwestern part of the county and in the towns of Franklinville, Machias, and Freedom in the northeastern part. The total area is 59.1 square miles, 70 percent of which is cleared and in farms. Probably 15 percent of the cleared land is abandoned.

Agriculture consists of dairying, with cropping systems the same as those practiced on the Volusia soils. Yields may be slightly higher.

Erie silt loam, steep phase.—The steep phase of Erie silt loam includes slopes of Erie silt loam that have reduced agricultural value because of steepness, a fact demonstrated by the greater proportion in wood lots and forest, compared with the typical soil. Sheet and gully erosion are active on the cleared and cultivated slopes. Approximately 90 percent of this land is covered by second-growth forest. Much of the land, once cleared, is now idle or abandoned. The small area in use is principally pasture land.

Hornell silty clay loam.—Hornell silt clay loam has a yellowish-brown or brownish-gray silty clay loam or heavy silt loam surface soil that puddles and clods very easily. The subsurface material is yellow firm lumpy silty clay loam mottled with gray and brown. The upper subsoil layer, beginning at a depth of 12 inches, is dense tight blocky clay highly mottled with yellow, light red, brown, and gray. The surfaces of structural blocks have a coating of steel-gray colloidal matter. Roots penetrate along the cleavage planes, which are very distinct. The lower part of the subsoil, between depths of 28 and 36 inches, is composed of dense hard blocky clay with a distinct prismatic structure. Laminations of the original partly weathered shaly material are apparent at the lower depths of this layer. The substratum consists of thinly bedded soft acid clay shales.

Hornell silty clay loam has a total area of 10.9 square miles. It is developed principally on flat poorly drained hilltops and gentle slopes, which have a relief and topographic position similar to those features of Fremont silt loam. The largest and most representative areas are in the towns of Little Valley and Great Valley in the central part of the county and in the towns of Humphrey, Franklinville, and Freedom in the northeastern part. The soil is largely residual, in that it has developed from materials produced through the weathering in place of the soft underlying shales. The soil is noncalcareous and is highly erodible even on slight slopes.

A large proportion of the land has been cleared, probably because of the smooth relief, but less than 5 percent is now under cultivation. The rest has been abandoned for many years. The natural fertility of this soil is low, and the heavy texture makes cultivation extremely difficult. These properties, together with poor surface and subsoil drainage, render this a very poor agricultural soil. The few fields under cultivation are producing indifferent yields of buckwheat and weedy hay. A considerable acreage has been reforested by the State.

Aurora silty clay loam.—Aurora silty clay loam is a soil of low productivity, which is distinguished from Hornell silty clay loam chiefly by the alkaline reaction of the subsoil and of the shales from which it has developed. This soil has a grayish-yellow or gray lumpy silty clay loam surface layer underlain by a brownish-yellow or yellow smooth heavy silt loam subsurface layer that is firm in place and highly mottled with gray and brown. The subsoil is highly mottled dense blocky clay loam. At a depth ranging from 30 to 40 inches the

material consists of soft partly weathered alkaline shales. In the area just west of Gowanda the soil is deeper than elsewhere and shows more influence of glacial till in the parent material. The parent material consists of a thin mantle of glacial till over soft thin-bedded shales, and in places the soil is entirely residual from the shales. In few places are the surface soil and subsoil gravelly or stony.

This soil is low in organic matter and under cultivation is frequently in a very lumpy and cloddy state. If worked when wet it tends to bake and crust badly. The surface and subsurface layers are acid in reaction, but the lower part of the subsoil and the substratum are alkaline or calcareous. Roots seem to penetrate readily enough along cracks in the soil and along the joint planes of the underlying shales.

Aurora silty clay loam occurs principally in the town of Perrysburg in the extreme northwestern part of the county and in the town of Ashford in the north-central part. The total area is 10.3 square miles. The areas range from flat to slightly rolling, and neither surface nor internal drainage is good. The Aurora soils in Cattaraugus County seem to be somewhat less well drained than those in Erie County.

The drainage properties and physical characteristics are not especially favorable for agriculture. Nevertheless, a considerable acreage of this soil is devoted to the production of grapes because of the longer frost-free season of this section, due to the lower average elevation and to the proximity of this soil to Lake Erie. Larger yields are obtained and grapes of a better quality are produced, however, on the lighter textured soils of this section.

Besides grapes, timothy, oats, and silage corn are grown to some extent. Yields and methods of management are similar to those on Erie silt loam. Approximately 40 percent of the land is in forest, 20 percent is idle or abandoned, 10 percent is used for the production of grapes, and 20 percent is used for crops produced in support of dairying.

Aurora silt loam.—Aurora silt loam differs from Aurora silty clay loam in its considerably lighter texture, its greater content of gravel and stone in the surface and subsurface layers, and its deeper parent material that is entirely glacial till. It has a yellowish-brown friable gravelly or stony surface layer overlying yellow firm silt loam subsurface material. The subsoil is moderately compact stony silt loam mottled with brown and gray. Angular fragments of shale and thin fine-grained sandstone are numerous in most places.

The relief is more rolling, both surface and subsurface drainage are better, and the reaction is less alkaline than in the silty clay loam.

This is a less extensive soil than Aurora silty clay loam. Yields are about 10 percent higher than on that soil. A small acreage is devoted to canning crops, such as tomatoes and peas, in addition to the crops grown on the silty clay loam.

Ernest silty clay loam.—Ernest silty clay loam is a very unproductive soil associated with the Dekalb soils. The surface soil consists of gray or light-yellow heavy silty clay loam underlain by pale-yellow moderately dense clay loam. The subsoil is highly mottled heavy tight clay loam with a massive blocky structure. The presence of numerous large stone fragments and, in places, conglomerate boulders render some areas nonagricultural. The soil is very poorly drained and strongly acid.

This soil is developed on the lower slopes of all the large and small valleys of the rugged unglaciated section in the southern part of the county. The soil is partly residual from the underlying shale and sandstone and partly developed from colluvial wash from the higher lying Dekalb soils.

This soil occupies a total area of 20.4 square miles, 75 percent of which is in second- and third-growth forests of hard maple, beech, hickory, ash, white oak, red oak, hemlock, black cherry, and yellow birch, 20 percent is idle or abandoned, and 5 percent is used for the production of hay, buckwheat, silage corn, and oats. Very little fertilizer or lime is used, consequently yields are very low, even less than on the Volusia soils. The areas occurring in the State park area are being reforested.

Ernest silty clay loam, steep phase.—The steep phase of Ernest silty clay loam includes the higher slopes that are so steep that the use of machinery would be very difficult. The surface soil is thinner and the depth to bedrock is less than in the typical soil. In other respects the profiles are similar.

The agricultural value of the steeper land is low. The areas originally cultivated have been abandoned for many years and are growing up in forest. Many of the forested areas are strewn with numerous boulders of conglomerate and massive blocks of sandstone.

Ernest silt loam.—Ernest silt loam differs from Ernest silty clay loam in having a browner surface soil, considerably better surface drainage, a thicker more friable subsurface layer, less mottling, and a less heavy and compact subsoil. The two soils have similar relief.

The silt loam is the better agricultural soil of the two, and more of it is under cultivation. In some places, however, the conglomerate boulders, indicated on the soil map by stone symbols, render the land largely nonagricultural.

This soil has a total extent of 21 square miles, 40 percent of which is cleared and in farms. The principal crops grown are timothy hay, silage corn, oats, and buckwheat. Yields and methods of management are comparable to those on the Volusia soils.

Chippewa silty clay loam.—The surface layer of Chippewa silty clay loam is gray or dark-gray silty clay loam that in places is stony. The line of separation between the surface material and the highly mottled firm silt loam subsurface material is distinct. The subsoil is hard compact highly mottled stony silt loam or silty clay loam.

This soil occupies swales, depressions, or areas around the heads of streams, in association with the Lordstown, Volusia, Fremont, and other upland soils. It is widely distributed through the uplands of all except the unglaciated part of the county, but it occurs only in small isolated bodies surrounded by better drained soils. Drainage is very poor, and some areas approach a swampy condition.

Most of the land remains in forest, and the few cleared areas are utilized principally for pasture land. The soil is not suitable for artificial drainage and cultivation.

MODERATELY WELL-DRAINED SOILS OF THE UPLANDS

The moderately well-drained soils of the uplands are widely distributed, are closely related in profile characteristics, and are similar in

agricultural capacities. Distinctions between them are based mainly on reaction and topographic position. Drainage is only moderately well developed. They occupy positions on rolling uplands and lower slopes where conditions are favorable for cultivation. As a general rule, the areas where these soils predominate are more accessible than those of the poorly drained soils. They are characterized by their brown or grayish-brown surface layers and fairly thick friable subsurface layers. The hard compact lower subsoil layers resemble those of the poorly drained Volusia and Erie soils.

Agriculture consists entirely of dairying, but these soils can be worked under wider ranges of moisture conditions and produce consistently higher yields than do the poorly drained soils. The members of three series, the Mardin, Canfield, and Langford, comprise the group.

Mardin silt loam.—Mardin silt loam occurs on rolling to steep relief at rather high elevations, in association with the Volusia and Lordstown soils. It has developed from glacial till, the materials of which were derived almost entirely from local underlying shales and thin-bedded dense fine-grained sandstones. The reaction is strongly acid throughout. The cultivated surface layer is brown, yellowish-brown, or grayish-brown mellow silty loam containing considerable thin angular stone fragments. The subsurface layer, between depths of 8 and 22 inches, is yellowish-brown firm but friable silt loam that is slightly mottled below a depth of 20 inches. Beneath this is the hard compact highly mottled subsoil, which has an irregular blocky structure. The blocks, when broken, are brittle. This somewhat indurated subsoil layer greatly impedes the penetration of roots and moisture.

Mardin silt loam resembles Canfield silt loam in most respects. It differs in lying at a higher average elevation and in having a very light gray surface horizon immediately under the leaf mat in virgin areas.

The soil generally is uniform in its textural and profile characteristics. The rather large area mapped northwest of Little Valley does not have so thick a subsurface layer as is typical and occurs on a flat hilltop.

The total area is 33.8 square miles, most of which is distributed throughout the uplands of the northern half of the county. Surface drainage is good, but internal movement of water is slow, owing to the compact subsoil.

Agriculture, as practiced on this soil, consists almost entirely of dairying, with crops such as timothy and clover, oats, silage corn, and buckwheat leading in importance. Rotations are usually of 4 years' duration and consist of 2 years of hay, followed by corn for silage, and then oats or buckwheat. The common fertilizer practice includes an application ranging from 150 to 250 pounds of superphosphate an acre for the silage corn and grain crops, and applications of manure on new meadows and cornland. More lime is used on the Mardin, Langford, and Canfield soils than on those of the poorly and imperfectly drained group. The applications range from 1 to 2 tons an acre of ground limestone or its equivalent. Yields under this management range from 1½ to 2 tons of hay an acre, 8 to 10 tons of corn silage, and 35 to 40 bushels of oats. Erosion is rather serious in

the more sloping areas, because of the practice of plowing up and down the slopes rather than along the contours. Pastures in general are poor but could be greatly improved by applications of phosphate, in which the soil is naturally deficient. Serious invasion of pastures by hawthorn and wild apple is frequent.

About 50 percent of the soil is in forest and wood lots, 10 percent is idle or abandoned, and 40 percent is in use for crops, hay, and pasture land.

Mardin silt loam, steep phase.—Mardin silt loam, steep phase, is mainly a topographic distinction and indicates the areas of Mardin silt loam that are of low value because of excessive steepness. There is considerable variation in the soil on these steep slopes, especially in the thickness of the surface layer. Erosion is more active on the steep slopes, and much of the surface soil has washed away. A higher proportion of this steep land is in forest and wood lots, as compared with the typical soil. The cleared areas are used mainly for pasture, most of which is rather poor.

Canfield silt loam.—Canfield silt loam has a 6-inch surface layer that consists of yellowish-brown or grayish-brown loose silt loam, in some places containing many small angular stone fragments. The subsurface layer, which extends to a depth of 24 inches, is brownish-yellow or pale-yellow friable heavy silt loam, faintly mottled in the lower part. The subsoil, to a depth of 45 inches, is highly mottled with shades of brown and gray and is moderately compact and dense in place. The texture ranges from gritty loam to heavy silt loam, and the material breaks out in irregular lumps that are readily broken. The compaction of the subsoil in most places is not enough to stop the penetration of roots and moisture completely.

This soil is distinguished from Mardin silt loam by its occurrence at lower elevations and by its lack of a gray surface layer in virgin areas. The Canfield soil is typically developed on the lower slopes just above the valley floor, in positions similar to those occupied by the Wooster soils. The relief in many places is sharply rolling or hummocky, that is, almost morainic in character. Compaction of the subsoil is not so distinct and the reaction is not so strongly acid as in Mardin silt loam.

The soil shown on the map as Canfield silt loam in the vicinity of Randolph and northeastward from there to Little Valley is more rolling and somewhat browner in the surface soil than that mapped through the central and northern parts of the county. This included soil is essentially the same as Meadville silt loam in Crawford County, Pa. It is developed on materials containing a higher proportion of sandstone and less shale than the parent materials of Canfield silt loam.

Typical Canfield silt loam is developed from deep glacial till having nearly the same geological derivation as that of the parent materials of the Wooster soils, which differ from the parent material of the Mardin soils in having more foreign crystalline materials. Internal drainage in Canfield silt loam is less perfect than that of the Wooster soils because of the greater compaction in the lower part of the subsoil.

Canfield silt loam has about the same general distribution as the Wooster soils. It covers a total area of 49.6 square miles.

The agriculture is similar to that practiced on the associated soils, that is, the production of forage crops in support of dairying. Crop yields are from 5 to 8 percent higher than those obtained on Mardin silt loam. Probably 70 percent of the land has been cleared of its original forest and brought under cultivation. The proportion of idle and abandoned land is smaller than on the Mardin soils but somewhat larger than on the Wooster soils.

Canfield silt loam, steep phase.—The steep phase of Canfield silt loam has a more compact subsoil and poorer internal drainage than the typical soil, as well as more seepy spots and springs, which lower its agricultural value considerably. This fact is reflected in the larger proportion of forests and wood lots, as compared with the typical soil.

Not much of the steeper land is devoted to cultivated crops, as the excessive slope renders the use of machinery difficult. Moreover, it is impossible to prevent serious washing on these slopes when they are plowed. The cleared areas are used principally for pasture, which generally is poor, owing to the presence of unpalatable grasses and the encroachment of hawthorn.

Langford silt loam.—Langford silt loam is less extensive than either Mardin silt loam or Canfield silt loam. It has a grayish-brown or yellowish-brown mellow surface layer that in places contains numerous angular gravel and stone fragments. The subsurface material, which extends to a depth of 22 inches, is yellow or brownish-yellow firm but friable heavy silt loam, in places slightly mottled at a depth of 20 inches. The subsoil is hard compact highly mottled gravelly silt loam or stony silt loam. The surface and subsurface layers are acid in reaction, but the subsoil is alkaline or calcareous below a depth ranging from 24 to 36 inches.

The parent material is glacial till, derived from local shales and sandstone, and foreign crystalline rocks. Limestone gravel and cobbles are common in the subsoil. Surface drainage is good, but the compact subsoil impedes the internal movement of water. This soil resembles Canfield silt loam except that it has an alkaline subsoil.

Langford silt loam covers a total area of 27.3 square miles, distributed chiefly through the towns of Leon, Perrysburg, East Otto, and Otto in moderately rolling or sloping areas.

The principal crops are hay, mainly timothy and medium-red clover, corn for silage, oats, and buckwheat. Here and there a small acreage is devoted to potatoes. Yields are from 5 to 10 percent higher than those obtained on Mardin silt loam. Approximately 35 percent of the land is in forest and wood lots, 10 percent idle or abandoned, 20 percent in pasture, 15 percent in hay, and 20 percent in oats, silage corn, and buckwheat.

The soil in a few small areas, included on the map with Langford silt loam, has a similar profile, but the excessive steepness of the slope precludes the use of machinery on all except a few areas that are most commonly used as meadow or pasture land. Approximately 80 percent of this included land is forested.

SOILS OF THE LOWLANDS

Among the soils of the lowlands and valleys are the choice agricultural soils of the county. All have favorable relief and the ad-

vantage of an average frost-free season that is from 1 to 2 weeks longer than on the higher upland soils. Variations in texture and drainage, however, cause as wide a range in agricultural value of the soils of the lowlands as in the agricultural value of the soils of the uplands.

Even though the agriculture consists principally of dairying, the opportunity for diversification of crops is greater than in the uplands. In unfavorable seasons, as when rainfall is below normal, emergency crops can be grown with greater success than on any of the soils of the uplands. Transportation facilities also are superior on the soils of the lowlands. All these factors contribute to a more prosperous type of farming in the numerous valleys and lowlands, as compared with the uplands.

The soils of the lowlands occur on two main types of land forms:

(1) Terraces, outwash plains, deltas, and lake plains; and (2) first bottoms and flood plains. Smaller subgroups are indicated on the basis of drainage conditions, as is done with the soils of the uplands.

WELL-DRAINED SOILS OF OLDER OUTWASH MATERIALS AND LAKE DEPOSITS

This subgroup includes members of the Chenango, Unadilla, Otisville, and Mentor series. The first three occupy terrace, or bench, positions and include some of the most highly prized soils of the county. The Chenango soils occur in all the larger valleys north of the section occupied by Dekalb soils. The Mentor soil, which is of minor extent, includes the steep faces of the terraces and certain hummocky areas of stratified drift with kettle-and-kame topography.

These soils are characterized by their grayish-brown friable surface soils and by the bedded sands and gravel of the lower subsoil layers and substrata. The Chenango and Otisville soils are gravelly, but the Unadilla soils are, for the most part, free from gravel. The latter are distinguished also by their bright-yellow or richer brown color, an inheritance from the Dekalb soils, from which they are washed. They are not so productive as the Chenango soils. With the exception of the Otisville soils, the soils of this group have very favorable relief for agriculture. Drainage is excellent, and cultivation can be carried on under a wide range of moisture conditions.

The sale of dairy products accounts for most of the income of farmers located on these soils. Such crops as hay, silage corn, and oats are the most important, but practically all of the alfalfa and considerable of the other specialized crops, including vegetables and small fruits, are produced on the Chenango soils. More than half of the total acreage of Unadilla soils is included in the Allegany Indian Reservation, where very little of the land is under cultivation. The few acres under lease to white farmers in the vicinity of Salamanca give evidence that the soils will produce well under proper management.

Chenango gravelly loam.—Chenango gravelly loam has an 8-inch surface layer of brown or grayish-brown loose mellow gravelly loam. The subsurface material, to a depth of 20 inches, is brownish-yellow or grayish-yellow firm silt loam or gravelly silt loam. Below this in many places is a slightly compact layer composed of dark-brown mixed sand and gravel loosely cemented by an infiltration of silt from the layers above. In places, tongues of this material extend

from 2 to 3 feet into the sand and gravel substratum that underlies the soil, which, at a depth ranging from 3 to 4 feet, generally is bedded or stratified.

This soil as a whole is fairly uniform. Slight variations in texture, thickness of horizons, and quantity of gravel in the surface horizon, however, do occur. The gravel consists mostly of water-worn rounded material, derived mainly from local shales and sandstone, with variable quantities of foreign crystalline materials, and nowhere is it so abundant as to interfere seriously with the preparation of the seed-bed. The soil is rather strongly acid in the surface soil and subsoil, but a few limestone pebbles are present in many places at a depth ranging from 6 to 8 feet.

The most extensive areas of Chenango gravelly loam are along Cattaraugus Creek, especially near Gowanda and north of Delevan, and along Slab City Creek in Dayton Town. The total area of this soil is 31 square miles.

The land is level or slightly undulating, and this relief is characteristic of deposits, laid down by water as stream terraces, outwash plains, and deltas, that represent the parent material of the Chenango soils. Drainage is excellent and may be excessive in areas where the gravel content is high.

Acre yields of the main crops grown on Chenango gravelly loam are: Timothy and clover, from 1½ to 2 tons; oats, 40 bushels; silage corn, 8 to 10 tons; and alfalfa, 2 to 3 tons. The soil is physically well adapted to the production of alfalfa, but, because of its acid reaction, some form of lime is necessary for success. The soil warms early in the spring and can be worked almost as soon as the frost leaves the ground—reasons that make this a good soil for the production of potatoes, vegetables, and canning crops. The acreage of such crops, although low at present, is increasing annually. There is a canning factory at South Dayton, and some of the produce is trucked to canneries in Erie County.

The most common rotation is corn, oats, and hay for 2 or 3 years or longer if alfalfa is substituted for the usual timothy and medium red clover. Phosphate fertilizer is applied to land for corn and oats and lime to that for the new alfalfa seedings. Complete fertilizers are used to some extent on the specialized crops.

Practically all the land is under cultivation, with 50 percent of the area devoted to hay, 10 percent to oats, 10 percent to corn, 5 percent to pasture, and the rest to such crops as grapes, other small fruits, and vegetables.

Chenango gravelly silt loam.—Chenango gravelly silt loam, as the name signifies, has a heavier textured surface layer than the gravelly loam. The distinction between these two soils, however, is not very marked, and wherever they are associated the boundary drawn between them is more or less arbitrary. The profiles, aside from the texture of the surface layers, are identical, as are the mode of deposition of the parent material, relief, and reaction. The brown or gray-brown surface layer and the yellowish-brown silty subsurface layer, which overlies bedded sand and gravel, are characteristic of Chenango soils in general.

This soil has its most typical and extensive development in the towns of Machias and Freedom in the northeastern part of the

county. Here and there the broad level areas include wet depressions. A variation from the typical soil is developed in the town of Perrysburg, where several old glacial lake beach lines occur. Here are low broad ridges composed principally of shaly material.

Chenango gravelly silt loam, like Chenango gravelly loam, is an excellent soil used principally for the production of field crops. Vegetables are grown to less extent than on the gravelly loam because of the greater distance to Buffalo markets and lack of nearby canning factories. This soil has a total area of 20.4 square miles, all which is under cultivation for such crops as hay, oats, corn, and plowable pastures. In order to obtain good pastures on the Chenango soils, fertilization and lime are necessary because the natural fertility level of gravelly soils like these is low and the soil reaction is acid. Their value lies in their marked and quick response to good management and fertilization.

Chenango gravelly silt loam, alluvial-fan phase.—The alluvial-fan phase of Chenango gravelly silt loam occupies land forms built up by wash from the small lateral streams in places where the streams pass into the main valleys. The materials of these alluvial fans differ from those of the typical Chenango soils, in that they are derived from a local source and the gravel particles are larger and of somewhat angular shape. Considerable quantities of angular stones also are present in places. Under normal conditions the 8-inch surface layer is composed of yellowish-brown gravelly silt loam or stony silt loam and overlies a subsurface layer of yellow stony silt loam or gravelly silt loam. The subsoil and substratum are composed of a mass of angular stones and gravel with various quantities of finer sediments.

Most of the coarser materials are deposited at the upper ends of the fans, and the materials become progressively finer as they merge with the stream terraces or flood plains. Even though this soil contains much coarse gravel and stone, the fine material is sufficient to give it as great a water-holding capacity as the other Chenango soils.

This soil is widely distributed throughout the county in practically all of the valleys. Although many of the bodies are small and isolated, they have considerable significance because in many places they represent the best agricultural soil of the farms. In the smaller valleys these fans furnish a favorable place for the location of buildings and a few acres of excellent cropland.

The total extent of this soil is 14 square miles, and it all has been cleared and is used for farmsteads and cropland. It is managed in the same way as is Chenango gravelly loam, and yields compare favorably with those produced on typical Chenango gravelly silt loam. The principal crops are timothy, clover or alfalfa, corn, and oats. The reaction is acid, so that lime is needed for success with alfalfa.

Chenango gravelly sandy loam.—Chenango gravelly sandy loam has a light-brown coarse sandy loam mellow loose surface layer containing various quantities of small gravel and pebbles. The subsurface material is yellowish-brown friable fine sandy loam overlying mixed sand and fine gravel. This soil is strongly acid and is somewhat excessively drained. It is distinguished from the other members

of the Chenango series by its browner color and the presence of fine gravel and pebbles in the surface and subsurface layers.

This soil covers a small total area, mainly in the towns of Ashford and Yorkshire along Cattaraugus Creek, which forms the northern border of the county. The land is level or flat, a characteristic of the Chenango soils, and this soil has developed from stream-deposited sediments derived from sandstone, shales, and crystalline materials.

Agriculture is similar to that practiced on Chenango gravelly silt loam, that is, a corn, oats, and hay rotation, in support of dairying. A few acres are devoted to potatoes in the town of Ashford, but in general fewer vegetables are grown on this soil than on Chenango gravelly loam. Yields probably are slightly less than those produced on the gravelly loam, because of the lower water-holding capacity and the tendency of crops to suffer when rainfall is much below normal. This soil, like other soils of the Chenango series, has a low natural fertility level, but it responds quickly and well to liming and fertilization.

Chenango gravelly loamy sand.—From Markham south to Rutledge in the Conewango Valley are several areas of Chenango gravelly loamy sand associated with the Lorain soils. They have loose brown loamy sand or mixed loamy sand and gravel surface layers with rust-brown loamy sand and gravel subsurface material. The subsoil consists of moderately compact yellowish-brown loamy sand and gravel overlying compact gray sand at a depth ranging from 40 to 50 inches. This soil has developed from sand bars and beach deposits of temporary glacial lakes, long since extinct. These areas are inferior in value to Chenango gravelly sandy loam. They cover only a very small total acreage.

Chenango silt loam.—Chenango silt loam is like Chenango gravelly silt loam, except that the surface and subsurface layers are comparatively free from gravel. The subsoils of the two soils are similar. The silt loam is less extensively developed than the gravelly silt loam. It occurs in rather small areas throughout the valleys of the northern part of the county in association with other Chenango soils.

The soil in an area southeast of Maples in the town of Mansfield is much browner than the typical soil, in which respect it resembles Wooster silt loam.

The crops grown, methods of management, and fertilization of the silt loam and the gravelly silt loam are much the same. Yields probably are higher on the silt loam, because of its somewhat higher water-holding capacity.

Unadilla silt loam.—Unadilla silt loam has an 8-inch surface layer of yellowish-brown or brown mellow smooth silt loam. The subsurface layer, which extends to a depth of 15 inches, is bright yellow-brown or light reddish-brown firm silt loam. It is underlain by pale yellowish-brown firm silt loam that has an irregular small-blocky or nutlike structure. Between depths of 36 and 60 inches the material is reddish-brown moderately compact loamy sand and gravel. In places the gravel particles are coated with silt and clay, which tend to bind them together. Below a depth ranging from 8 to 10 feet some of the gravel fragments are limestone, cemented with

carbonate of lime. The cemented materials occur only in those areas along the Allegheny River.

While the terminal moraine was being built up north of the river, enormous quantities of outwash materials were deposited along this valley, but most of them subsequently were carried away. It is the remnants of these old terraces, distinctive because of their greater elevations, that have the limestone gravel and cementation in the lower depths.

Valleys of streams tributary to the Allegheny River were dammed by these outwash deposits and formed temporary lakes. The soils of these tributary valleys, therefore, have developed in part from lake-laid sediments. The lacustrine influence is apparent only in the lower parts of the valleys and is not very pronounced. For this reason the well-drained soils not subject to overflow are included in the Unadilla series. A somewhat finer texture and more angular gravel, where present at all, are the main differences between the soil in these areas and the typical soil.

Unadilla silt loam has a total extent of 24.3 square miles, the largest and most typical areas of which are those along the Allegheny River. Smaller areas occur through the valleys in the section occupied by the Dekalb soils across the southern part of the county. The relief ranges from level to gently sloping, and both surface and subsoil drainage are good. The reaction is strongly acid in both the surface soil and the subsoil.

The original vegetation was a forest, principally of white pine, but, after this was cut, oak and hickory came in, and these now make up most of the forest cover.

The area included in the Allegany Indian Reservation is, for the most part, covered with brush or oak and hickory saplings. The area outside the reservation, from Vandalia southeastward to the point where the river enters New York State from Pennsylvania, is good agricultural land, used mainly for the production of field crops in support of dairying. The systems of management and crops grown are no different from those on the Chenango soils. The rotation, of 4 or 5 years duration, is hay, corn, and oats. The hay is timothy and clover, and the corn is grown for silage. In order to obtain substantial yields, considerable lime and fertilizer are necessary, because this soil, like all the Unadilla soils, has a low natural fertility level and a very strongly acid reaction. With their favorable physical properties, however, they respond readily to good management. Yields under comparable systems of management are from about 5 to 10 percent less than those obtained on the Chenango soils.

Approximately 45 percent of Unadilla silt loam is in forest or brush, 5 percent is idle, 15 percent is used for hay, 10 percent for oats, 10 percent for corn, and 15 percent for pasture.

Unadilla fine sandy loam.—Unadilla fine sandy loam is developed only in Allegheny Valley. It does not have so bright colored a surface soil nor so heavy textured surface and subsurface layers as the silt loam. The other profile characteristics of the two soils are similar.

The fine sandy loam is not so productive a soil as the silt loam, mainly because its lighter texture lowers its water-holding capacity. Crops are likely to suffer from lack of moisture during the latter part of the season. Management and cropping systems are the same

as for the silt loam; yields, however, range from 5 to 10 percent less. A higher proportion of the fine sandy loam is cultivated than of the silt loam, mainly because it is developed to a greater extent outside the Indian reservation.

Included on the map with Unadilla fine sandy loam are several small areas with an 8-inch surface layer composed of light-brown or yellowish-brown loose gravelly loam underlain to a depth of 20 inches by light-yellow or yellow loose gravelly silt loam. The subsoil and substratum are made up of bedded sand and gravel, derived mainly from local shale and sandstone rocks. This included soil is used in the same way as the other Unadilla soils. A greater proportion is idle, however, and crop yields are approximately 10 percent less than those obtained on typical Unadilla silt loam.

Otisville gravelly loam.—The productivity of Otisville gravelly loam is medium to low, mainly because of its unfavorable relief. The profile of the typically developed surface soil is essentially like that of Chenango gravelly loam and consists of an 8-inch layer of grayish-brown or yellowish-brown loose gravelly loam overlying brownish-yellow firm but friable gravelly silt loam that extends to a depth of 20 inches. The subsoil and substratum are made up of either unsorted or stratified sand and gravel, with various quantities of finer sediments present. The soil is low in organic matter and has an acid reaction in both surface soil and subsoil. The depth to loose gravel and sand varies greatly from place to place.

Typical Otisville gravelly loam is developed from stratified morainic deposits with a hilly kettle-and-kame relief, such as is developed in the vicinity of Delevan in the town of Yorkshire. In Cattaraugus County it also includes the steep slopes between terraces and flood plains, also benches at different levels, which are considerably inferior in value. A part of the area in the town of Dayton consists of stratified beds of sands and silts with little or no gravel.

Otisville gravelly loam is associated with the Wooster, Chenango, and Unadilla soils and covers a total area of 15.1 square miles. The largest and most representative areas are north of Machias. Practically all of the original forest has been removed.

The excessive drainage and rough relief reduce the value of the land for agriculture. On the more favorably situated areas, fair yields of hay, corn, and oats are obtained. With the use of lime to correct the acidity, the soil is probably better suited to alfalfa than to any other crop. Even though the soil is rather porous, it is subject to considerable erosion in places where cultivated crops are grown.

Approximately 30 percent of the land is in forest and wood lots, 15 percent is idle or abandoned, 20 percent is used for pasture, 20 percent for the production of hay, and the rest for corn silage and small grains.

With the same fertilization and management, yields average about 10 percent less than those obtained on Chenango gravelly loam.

Mentor fine sandy loam.—Mentor fine sandy loam is a productive but an inextensive soil. The cultivated surface soil, to a depth of 8 inches, is rich-brown or grayish-brown friable mellow fine sandy loam. This is underlain, to a depth of 22 inches, by yellowish-brown firm very fine sandy loam or light silt loam. The color becomes somewhat lighter in the lower part of the layer. Between depths of 22 and 30 inches the material is moderately compact very fine sandy loam

mottled with yellow, brown, and gray; below this it is less compact light grayish-yellow loamy fine sand faintly marbled with gray and rust brown. Heavy bluish-gray lake-laid clay underlies this soil at a depth ranging from 8 to 10 feet. The entire soil is gravel free and strongly acid.

This soil, which is fairly uniform in its characteristics, is developed mainly in the town of Otto along South Branch Cattaraugus Creek.

The relief is smooth or somewhat undulating, and the topographic position is similar to that of the Chenango soils. The sediments from which the soil developed were deposited by water in the form of terraces and deltas in temporary glacial lakes. Surface drainage is good, but internal movement of water is impeded in places by the dense layer in the subsoil.

The soil is used and managed like the Chenango soils, and crop yields are comparable. Practically all of the land is under cultivation.

IMPERFECTLY DRAINED SOILS OF THE OLDER OUTWASH MATERIALS

The group of imperfectly drained soils of the older outwash materials is represented in this county by one soil—Braceville silt loam. The water-laid parent materials of this soil were derived from the local shale and sandstone and foreign crystalline materials.

Braceville silt loam.—Braceville silt loam is an imperfectly drained associate of the Chenango soils. It occupies level terrace and bench positions. The cultivated surface soil is grayish-brown or dark grayish-brown loose somewhat gravelly silt loam to a depth of 8 inches and is underlain to a depth of 20 inches by grayish-brown or pale yellowish-brown firm silt loam that is faintly mottled at a depth of 18 inches. Below this is moderately compact highly mottled gravelly loam or silt loam, which continues to a depth of 30 inches, where it gives way to loose open gravelly loam. At a depth ranging from 40 to 50 inches this material rests on stratified beds of sand and gravel. The soil contains a moderate quantity of organic matter and is acid in reaction.

Braceville silt loam is an inextensive soil developed principally in the towns of Yorkshire, Freedom, and Farmersville, in the northeastern part of the county, and to less extent along the northern tributaries of the Allegheny River, north of Olean. In some areas the materials are dominantly sandy and include but little gravel. Surface drainage generally is good, but internal drainage is imperfect, owing to the compact layer in the subsoil and to the high water table.

The soil is used in the same way as are the Chenango soils and does not seem to be adversely affected by the slow drainage of the subsoil, except for the production of alfalfa. The main crops of corn, oats, and timothy and clover hay are managed in the same way as they are on the Chenango soils. Yields are only slightly less than on those soils.

IMPERFECTLY AND POORLY DRAINED SOILS OF HEAVY TILL, OLDER OUTWASH MATERIALS, AND LAKE DEPOSITS

The members of the subgroup of imperfectly and poorly drained soils of heavy till, older outwash materials, and lake deposits are among the most extensively developed of any occurring in the lowlands. They are, however, of low productive capacity. Agriculture

is limited almost entirely to dairying, because the physical properties and drainage characteristics of the soils are such that only crops tolerant of heavy textures and wet conditions can be grown with any degree of success. The good moisture supply is favorable to grasses, so that excellent pastures are the rule rather than the exception. Productive meadows of timothy and alsike clover can be established on these soils.

The soils have gray or dark-gray heavy-textured surface soils and highly mottled heavy plastic subsoils. The Mahoning, Caneadea, and Lorain soils, except the rolling phase of the former, are flat, and this feature retards run-off, and the much wetter Tyler soils are flat or depressed.

Mahoning silty clay loam.—Mahoning silty clay loam has a 6-inch surface layer of gray or cream-colored silty clay loam that is very sticky and plastic when wet and cloddy or lumpy when dry. The subsurface material, to a depth of 20 inches, is yellow dense highly mottled silty clay loam that assumes an irregular blocky structure on drying. The lower part of this layer is less yellow and more distinctly mottled than the upper part. The subsoil, which continues to a depth of 30 inches, is drab or olive-gray clay containing faint mottles of yellow and brown. The material is dense and tight in place and exhibits a well-developed prismatic structure. The substratum is unweathered bluish-gray clay. Numerous lime nodules and concretions occur between depths of 20 and 36 inches.

Mahoning silty clay loam is developed mainly in a large continuous body through the towns of Otto and East Otto in the north-central part of the county. The land is flat or somewhat rolling, and the relief is characteristic of more or less dissected lake-laid deposits, which represent, at least partly, the geological origin of the parent material of the Caneadea soils. The sediments that make up these deposits were derived from local and foreign materials. Although the greater part of the Mahoning soils of Cattaraugus County perhaps has developed on lake-laid materials, there is some evidence that a part of the parent material was deposited by ice. The important feature of the parent material, however, is its heavy sticky character and its comparatively high content of carbonate of lime. It is the heavy parent material that is responsible for the poor drainage and intractability of the Mahoning soils. The calcareous character of the subsoil is the result of materials carried in from the limestone section in Erie County to the north.

Internal drainage is slow and poor, owing to the heavy tight character of the subsoil. Surface drainage ranges from fair to poor, according to the relief; the more undulating areas are not so wet as the flatter ones, because run-off is rapid.

This soil is used for pasture, hay, oats, and silage corn. It is better adapted to pasture and hay than to the other two crops, because of the heavy intractable clay surface soil, which is difficult to work and puddles badly unless the moisture conditions are optimum. Approximately 25 percent of the land is in forest and wood lots, 10 percent is idle or abandoned, 25 percent is used as pasture, 20 percent for hay, 10 percent for oats, and 10 percent for corn.

The agriculture practiced on Mahoning silty clay loam is limited to dairying, since nothing but forage and feed crops can be grown

successfully. Rotations, where practiced, consist of hay, corn, and oats. Not much commercial fertilizer, with the exception of a small quantity of superphosphate, is used. Yields average about the same as those obtained on the Volusia soils having similar slopes. This soil is highly erodible and, if not managed properly, washes badly.

Mahoning silty clay loam, rolling phase.—The rolling phase of Mahoning silty clay loam includes the areas of Mahoning silty clay loam that are so dissected as to have a rolling to rough relief. These areas occur on the south slope of Cattaraugus Valley where streams have cut into these heavy deposits seeking the level of Cattaraugus Creek.

The soil texture in the rolling areas is variable. Much of the parent material consists of stratified lake-laid materials, and, as the streams cut through them, the various layers of very fine sands, silts, and clays were exposed on the slopes.

This soil, which is less extensive than the typical soil, is largely nonagricultural, and practically all of it is in forest. The few areas originally cleared eroded so severely that they were ruined rapidly and reverted to brush and weeds.

Mahoning silty clay loam, steep phase.—The steep phase of Mahoning silty clay loam is even less valuable than the rolling phase. It includes the steep, in places perpendicular, slopes of the valleys of Cattaraugus Creek and tributary streams. No attempt ever was made to bring these slopes under cultivation, and most of them remain in forest. Soil slipping is evident in places. The total area is slightly larger than that of the typical soil.

Mahoning silt loam.—Mahoning silt loam is somewhat superior to the silty clay loam, as the surface soil is not so heavy or so difficult to work, nor does it puddle and lump so readily. The same crops are grown, but yields are consistently higher. It has the light-gray or light grayish-yellow color, the gravel-free surface soil, the heavy highly mottled subsurface layer, and the stiff calcareous clay subsoil that are characteristic of the Mahoning soils.

The silt loam has a wider distribution than the silty clay loam and is developed at the southern end of Conewango Valley and across the northern part of the county. The largest and most typical areas are in the towns of Dayton and Persia. The several areas aggregate a total of 27.3 square miles, 20 percent of which is in forest and wood lots, 15 percent idle or abandoned, almost 65 percent in use for pasture and hay, and here and there a few areas devoted to corn for silage and to oats.

This soil is more intensively farmed than the heavier soil, owing to the greater ease with which the land can be worked. Similar crops are grown, but yields range from 5 to 10 percent higher on the silt loam.

Mahoning silt loam, rolling phase.—Mahoning silt loam, rolling phase, occurs on moderate to steep slopes where the normal soil has been dissected by streams. Its profile characteristics are essentially the same as those of typical Mahoning silt loam, except that in many places sheet erosion has removed much or all of the surface soil and gullies have cut deep grooves in the slopes. Most of the rolling areas are too steep to be successfully cultivated without practices for the

control of erosion, and the land should be reforested or planted to permanent pasture. It occurs principally in one body north of Persia.

Caneadea silt loam.—Several areas of Caneadea silt loam are developed on lake-laid calcareous deposits, but they are considerably lighter textured than the Mahoning soils. They have light silt loam surface soils and stratified silt and very fine sand subsoils that show considerable mottling. The village of Cattaraugus is situated on such material. The area just east of the village of Otto and that shown on the north side of Mansfield Creek are made up of similar materials. The soil along Conewango Valley in the vicinity of Randolph varies somewhat from the typical soil in that it carries considerable gravel.

Caneadea silt loam is somewhat more productive than Mahoning silt loam.

Lorain silty clay loam.—The Lorain soils occur in the Conewango Valley, from Randolph north to Markham. This valley represents the preglacial channel of the Allegheny River which has been filled by glacial lake and stream detritus (*β*). Conewango Creek meanders through the valley, which is remarkable for its flat plainlike character. The elevation at Markham is 1,300 feet, and where the creek leaves the county west of Randolph it is 1,276 feet, a fall of only 24 feet in a distance of approximately 20 miles. The valley formerly was covered with water for long periods, but a drainage canal, dug sometime before 1900, has greatly facilitated the removal of excess water.

Lorain silty clay loam under cultivation has a light-gray or gray cloddy acid 8-inch surface layer overlying a highly mottled dense tenacious clay subsurface layer. The subsoil, to a depth ranging from 20 to 30 inches, is a blue tight calcareous clay underlain in places by stratified sands and silt below a depth of 40 or more inches. As mapped, this soil type includes several areas in the northern part of the valley, in which the surface soil is very dark gray or black.

Those areas indicated on the map as Lorain silty clay loam in association with the Mahoning soils in very wet swales, depressions, and areas around stream heads, most of which are too wet for use except to furnish some poor pasture land, are not typical of the Mahoning series. The 6- or 8-inch surface soil is dark-gray or black silty clay loam. It is underlain by dense plastic gray clay mottled with brown and yellow to a depth of about 36 inches. The substrata consist of bluish-gray tight calcareous clay. Most of this included soil never was entirely cleared of its original forest growth, because it is covered with water for long periods.

Lorain silty clay loam in the southern part of the valley has a lighter colored surface layer and is more acid in reaction in the surface soil and subsurface soil than those areas in the vicinity of South Dayton and Markham.

Most areas of this soil are very flat, and this feature greatly retards surface run-off. The heavy impervious subsoil impedes internal movement of water. Although originally forested with soft maple, black ash, elm, and white pine, the soil now supports only brush and second-growth trees on the uncultivated areas.

The natural fertility of Lorain silty clay loam is high, but the heavy texture and the poor drainage restrict its utilization to pasture and the production of timothy hay. Some oats and corn are grown, but the adequate preparation of a seedbed for these crops is difficult. Moreover, the soil remains too wet to work until late in the season. Much of the soil is still subject to overflow in the spring.

Fertilization consists of a light application of phosphate on land for corn and oats and manure on meadows and cornland. Normal yields are 1½ tons of hay an acre, 6 tons of corn silage, and 30 bushels of oats.

There are 16.4 square miles of this soil in the county, 40 percent of which is used for pasture, 35 percent for hay; 5 percent for oats, and 5 percent for silage corn. About 15 percent is in forest.

Lorain silt loam.—Lorain silt loam is differentiated from the silty clay loam by the lighter textured surface soil and by the occurrence in places of a layered arrangement of clay, silt, and sands in the subsoil. It has the same gray surface soil and flat surface as the silty clay loam.

There is more variation in the texture, both in the surface soil and subsoil, of Lorain silt loam than in the corresponding layers of the silty clay loam. In places, the surface soil is mellow and contains considerable sand and the subsoil contains enough coarse sediments to reduce greatly the toughness and tenacity of the material. In most places adjacent to streams the presence of a thin surface mantle of recent alluvium imparts a mellowness that the typical soil does not have.

The soil is gravel free and is acid in the surface and subsurface layers, but some carbonate of lime is present in most areas, at a depth ranging from 30 to 36 inches. This soil not only has poor surface and subsoil drainage, but it also is subject to periodic overflows.

The land is best adapted to pasture and to the production of timothy and alsike hay. Some corn and oats are grown, but the poor drainage makes the soil unsuitable for these crops. Yields are from 5 to 10 percent higher than those obtained on the silty clay loam. The proportions of this land in forest, pasture, and crops are about the same as for the silty clay loam.

Lorain fine sandy loam.—Lorain fine sandy loam is distinguished by its gray fine sandy loam surface soil and sandy clay or stratified sand and silt subsoil highly mottled with yellow and brown. As mapped it includes some soils with surface soils of sandy loam and coarse sandy loam textures.

The relief is flat or depressed, and drainage is similar to that of the other Lorain soils. This soil is the least extensive member of the Lorain series. It is used for the same purposes as the silt loam, and yields on the two soils are similar.

Tyler silty clay loam.—Tyler silty clay loam is a very poor agricultural soil associated with the Unadilla soils in the Allegheny Valley. It occupies flat or depressed areas in second-bottom or terrace positions. The 4-inch surface layer consists of dark-gray silty clay loam, in most places badly puddled and cloddy. It is underlain to a depth of 8 inches by pale yellowish-brown firm faintly mottled silty clay loam that gives way, at a depth of 16 inches, to dense tight

clay highly mottled with gray and yellow. The subsoil, which continues to a depth of 40 inches, is dense blue-gray clay containing a few splotches of rust brown and yellow. The subsurface layer and subsoil have a definite prismatic structure. This soil is free from gravel and stone and has a strongly acid reaction.

This is an inextensive soil that has developed from slack-water deposits, the materials of which were derived principally from the surrounding Dekalb soils of the upland. Both surface and internal drainage are poor.

Approximately 75 percent of the land remains in forest, and most of the cleared land is utilized for pasture. A few areas are used for hay, but the poor drainage and heavy texture of the soil prevent its use for cultivated crops.

Tyler silt loam.—Tyler silt loam has a light-gray, grayish-brown, or yellowish-brown heavy silt loam surface layer underlain by yellowish-brown firm heavy silt loam mottled with yellow, brown, and gray. The subsoil is dense moderately compact silty clay loam mottled with brown and gray. Drainage is somewhat better and the textures of the surface and subsurface layers are considerably lighter than in Tyler silty clay loam, but the silt loam is, nevertheless, a soil of rather low productivity.

This is not an extensive soil. It is developed along the Allegheny River and in most of the valleys of minor tributary streams. It is mapped also in the town of Ellicottville.

The topographic position of this soil is similar to that of Unadilla silt loam. Surface drainage is fair, but subsoil drainage is poor. The soil is acid in reaction.

This soil is used mainly for pasture and hay land, but some of the more favorably situated areas may be used for silage corn and oats. Approximately 50 percent of the total acreage supports a second- and third-growth forest. About 15 percent of the cleared land is idle, and the rest is used for pasture and timothy hay.

WELL-DRAINED SOILS OF THE FIRST BOTTOMS

The group of well-drained soils of the first bottoms includes those soils having the highest natural fertility levels of the soils in this county. Their value and productivity is limited, however, by the periodic flooding to which they are subject. The length of time they are under water during flood periods usually is short, and subsequent run-off is rapid. Flooding occurs chiefly in the spring before planting starts, so that it does not always interfere with the cropping practices. Certain areas, designated as high-bottom phases, escape all except unusually high floods and represent some of the best agricultural land of the county.

Good drainage and favorable textural characteristics give these soils a wide adaptability. Their greatest value, however, is for pasture, hay, corn, and oats. Yields are greater and less fertilization is necessary than on any other soils.

These soils have grayish-brown or yellowish-brown mellow surface soils with friable brown or grayish-brown subsoils. They have developed from recent alluvium, and, as in all soils subject to flooding, the textures of the surface soil and the subsoil are variable and soil profiles are not well developed. The group includes members of

the Tioga, Genesee, Pope, and Chagrin series. The Genesee soils are neutral or alkaline from the surface downward, the Tioga and Pope soils are acid throughout, and the Chagrin soils are acid to a depth of 30 inches, below which the reaction is alkaline. The Tioga soils are the most extensive. The Genesee soils are mapped mainly along Cattaraugus Creek and South Branch Cattaraugus Creek, also along Clear Creek southwest of Rutledge.

Tioga silt loam.—Tioga silt loam has a brown or grayish-brown mellow silt loam surface layer about 8 inches thick, well supplied with organic matter. It is underlain to a depth of 20 inches by brown or yellowish-brown firm very fine sandy loam or silt loam. The subsoil is yellow firm but friable fine sandy loam. The texture is variable, especially in the subsoil, and lenses of coarse sand and gravel are commonly present. Typically the soil is rather free of gravel and is strongly acid throughout.

In the central and northern parts of the county the surface soil is darker and the subsoil is less yellow than in areas along the Allegheny River.

The largest bodies are along the Allegheny River, but the soil is developed in all the main valleys except that of Cattaraugus Creek. In general, the land is flat, but here and there it is cut by old stream channels. The soil has developed from recent alluvium, the sediments of which were derived from the nearby upland soils. Both surface and subsoil drainage are good.

Tioga silt loam and the Tioga soils in general are used principally for pasture and the production of hay, but a considerable acreage is devoted to growing corn for silage. Some oats also are grown, but they tend to lodge owing to the heavy growth of stalk. Yields are as high on this soil as they are on any other soil of the county. Less fertilizer is needed than on the gravelly soils of the terraces.

The meadows are chiefly of timothy and red clover, but alfalfa can be grown successfully when lime is applied. Yields under the common system of management that includes light applications of superphosphate for the corn and small-grain crops and manure on meadows and cornland, are as follows: Timothy and clover hay, 2 tons an acre; corn for silage, from 8 to 12 tons; and oats, from 40 to 50 bushels.

Approximately 20 percent of this land is covered with forest, 30 percent is used as pasture, 25 percent for the production of hay, 15 percent for corn, and 10 percent for oats, barley, and other crops.

Tioga silt loam, high-bottom phase.—The high-bottom phase of Tioga silt loam is differentiated from the typical soil on the basis of its occurrence at levels that prevent flooding except in periods of unusually high water. Its position increases its agricultural value because it can be used more extensively for cultivated and small-grain crops than the typical soil. The profile is essentially like that of the lower-lying silt loam. All the land is cleared and is used for the same crops as those grown on the silt loam, but the proportion of the total area devoted to small-grain and cultivated crops is somewhat greater.

Tioga fine sandy loam.—Tioga fine sandy loam has a 6- to 10-inch yellowish-brown or brown mellow sandy surface soil overlying a firm

but friable light yellowish-brown subsoil, the texture of which ranges from silt loam to coarse sandy loam. A small quantity of gravel is scattered over the surface and mixed through the soil in places. It is a very inextensive soil.

This soil differs from Tioga silt loam mainly in the texture of the surface layer. The two soils occupy similar topographic positions and have the same drainage characteristics. The fine sandy loam is used in the same way as the silt loam, and yields on the two soils are about equal.

Tioga fine sandy loam, high-bottom phase.—Like the high-bottom phase of Tioga silt loam, the high-bottom phase of Tioga fine sandy loam simply differentiates the areas lying above the flood plains, which are subject to overflow only occasionally, if at all. As a result of the less frequent flooding the soil is better adapted to small grains and cultivated crops than is the typical soil. A higher proportion of the land is utilized for growing small grains, corn, alfalfa, and other cultivated crops. The largest bodies of this soil occur along the Allegheny River.

Genesee fine sandy loam.—The 6- to 10-inch surface layer of Genesee fine sandy loam consists of brown or grayish-brown mellow fine sandy loam. It is underlain by yellowish-brown firm silty material to a depth of about 20 inches. The subsoil is composed of materials ranging in texture from coarse sand to silt, with here and there lenses of gravel. As mapped the soil includes small areas having a silt loam surface soil.

The main differences between the Tioga and Genesee soils are in the darker surface soils of the latter and in their neutral or alkaline reaction from the surface downward. In topographic position, relief, and mode of deposition of the parent material, they are similar.

Genesee fine sandy loam has a small total area, 80 percent of which is cleared and used for agricultural purposes. Agricultural uses and crop yields are approximately the same as those for Tioga silt loam. Owing to the neutral or alkaline reaction, less lime is necessary for the growth of legumes, such as alfalfa and red clover, on the Genesee soil than on the Tioga. Much of the soil along Cattaraugus Creek is adapted only to pasture because of its inaccessibility.

Genesee fine sandy loam, high-bottom phase.—Certain areas of Genesee fine sandy loam that occupy second-bottom positions, not subjected to such frequent flooding as the normal soil, are designated as a high-bottom phase. The soil profile is essentially the same as that of the typical soil, but the higher-lying areas have a somewhat greater value because of the less frequent flooding. In agricultural use and crop adaptations this soil closely approximates the high-bottom phases of the Tioga soils.

Genesee silt loam.—Genesee silt loam consists of grayish-brown smooth but friable silt loam to a depth of 10 or 12 inches. This is underlain by yellowish-brown friable silt loam to a depth ranging from 20 to 30 inches. The latter material tends to be somewhat firm in place. Beds of silt, sand, and a few lenses of gravel compose the substratum. The reaction is slightly acid or neutral in the surface soil and neutral or alkaline below.

Most of the land is cleared and used chiefly for hay, pasture, and some cultivated crops. It is especially well suited to legumes because

of its low acidity or actual alkalinity in places. It is highly productive where planted to clean-tilled crops, but its usefulness for such crops is limited because it is subject to overflow during periods of high water.

Genesee silt loam, high-bottom phase.—Genesee silt loam, high-bottom phase, resembles the normal soil in most respects. The second layer tends to be somewhat heavier in texture than the corresponding layer in the typical soil and in many places is heavy silt loam or light silty clay loam. The reaction of the surface soil ranges from medium to slightly acid, and that of the second horizon from slightly acid to neutral. The parent materials are essentially the same in texture and reaction as those of the normal Genesee silt loam.

This soil is highly productive and can be used for a wider range of crops and produces better yields than the typical soil, because it is overflowed only during the worst floods.

Pope silt loam.—Pope silt loam is very much like Tioga silt loam, but it occurs only in the unglaciated southern part of the county and has developed from sediments washed from the Dekalb soils of the uplands. In general it is more yellow and somewhat more acid than the Tioga soil.

The 8-inch surface layer is grayish-brown or yellowish-brown granular silt loam underlain to a depth of 18 inches by bright-yellow or brownish-yellow firm smooth silt loam. The subsoil is yellow or yellowish-brown silt loam that is firm in place but friable when broken out. In most places below a depth of 30 inches the material consists of bedded sands and silt. As mapped, Pope silt loam includes small bodies in which the texture of the surface soil is fine sandy loam.

Pope silt loam is most typically developed along Tunungwant Creek; it also occurs in the minor valleys south of the Allegheny River. The total extent is not large. This land is flat, a characteristic of the first bottoms, and is subject to periodic flooding. Under average weather conditions the soil has good surface and internal drainage.

This soil is used principally for pasture and hay, with some corn and oats on the areas least subject to flooding. Management practices are similar to those used on the Tioga soils, and crop yields also are similar, perhaps somewhat less.

Chagrin silt loam.—Chagrin silt loam occurs as flood plains along streams in the northern part of the county. The 8-inch surface layer of brown or grayish-brown mellow silt loam is underlain to a depth of 20 inches by yellow-brown firm silt loam or loam. The subsoil is yellowish-brown material that in some places is silt loam and in others is sand and gravel. This variation in the subsoil material is a characteristic of the soils developed from recent alluvium.

Chagrin silt loam is differentiated from either the Tioga soils or the Genesee soils mainly on the basis of reaction, the Tioga being acid throughout and the Genesee alkaline from the surface downward. The reaction of Chagrin silt loam is acid in the upper part but is alkaline below a depth of 30 inches, a factor of significance in the production of alfalfa.

This is a very productive soil and is used for alfalfa, timothy and clover, silage corn, and pasture. It is subject to periodic flooding, and this reduces its agricultural value to some extent. Very excellent pastures are on this soil.

IMPERFECTLY DRAINED SOILS OF THE FIRST BOTTOMS

The group of imperfectly drained soils of the first bottoms is represented by one soil only—Middlebury silt loam.

Middlebury silt loam.—Middlebury silt loam differs from Tioga silt loam in that it has imperfect subsoil drainage. The 8-inch surface layer consists of grayish-brown mellow silt loam. It is underlain to a depth of 20 inches by yellowish-brown moderately dense silt loam that is slightly mottled in the lower part. The subsoil is highly mottled slightly compact silt loam that extends to a depth of 30 inches. Below this the material in most places consists of stratified sands and gravels. The soil is noncalcareous throughout.

Middlebury silt loam is distributed through most of the valleys north of the Allegheny River, generally in small irregular areas surrounded by one or more types of Tioga soils. It has developed from materials similar to those that give rise to the Tioga soils, and like those soils it is subject to overflow. The land is flat, with the exception of an abandoned stream channel here and there. Surface drainage is good, but subsoil drainage is only fair.

The best use made of this soil is for the production of hay and for pasture, which occupy about 75 percent of the land. Of the rest, 15 percent is forested, principally with elm, soft maple, hemlock, alder, and willow, and 10 percent is cropland, mainly in oats and corn. Yields of these crops are only slightly lower than those obtained on the Tioga soils.

POORLY DRAINED SOILS OF THE FIRST BOTTOMS

The soils of this subgroup are mainly nonagricultural because of excessive moisture. They are subject to flooding and may remain submerged for comparatively long periods. A few of the less wet areas are used for pasture. The land is flat or depressed.

The soils are characterized by gray or black surface soils and highly mottled plastic clay subsoils. Members of three series, Holly, Wayland, and Atkins, comprise the subgroup.

Holly silty clay loam.—Holly silty clay loam has an 8-inch dark-gray or black silty clay loam surface soil that puddles and lumps very readily when plowed or cultivated. The upper part of the subsoil, to a depth of 18 inches, is grayish-yellow plastic clay loam highly mottled with gray, yellow, and brown. The lower subsoil layer in most places is dense tight grayish-blue clay that continues to a depth of 30 inches. In a few places where this land is artificially drained or where open ditches remove surplus water, the soil may be planted to corn or oats, but in general it is too wet for cultivation and its best use is as pasture land.

Holly silty clay loam is fairly well distributed through the larger valleys north of the section occupied by the Dekalb soils. The largest and most typically developed area lies in the town of Machias in the

Beaver Meadows between Devereaux Branch of Great Valley Creek and Ischua Creek. The total area is 12.2 square miles.

This soil occupies flat or depressed first bottoms and is developed from alluvial material derived from the same source as the parent materials of the Tioga and Middlebury soils, with which it is closely associated. A high percentage of the total acreage is covered with elm, soft maple, hemlock, balsam, alder, and other wet-land species of trees. The cleared areas are used mainly for pasture.

Wayland silty clay loam.—Wayland silty clay loam is an inextensive wet bottom soil that occurs principally in the extreme northwestern part of the county. It occupies sags, areas around stream heads and areas along old glacial stream channels, where surface and internal drainage are poor. The basis for separating this soil from Holly silty clay loam is its alkaline reaction in the subsoil; in other respects the two soils are similar.

The surface soil is light brownish-gray silty clay loam to a depth of 8 or 10 inches, where it is underlain by highly mottled ash-gray tough clay. The lower part of the subsoil, beginning at a depth of about 30 inches, is light bluish-gray dense plastic clay. The poor drainage and heavy texture limit the use of this land, where it has been cleared, to pasture.

Atkins silt loam.—Atkins silt loam is a poorly drained soil associated with Pope silt loam. It differs from the Holly soil in that it occurs exclusively in the valleys in the section occupied by the Dekalb and associated soils, from which its parent materials are washed. The surface soil is gray or dark-gray silt loam to a depth of 10 inches, where it is underlain by yellowish-brown silty clay loam mottled with gray and rust brown. The subsoil is yellowish-gray highly mottled dense silty clay loam. It has the flat or depressed relief and saturated condition characteristic of the poorly drained first-bottom soils. It covers only a small total area, 70 percent of which is forested. The cleared areas are used for pasture.

MISCELLANEOUS SOILS AND LAND TYPES

Alluvial soils, undifferentiated.—Alluvial soils, undifferentiated, include materials not easily classified separately because of their variable texture, poor drainage, and small extent. They contain spots of Chenango soil, first-bottom materials, old stream channels, gravel bars, and small swampy areas, all which are too small to show separately on the soil map. The flooded bottom lands in short narrow valleys also are placed in this category.

Materials of this character are mapped in all parts of the county and aggregate a total of 35.7 square miles. Most of the different areas included in this category are cleared and furnish fair pasturage.

Muck.—The material mapped as muck represents vegetable matter, such as sedges, rushes, cattails, moss, and wood, in various stages of decomposition. In typical muck the organic matter is black and granular and the plant remains cannot be identified. In places considerable mineral soil may be mixed in the surface layer, and in other areas the soil is brown fibrous peat in which the structure of the original plant tissues is apparent. These inclusions were made because of the small area involved.

Most of the muck in this county occurs in small areas. The largest ones under cultivation are between Randolph and Rutledge. The area west of Conewango Creek is the only place in the county where vegetables are produced on muck soils. Here lettuce, onions, potatoes, and celery are grown for markets in Jamestown. Muck covers 7.3 square miles, 90 percent of which is wet and forested. Most of the muck around Lime Lake is underlain by calcareous marl at a depth ranging from 3 to 5 feet.

Muck, shallow phase.—The shallow phase of muck, as mapped, is variable, but in typical areas it consists of a 10-inch layer of black granular thoroughly decomposed organic matter overlying bluish-gray dense highly mottled plastic clay that in many places is calcareous at a depth of 30 inches. The area 2 miles north of the village of Conewango Valley, along the county line, is underlain by marl at a depth ranging from 24 to 30 inches. In numerous places along Conewango Creek, gray sand, rather than the bluish-gray plastic clay, underlies the mucky surface layer, and the depth of the muck layer in places is less than 10 inches. Here and there the surface layer is no more than a highly organic mineral layer.

The largest areas of this shallow phase of muck are mapped in Conewango Valley. Elsewhere it occurs in narrow sags, depressions, or around stream heads, positions that are similar to those occupied by Holly silty clay loam, except that the drainage is still poorer than in the Holly soil.

A large proportion of this land is forested. The cleared areas are too wet for anything except pasture.

Rough stony land.—Rough stony land as mapped in Cattaraugus County includes steep precipitous slopes, where little soil formation has taken place, as well as bluffs and rock ledges. Most of this class of land occurs in the southern part of the county, where the relief is much more rugged than that in the northern part. In the section occupied by the Dekalb soils, much of the land is littered with boulders. Ledges of conglomerate also are common. This land is entirely nonagricultural, and in places it is even too steep to support a forest growth.

PRODUCTIVITY RATINGS

In table 6 the soils of Cattaraugus County are rated according to their ability to produce the more important crops of southwestern New York and are listed in the order of their relative general productivity under the prevailing farming practices that include the use of lime, fertilizers, and manure.

TABLE 6.—Productivity ratings of soils in Cattaraugus County, N. Y.

Soil ¹	Crop productivity index ² for—										General productivity grade ³		Land classification ⁴	Principal crops or type of farming (present land use)				
	Corn (silage)	Oats	Buckwheat	Timothy and clover ⁵	Red clover	Alfalfa	Potatoes	Vegetables ⁶	Vegetables ⁶	Apples ⁶	Pasture ⁶	Current practices			Without amendments			
Genesee silt loam, high-bottom phase.	80(100)	70(90)	80 --	90(100)	80(100)	70(80)	50(60)	50(60)	60(80)	-----	90 --	1	2	Excellent crop-land.	Corn silage, oats, hay, pasture.			
Genesee fine sandy loam, high-bottom phase.	80(90)	70(90)	70 --	90(100)	70(90)	55(80)	40(60)	50(60)	60(80)	-----	90 --				2	Do.		
Tloga silt loam, high-bottom phase.	80(90)	70(90)	70 --	90(100)	60(80)	45(70)	50(70)	50(60)	60(80)	-----	90 --				3	Do.		
Tloga fine sandy loam, high-bottom phase.	70(90)	60(90)	70 --	90(100)	50(80)	45(70)	50(70)	50(60)	60(80)	-----	80 --				3	Do.		
Tloga silt loam.....	80(90)	70(80)	70 --	90(100)	60(80)	45(70)	50(60)	50(60)	60(80)	-----	90 --				3	2	Good crop-land.	Pasture, hay, corn silage, oats.
Genesee silt loam.....	80 --	70 --	70 --	90 --	80 --	70 --	50 --	50 --	60 --	-----	100 --				2			Do.
Chagrin silt loam.....	80 --	70 --	70 --	90 --	70 --	45 --	50 --	50 --	60 --	-----	100 --				2			Do.
Genesee fine sandy loam.....	80 --	70 --	70 --	90 --	80 --	70 --	50 --	50 --	60 --	-----	80 --				2			Do.
Tloga fine sandy loam.....	80(90)	60(80)	70 --	80(90)	60(80)	45(70)	50(60)	50(60)	60(80)	-----	80 --				3			Do.
Chenango silt loam.....	70(80)	70(90)	80 --	70(90)	60(70)	45(70)	50(70)	30(60)	40(70)	60 --	70 --				4			3
Chenango gravelly silt loam.....	70(80)	60(80)	50 --	60(90)	40(70)	45(70)	50(70)	20(40)	40(60)	60 --	70 --	5	Corn silage, oats, alfalfa, hay, potatoes.					
Mentor fine sandy loam.....	70(80)	60(80)	60 --	60(90)	50(60)	45(70)	50(70)	30(70)	40(70)	50 --	70 --	5	Corn silage, oats, hay.					
Wooster silt loam.....	60(80)	50(80)	50(70)	60(80)	30(70)	35(55)	50(80)	40 --	60 --	60 --	70 --	6	Hay, oats, corn silage, buckwheat.					
Chenango gravelly loam.....	70(80)	60(80)	50 --	60(80)	40(70)	45(70)	50(70)	20(40)	40(60)	50 --	50 --	5	Corn silage, oats, hay, alfalfa, potatoes.					
Wooster gravelly silt loam.....	50(70)	40(80)	50(70)	60(80)	30(60)	35(55)	50(80)	30 --	50 --	60 --	60 --	5	Hay, corn silage, oats, potatoes, buckwheat.					
Chenango gravelly silt loam, alluvial-fan phase.	60(70)	60(80)	50 --	60(80)	40(70)	55(70)	40(60)	20(40)	40(60)	40 --	50 --	5	Corn silage, oats, alfalfa, pasture.					
Chenango gravelly sandy loam.	60(70)	50(70)	40 --	60(80)	40(60)	45(70)	50(70)	30(50)	50(70)	50 --	40 --	6	Hay, corn silage, oats, alfalfa, potatoes.					
Unadilla silt loam.....	70(80)	60(80)	60 --	60(80)	40(60)	35(55)	50(70)	30(50)	40(70)	60 --	60 --	5	Hay, corn silage, oats, pasture.					
Unadilla fine sandy loam.....	70(80)	50(70)	50 --	50(70)	40(60)	35(55)	50(70)	20(40)	30(60)	60 --	60 --	5	Do.					
Pope silt loam.....	70 --	60 --	70 --	80 --	50 --	35 --	40 --	40 --	60 --	-----	80 --	4	Hay, pasture, corn silage.					
Middlebury silt loam.....	70 --	60 --	60 --	80 --	40 --	35 --	40 --	40 --	50 --	-----	80 --	4	Pasture, hay, corn silage, oats, buckwheat.					
Wooster gravelly loam.....	50(70)	40(70)	40(60)	60(70)	30(60)	35(55)	50(80)	30 --	50 --	60 --	50 --	4	Corn silage, oats, hay, potatoes, alfalfa.					

Bath gravelly silt loam.....	50(60)	40(70)	50(80)	50(70)	20(60)	20(55)	60(80)	20 --	50 --	50 --	50 --	50 --	5	Fair crop-land.	Hay, pasture, buckwheat, corn silage, oats.
Braceville silt loam.....	60(70)	50(70)	60 --	60(80)	40(60)	20(45)	40(50)	30 --	50 --	40 --	70 --	4	5		Hay, corn silage, oats, pasture.
Muck, drained.....							(80)	(100)	(80)				9		Calery, onions, potatoes.
Langford silt loam.....	40(70)	40(70)	60(70)	50(80)	20(50)	20 --	30(50)	10 --	30 --	20 --	60 --	6	6		Hay, corn silage, oats, pasture, buckwheat.
Canfield silt loam.....	40(70)	40(70)	50(70)	50(80)	20(50)	20 --	30(50)	10 --	30 --	20 --	60 --	4	6		Do.
Mardin silt loam.....	40(70)	40(60)	40(60)	50(70)	20(50)	20 --	30(50)	10 --	30 --	20 --	60 --	6	6		Hay, buckwheat, oats, pasture, corn silage.
Aurora silt loam.....	40(60)	40(60)	50(70)	60(70)	20(50)	20 --	30(50)	20 --	40 --	30 --	40 --	6	6		Grapes, corn silage, oats, hay, buckwheat.
Lorain silt loam.....	50(80)	60(70)	40 --	80(90)	60 --	20 --		10 --	30 --		80 --	5	5		Pasture, hay.
Canesada silt loam.....	50(80)	50(80)	50 --	70(80)	40(50)	20(45)		10 --	30 --		70 --	5	5		Hay, pasture, oats, corn silage.
Mahoning silt loam.....	40(50)	40(50)	40 --	70(80)	40(50)	20(35)		10 --	20 --		70 --	5	5		Hay, pasture, corn silage, oats.
Wooster gravelly silt loam, rolling phase. ^a	50(60)	40(60)	40(50)	40(50)	30(60)	35(55)	40(60)	20 --	40 --	60 --	40 --	6	6		Pasture, hay.
Lorain fine sandy loam.....	40(60)	50(60)	40 --	70(80)	60 --	20 --		20 --	20 --		70 --	5	5		Do.
Chemango gravelly loamy sand.	40(60)	30(50)	30 --	40(50)	30(40)	35(55)	40(60)	20(40)	40(60)	40 --	20 --	7	7		Do.
Lordstown silt loam.....	50(60)	30(60)	40(60)	40(50)	20(50)	20 --	60(80)		10 --	20 --	40 --	6	6		Hay, pasture, corn silage, oats, idle land.
Lorain silty clay loam.....	40(50)	50(60)	30 --	70(80)	50 --	10 --			10 --		70 --	5	5		Pasture, hay.
Tyler silt loam.....	50 --	50 --	40 --	70 --	40 --	20 --			20 --		70 --	5	5		Pasture, wasteland.
Erie silt loam.....	30(50)	30(60)	40(60)	50(60)	30(40)						40 --	7	7		Hay, pasture, corn silage, oats, buckwheat, idle land.
Volusia silt loam.....	30(50)	30(60)	40(60)	40(50)	20(30)						40 --	7	7		Do.
Fremont silt loam.....	30(50)	30(50)	40(60)	40(50)	10(30)						40 --	7	7		Do.
Mahoning silty clay loam.....	30(40)	40(50)	30 --	60(70)	40(50)	20(45)			10 --	20 --	50 --	6	6		Pasture, hay, wasteland.
Bath gravelly silt loam, rolling phase.	20(40)	30(50)	40(60)	40(60)	20(50)	20(45)	30(50)		40 --	50 --	40 --	7	7	Pasture, hay, buckwheat, idle land.	
Holly silty clay loam, drained.	50 --	50 --	40 --	60 --	50 --		20 --	40 --	50 --		50 --	6	6	Hay, pasture, corn silage, oats.	
Aurora silty clay loam.....	20(40)	30(50)	30(50)	60(70)	20(40)	10 --			10 --	20 --	30 --	7	7	Pasture, hay, grapes, idle land.	
Cattaraugus silt loam.....	30(50)	30(30)	30(50)	40(50)	10(30)						40 --	6	6	Hay, pasture, idle land.	
Lordstown stony silt loam.....	30(50)	30(50)	40(50)	30(40)	20(40)	10 --	40(60)		10 --	20 --	30 --	7	7	Pasture, hay, idle land.	
Ernest silt loam.....	20(40)	20(40)	40(50)	40(50)	30 --						40 --	7	7	Idle land, forest.	
Dekalb silt loam.....	20(50)	20(50)	40(50)	30(40)	20 --						30 --	8	8	Hay, idle land, forest.	
Dekalb silty loam ^b	40 --	40 --	30 --	30 --	30 --	35 --	30 --	10 --	20 --	50 --	40 --	7	7	Pasture, wasteland.	
Ottsville gravelly loam ^c	20(40)	10(30)	30(40)	30(40)	20 --						30 --	8	8	Pasture, buckwheat, idle land.	
Hornell silty clay loam.....	10(30)	10(30)	20(30)	30(40)	10 --						30 --	8	8	Pasture, idle land, forest.	
Ernest silty clay loam.....	10 --	10 --	20 --	30 --	10 --						20 --	8	8	Idle land, forest.	
Dekalb stony silt loam.....				30 --							60 --	8	8	Pasture.	
Alluvial soils, undifferentiated.															
Mahoning silty clay loam, rolling phase.	20 --	20 --	10 --	20 --	20 --		10(20)				40 --	8	8	Pasture, wasteland, forest.	
Canfield silt loam, steep phase.	20 --	20 --	10 --	20 --	20 --		10(20)				40 --	8	8	Pasture, idle land, forest.	
Erie silt loam, steep phase.		20 --	10 --	20 --	20 --		10(20)				40 --	9	9	Do.	
Mardin silt loam, steep phase.	20 --	20 --	10 --	20 --	20 --		10(20)				40 --			Do.	
Volusia silt loam, steep phase.		20 --	10 --	20 --	10 --						40 --			Do.	

See footnotes at end of table.

¹ Soils are listed in the approximate order of their general productivity under the prevailing current practices.

² Soils inherently most productive (without amendments) for the specified crop in the United States are given the index 100. The soils in Cattaraugus County are given indexes that give the approximate production in percent of the standard. The figures in parentheses indicate production under the prevailing system of management that includes the use of lime, fertilizers, and manure. It should be realized that these ratings are largely inductive, as yield data by soil types are yet too fragmental to be adequate.

³ Alsike clover replaces red clover as drainage becomes poorer.

⁴ Vegetables doing best on highly organic soils, such as lettuce, celery, and onions. These indexes for vegetables are only for local comparison of soil types and are not based on standards of reference for any particular kind of vegetable.

⁵ Vegetables not requiring highly organic soils, such as tomatoes, peas, and carrots.

⁶ These indexes for apples and pasture are largely comparative for the soil types of this and adjoining counties. Although not based on quantitative-yield data or used strictly in reference to the standards, it is believed they are fairly comparable.

⁷ This classification indicates the comparative general productivity of the soils under prevailing current practices and also without the use of amendments. Refer to the text for further explanation.

⁸ This is a general classification to show comparative productivity and use adaptation in simple terms. The delineation on a map of areas of land classes in a given county is a distinct and supplemental step to this type of characterization of soil types, and is influenced also by the pattern of soil-type distribution.

⁹ Strongly rolling and erodible land.

¹⁰ Land too steep for the efficient use of machinery.

Note: Leaders, according to position, indicate either that the crop is not commonly grown because of poor adaptation, or that amendments are not commonly used.

The rating compares the productivity of each of the soils for each crop to a standard, namely, 100. This standard index represents the inherent productivity of the most productive soil or soils of significant extent in the United States for that crop. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index. Soils given amendments, such as lime, commercial fertilizers, or irrigation, or unusually productive soils of small extent, have productivity indexes of more than 100 for some crops. Inherent productivity is conceived to be that level of productivity at or near that existing when the virgin condition became adjusted to tillage practices. The following tabulation sets forth some of the acre yields that have been set up as standards of 100. They represent long-time average yields of crops of satisfactory quality on the better soils without the use of amendments.

Crop:

Oats.....	bushels	50
Buckwheat.....	do	25
Potatoes.....	do	200
Apples.....	do	200
Corn silage.....	tons	12
Timothy and clover.....	do	2
Red clover.....	do	2
Alfalfa.....	do	4
Pasture.....	cow-acre-days ¹	100

¹ Cow-acre-days is a term used to express the carrying capacity of pasture land. As used here it is the product of the number of animal units carried per acre multiplied by the number of days the animals are grazed without injury to the pasture. For example, the soil able to support 1 animal unit per acre for 360 days of the year rates 360, whereas another soil able to support 1 animal unit for 2 acres for 180 days of the year rates 90. Again, if 4 acres of pasture support 1 animal unit for 100 days the rating is 25.

The drainage considered for these ratings is that provided in general practice in the county and is not necessarily optimum. Optimum drainage would change the places of some of the soils. Again, certain soils, such as Wayland silty clay loam, if artificially drained, as they are in some other counties, would have much higher productivity ratings. No ratings are given for those crops not commonly grown on the particular soil type.

Only ratings for the unprotected condition from flooding have been given to the soils of the flood plains, as no areas are definitely protected by dikes or levees. As the floods usually occur prior to planting, crop damage and loss generally are not extensive. As a result, the indexes almost parallel those of the high-bottom phases of soils. It will be noted that the common farming practices on these soils of the bottom lands do not include the use of amendments, except with the Tioga soils.

Factors influencing productivity of land are mainly climate, soil (including drainage and relief), and management. Crop yields over a long period of years furnish the best available summation of those factors contributing to productivity, and they are used whenever available. Because of a lack of definite information and yield data by soil types in many instances in Cattaraugus County, the indexes in this table represent, in part, inductive estimates rather than established yields. This is especially true of the indexes for vegetables, apples, and pasture. They are an attempt, however, to portray the

comparative productivity of the soils of this county and are based largely on observations and interviews made in the progress of the soil survey.

The soils are listed in the order of their general productivity under the prevailing current practices, as determined by the weighted average of the crop indexes in parentheses. The weighted average is based both on the areal extent of the individual crops in the county and the comparative total value.

Because of the marked differences in the suitabilities and uses of the soils of different drainage conditions and textures of both the uplands and bottoms for the common crops, no uniform set of weightings of crop indexes was established to determine the general productivity grades of all the soil types. Instead, separate weightings of crop indexes were set up for each of six general conditions, as shown in table 7.

TABLE 7.—Percentage weights given to crop indexes to aid in the determination of the general productivity grades

Crop	Well drained and imperfectly drained soils of—				Poorly drained soils	Grazing and forest land
	Rolling uplands	Higher elevations	Terraços	Bottoms		
Corn silage.....	10	2	15	25	5	-----
Oats.....	10	15	10	5	15	-----
Buckwheat.....	4	10	-----	-----	5	-----
Timothy and clover.....	35	45	25	30	40	-----
Red clover.....	8	-----	10	10	7	-----
Alfalfa.....	5	-----	10	5	3	-----
Potatoes.....	10	5	10	5	5	-----
Vegetables.....	5	-----	10	5	5	-----
Apples.....	3	-----	5	-----	-----	-----
Pasture.....	10	20	5	15	15	25
	100	100	100	100	100	25

As it is difficult to measure mathematically either the exact significance of a crop in local agriculture or the importance and suitability of certain soils for particular crops, the weightings for indexes that were set up were used only as guides. Certain modifications in the general ranking of the soils according to personal judgment have been allowed.

In addition to listing the soils in the order of their general productivity according to prevailing farming practices, productivity-grade numbers are assigned in the two columns, under "General productivity grade," according to "Current practices" and "Without amendments." These are based also on the weighted average of the crop indexes. If the weighted average falls between 90 and 100, the soil type is assigned a grade of 1; if the weighted average falls between 80 and 90, a grade of 2 is given, etc. The column, "Land classification" summarizes in simple language and compares on a national basis the principal aspects of productivity and use of each soil.

Productivity tables do not present the relative roles which soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. The tables give a character-

ization to the productivity of individual soil types. They cannot picture the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types devoted to each of the specified crops.

Economic considerations have played no part in determining the productivity indexes; therefore they cannot be interpreted into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land.

LAND USES AND AGRICULTURAL METHODS

It was recognized by the first settlers soon after they started cultivating the uplands that the soils were better adapted to grazing and the production of hay than they were to grains, fruit, and cultivated crops. Yields were moderately good for the first few years, owing to the fair supply of organic matter and to the elements returned to the soil through burnings of the timber. After the exhaustion of these constituents, the physical conditions of the soils became poor and yields fell rapidly.

Cattle raising was then undertaken, and the soils were used for pasture and the production of forage crops. With the advent of rail transportation, the raising of beef cattle gave way to the raising of dairy cattle. This change in farming practices was an adaptation of the agriculture to the soils. Even the farms in valleys, with their superior soils, followed the trend initiated on the upland farms.

The hilly soils have physical properties that are not favorable to the production of most crops. Many of them are poorly drained and have hard compact subsoils. With the use of moderate quantities of lime, however, good meadows of medium red or alsike clover and timothy can be obtained.

The well-drained upland soils, most noticeably those of the Wooster series, have good physical properties and are capable of producing good yields of the crops commonly grown, such as timothy, clover, oats, corn for silage, and buckwheat. The natural fertility level of these soils is low; therefore, they require fertilization for best results. Their response to treatment is good, owing to their friability, medium textures, and good drainage.

During the last few years the use of soil amendments, especially lime, has decreased. This is reflected in the condition of the meadows, many of which are weedy and in need of improvement. The soils are well adapted to the production of potatoes, and the acreage of this crop should increase. Potatoes occupying considerable acreages in Steuben County are produced on soils similar to those of Cattaraugus County (13).

The native pastures of the well-drained upland soils are poor. Poverty grass makes up the bulk of the sward of the untreated fields, with some redtop and sweet vernalgrass. The response to treatment is very marked, and under a planned system of improvement excellent pastures can be obtained (10).

The poorly drained and imperfectly drained upland soils produce fair yields of the common crops even though these soils are not espe-

cially adapted to the production of such crops. They are late in warming and are inclined to droughtiness later in the season. Timothy and clover, corn for silage, oats, and buckwheat represent the limit in diversification of crops. Most of the buckwheat produced in the county is grown on the soils of this group, as this crop can be planted late in the spring and requires less preparation of the seedbed than any other crop that will grow on these soils. Returns from it are not great, but it is the only possible cash crop. Buckwheat does not form a very dense cover, and erosion sometimes is rather severe in fields planted to this crop, especially if the land is sloping.

Pastures, as a rule, are somewhat more thrifty on the less well drained soils than on the better drained lighter textured soils. Even at best, however, they are not good and can be greatly improved through the use of amendments and fertilizers. With an agriculture based entirely on the production of milk, the improvement of pastures should pay big returns for the money invested.

The poorly drained soils of the valleys, with the exception of the Wayland, Holly, Atkins, and the more poorly drained parts of the Lorain soils, which are too wet for use except as pasture, have about the same crop adaptations as the wet soils of the uplands. During favorable years when the spring season is not too wet, fair success is possible with corn and oats on these soils. They are difficult to work because of heavy textures and should be plowed in the fall if possible. Pastures on these soils, especially on the Caneadea and Lorain soils, are superior to those on any except the better drained soils of the bottoms. Good stands of bentgrasses, bluegrasses, and white clover are established in a number of places. Improvement in them is possible, however, through the use of fertilization and good grazing management which would increase the proportion of white clover.

The well-drained soils of the lowlands are the best agricultural soils of the county. They not only have the advantage of a longer growing season, but, owing to their favorable textures and good drainage, are capable of producing a wider range of crops than the soils of any other group. The acreage of crops other than those commonly grown on the other soil types is low, however, mainly because the distance to adequate markets is great. Practically all of the alfalfa, vegetables, and canning crops produced are grown on soils of this group. Meadows on these soils are the best in the county, but they tend to run out rapidly unless considerable lime is used in the rotation.

Native pastures on the gravelly soils are not good. The natural fertility level of these easily leached soils is low, as their loose porous character is not conducive to a good water-holding capacity. Consequently the establishment of the more desirable pasture grasses requires the use of amendments and fertilization.

No virgin forests remain in the county. The present forest stands are second- and third-growth trees of the original species. A considerable quantity of hardwood, beech, and hard maple is harvested annually, some is sawed locally by small portable mills, some is disposed of to a basket factory at Great Valley, and some is trucked to shoe last block factories at Ellicottville and at Arcade in Wyoming

County. Besides sawlogs, large quantities of fence posts and cross ties are harvested annually. Farm wood lots furnish most of the fuel for the rural people.

The State, through its conservation department, is reforesting a considerable acreage of the abandoned land, in places where it is possible to acquire it in blocks of 500 or more acres. The trees most commonly planted are red pine, white pine, Scotch pine, white spruce, Norway spruce, and European larch.

According to the 1935 census, a total of 154,114 acres of farm wood lots, or an average of 32 acres a farm was reported. Approximately 24 acres of this average was pastured, a practice that, from the point of view of its effect on the forest, is very harmful (2). The value of forest pasture is not high, and the damage to both the young and old trees is great. Moreover, the mat of litter is destroyed and the water-holding capacity of the soil is greatly lowered. A better policy would be to improve the pasture land not forested and protect the wood lot which would give a greater return in fuel, posts, and merchantable timber.

Special provision in taxation is made for land reforested by the farmers (12), making it possible for the individual to reforest areas not suitable for crop production. Seedlings are obtained from the conservation department. Most of them are conifer species, as these grow more rapidly than the hardwoods, and, therefore, give quicker returns (14).

The common system of management on the farms in this county, and the one that seems to give the greatest returns, consists of a 5-year rotation of corn for silage, oats, and clover and timothy, the meadows remaining down for 3 years. Practically the same rotation is followed on all the farms, whether they occur on the well-drained soils of the valleys or the so-called hardpan soils of the uplands. The main differences in the management of farms on the soils of the several groups is in the quantity of lime and fertilizer applied and in the production of alfalfa on the soils adapted to this crop. Alsike clover replaces medium red clover on some of the heavier less well drained soils.

Lime, generally in the form of ground limestone, is applied in quantities sufficient to satisfy the lime requirement of the clover; and superphosphate in quantities ranging from 200 to 800 pounds an acre is applied to the land for the small-grain and corn crops. This system of fertilization seems to be all that is required in the way of commercial fertilizers on those dairy farms where an abundance of manure is available. Most of the manure is applied to the cornland, and the surplus is used to top-dress the meadows.

The use of lime, phosphate, and manure with a legume in the rotation will adequately take care of the fertilizer problem on the dairy farms, but a much greater quantity of both phosphate and lime could be used to advantage throughout the county. Many of the meadows are poor and weedy and should be improved because they produce the most important crop the dairy farmer grows. Carefully checked demonstrations on Volusia soils (4) have shown substantial increases in the acre yield of both clover and the succeeding crops of timothy after applying lime at the rate of 1 ton of finely ground limestone an acre.

Great improvement in pastures can be brought about by the moderate use of superphosphate and by both lime and phosphate on the strongly acid soils. The recommended treatment (5) consists of an initial application of 800 pounds of 16-percent superphosphate an acre which should be sufficient for 3 years. Later applications should be made at the rate of 600 pounds an acre every 3 years. The lighter-textured members of the Chenango series would, no doubt, respond to light applications of potash every 3 years. Nitrogen generally can be obtained through the use of legumes in the pasture mixture. Wild white clover is best suited to this purpose because it is a true perennial and has the ability to withstand heavy grazing.

Poor pastures may be helped by an application of manure, which furnishes considerable nitrogen, but this tends to increase the difficulty of managing the grazing areas by decreasing the palatability of the grasses.

Good management of the grazing lands plays an important part in the improvement of pastures. They should be grazed closely so as to encourage the growth and spread of wild white clover. Moreover, the palatability and nutritive value of the closely grazed pasture is greater.

Extremely poor pastures without wild white clover or other desirable pasture plants should be plowed and reseeded (5). This is especially true of pastures on the better soil types, where a greater investment per acre can be justified. The best results will be obtained from seeding in the spring on a well-prepared seedbed without the use of a nurse crop.

Experiments at Cornell University have shown good results with the following mixture for pastures: Kentucky bluegrass 9 pounds per acre, rough-stalked meadow grass 1 pound, timothy 4 pounds, perennial ryegrass 5 pounds, and wild white clover 1 pound.

Besides those cited, the following publications will be helpful in dealing with problems regarding soils and crops in Cattaraugus County:

New York State College of Agriculture (Cornell) Extension Bulletins 181, Meadow Improvement through Seeding, Fertilization, and Management, and 183, Drainage, Plowing, Seedbed Preparation, and Cultivation in New York; and New York (Cornell) Agricultural Experiment Station Bulletins 500, Legumes as a Source of Nitrogen in Crop Rotations, and 645, The Residual Effects of Some Leguminous Crops.

MORPHOLOGY AND GENESIS OF SOILS

Cattaraugus County lies principally in the region of Gray-Brown Podzolic soils of the United States, which includes the midlatitude belt from the Atlantic Ocean westward to the prairies in Indiana. The southern part, coinciding with the unglaciated area of the county, is in the part of the Podzol soil region that includes the higher portions of the Allegheny Plateau. The soils, however, do not have strongly developed Podzol profiles except in a few areas. Even though climatic conditions closely approximate those of the Podzol region of more northern latitudes, the forest cover has a somewhat higher percentage of hardwoods than that on most Podzols and is more like that of much of the Gray-Brown Podzolic soils. It is true,

however, that in general, the development of a gray leached horizon (A₂), characteristic of Podzols, is more pronounced than in the northern part of the county.

The parent materials of the soils in the southern part have accumulated from the weathering in place of the underlying rocks, which consist of interbedded shales, sandstones, and conglomerates of the Mississippian period. The parent materials of the soils in the northern part are chiefly glacial drift derived principally from local shales and sandstones of the Chemung formation, which occurs in the Upper Devonian beds. In the valleys the soils have developed from materials laid down as glacial outwash, lake-laid sediments, and recent alluvium.

There is little difference between the normal profiles of members of the Dekalb and associated series and those of the Lordstown and Wooster series of the glaciated upland areas. The glacial materials were derived mainly from local rocks that are not materially different from those that have given rise to the Dekalb and Leetonia soils. The only important exception to this is the conglomerate rocks, which are composed of quartz pebbles in a matrix of silica. Soils developed from these rocks are very coarse and highly leached.

The soils have developed in a cool humid section under a forest cover predominantly of mixed hardwoods, together with some white pine and hemlock. With an average annual precipitation between 35 and 40 inches, water moves downward continuously when the soil is not frozen and removes the more soluble constituents from the surface layers. Iron and alumina tend to accumulate in the B horizon or to be partly removed from the surface soil by percolating waters.

The surface layer, or mat of organic matter, is thin, averaging not more than 1 or 2 inches, and it is well decomposed. Little of this material has been incorporated in the mineral soil, so that the soil colors are light—in most places some shade of yellow or brown. Soils with imperfect drainage have light-gray or gray surface soils, and those with poor drainage have dark-gray surface soils, indicating slower oxidation and greater accumulation of organic matter in the surface soil.

The most strongly developed Podzol of the rough southern part of the county is Leetonia coarse sandy loam, which is characterized by a pale-gray A horizon and light texture. Drainage ranges from good to imperfect. Associated with the Leetonia soil in more extensively developed areas are the Dekalb soils, derived mainly from shales and sandstone rocks and having only an incipiently developed Podzol profile. The latter are essentially A-C soils of the Lithosol group. Poorly drained soils associated with these are included in the Ernest series, which corresponds to the Volusia series of the glaciated sections.

The Bath soils have very weakly developed Podzol profiles and probably belong to the recently recognized group of Brown-Podzolic soils (1).

The Wooster soils have profiles of the Gray-Brown Podzolic type. They are brown or yellowish brown, low in organic matter, and well drained. The Lordstown profile is similar to that of the Wooster, but the depth to bedrock is less than 3 feet.

The well-drained soils of the valleys, which occupy terrace positions, have profiles very similar to those of the Wooster soils. They

belong to the Chenango and Unadilla series and have developed from easily leached sand and gravel deposits.

Soils without normally developed profiles have been retarded in their development mainly by an excess of water. In some instances a heavy texture has had a retarding effect. Soils with profile development influenced by poor drainage are members of the Volusia, Fremont, Erie, Langford, Canfield, and Mardin series. Those with both poor drainage and heavy texture are the Hornell soils of the uplands and the Caneadea and Lorain soils of the valleys.

The soils of the bottom lands are of such recent origin that little development of a profile has taken place. In the high-bottom phases a color profile is imperfectly developed, but little if any textural or structural differences exist between the surface soil and subsoil.

Leetonia coarse sandy loam, which represents the mature, normally developed soil of the high plateau section of the southern part of the county, has the following profile, as observed at the junction of the Bradford and Red House Brook roads in Allegany State Park:

- A. 0 to 2 inches, forest litter on the surface, with black well-decomposed organic matter highly matted with fine roots below.
- A₁. 2 to 5 inches, light-gray vesicular and somewhat laminated friable coarse sandy loam.
- B₁. 5 to 9 inches, coffee-brown or dark rust-brown smooth fine sandy loam, firm in place but easily crushed when broken out.
- B₂. 9 to 20 inches, yellowish-brown coarse sandy loam that is not compact and has an irregular lumpy structure. The structural aggregates are easily crushed.
- C. 20 to 40 inches, light-yellow or yellow slightly compact sandy loam exhibiting very little structural arrangement. Bedrock occurs at a depth ranging from 30 to 48 inches.

This soil has developed mainly from broken-down white quartz conglomerates under a cover of mixed hardwoods. It differs from the Dekalb soils in having a lighter texture and a more pronounced gray leached layer. The more prevalent gray layer no doubt is due, in part, to the more readily leached coarse-textured materials.

The Wooster soils exhibit the normal profile of the soils of the Gray-Brown-Podzolic soils region throughout the northern part of the county. A profile of an excavation of Wooster gravelly silt loam, $1\frac{1}{2}$ miles northeast of Pigeon Valley School, in the town of Napoli shows the following layers:

- 1. 0 to $1\frac{1}{2}$ inches, black well-decomposed somewhat fibrous organic matter.
- 2. $1\frac{1}{2}$ to 5 inches, dark-brown friable mellow gravelly silt loam.
- 3. 5 to 15 inches, yellowish-brown firm but friable silt loam or gravelly silt loam with little structural development. The material comes out in irregular soft lumps.
- 4. 15 to 36 inches, light-yellow slightly compact stony loam or silt loam.
- 5. 36 to 48 inches, pale-yellow moderately compact stony loam, in which the compaction increases with depth.

Soils with profiles modified by an excess of moisture are much more extensive than those with normal development. The following description of a profile of Mardin silt loam, an imperfectly drained Brown-Podzolic soil, is representative of the imperfectly drained upland soils. It was observed about one-half mile south of Elgin in Lyndon Town under a forest cover of second-growth hard maple.

- 1. 0 to 1 inch, undecomposed forest litter.
- 2. 1 to 8 inches, dark-brown mellow and granular silt loam containing numerous small fragments of sandstone. In many places there is a thin gray horizon 1 or 2 inches thick directly under the forest litter.

3. 8 to 18 inches, yellowish-brown firm silt loam that has an irregular small blocky structure.
4. 18 to 22 inches, pale-yellow firm but not compact gritty silt loam mottled with brown and gray.
5. 22 to 32 inches, hard compact silt loam highly mottled with brown and gray. The material breaks into irregular vesicular lumps that have a brittle consistence. Roots penetrate only along the cleavage lines.
6. 32 to 40 inches, light-gray material that has numerous splotches of iron staining and is hard and compact but less so than the material above. It breaks into irregular lumps.

Soils of the Langford and Canfield series have profiles much like that of the Mardin soil, but they are more closely related to the Gray-Brown Podzolic soils. The reaction of the parent materials of the first differs from that of the Mardin, and the topographic position of both is lower than that of the Mardin. The Volusia, Fremont, and Erie soils are related to the Mardin soils but have the so-called hardpan or indurated layer developed within 15 inches of the surface. The Erie soils are alkaline or calcareous in the parent material, and the Volusia and Fremont soils are acid throughout. The Fremont soils are developed on the flat-topped hills and smooth slopes and are more friable in the subsoil than the Volusia soils.

A representative profile of Volusia silt loam, as observed three-fourths of a mile north of the village of Farmersville, shows the following characteristics:

1. 0 to 8 inches, light-gray heavy silt loam in a lumpy and puddled condition.
2. 8 to 12 inches, pale-yellow or yellowish-brown silt loam mottled with yellow, brown, and gray. The material is firm, moderately dense in place, and breaks into irregular easily crushed lumps.
3. 12 to 20 inches, very compact and hard highly mottled silty clay loam that has definite lines of cleavage and breaks into hard brittle lumps. No roots penetrate this layer.
4. 20 to 30 inches, hard and compact material that is less highly mottled than that in the layer above. It comes out in irregular brittle lumps with definite breakage lines. The outer surfaces of the structural aggregates are light gray and the interiors of the freshly broken aggregates are darker. This is the lower part of the indurated layer.
5. 30 to 40 inches, olive-drab compact till, less hard than the material in the layer above. No mottles are present, but iron stains are numerous.

This profile is that of the cultivated soil. In the virgin condition a thin layer of black decomposed organic matter overlies the surface layer of mineral soil, which is darker gray than the cultivated surface soil and somewhat granular. All horizons are acid.

Table 8 gives the mechanical analyses of Volusia silt loam and Erie silt loam.

TABLE 8.—Mechanical analyses of 2 soils in Cattaraugus County, N. Y.

Soil type and sample No.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	<i>Inches</i>	<i>Per-cent</i>	<i>Percent</i>	<i>Percent</i>	<i>Per-cent</i>	<i>Per-cent</i>	<i>Per-cent</i>	<i>Per-cent</i>
Volusia silt loam:								
165056	0-8	2.1	1.2	0.6	1.6	6.2	58.0	30.3
165057	8-12	3.9	3.1	1.5	3.1	21.8	55.2	11.3
165058	12-20	3.3	2.9	1.1	2.0	7.3	59.9	23.5
165059	20-30	4.0	3.3	1.3	2.3	9.3	55.9	23.9
165060	30-40	4.7	2.9	1.1	1.7	7.2	50.1	32.3
Erie silt loam:								
165061	0-6	1.3	1.9	1.7	4.5	10.7	55.0	24.9
165062	6-10	2.6	3.4	2.6	6.7	20.3	54.0	10.4
165063	10-24	4.1	3.8	2.9	6.7	9.6	48.5	24.4
165064	24-36	6.7	4.1	2.2	4.4	6.8	52.0	23.8

Throughout the Conewango Valley and along the northern border of the county are large areas of heavy-textured soils which have developed from materials laid down in still water, although some of the Mahoning soil materials give evidence of deposition by ice rather than by water. These soils, belonging to the Lorain, Mahoning, and Caneadea series, are characterized by a gray color, poor or imperfect drainage, and, for the most part, by the absence of gravel or stones.

A profile of Mahoning silt loam, observed $1\frac{1}{2}$ miles northeast of the village of Persia, has the following characteristics:

1. 0 to 6 inches, grayish-yellow or very pale yellow silt loam that is puddled and lumpy. The virgin soil has a thin layer of dark-gray coarse-granular material in the upper part of the surface soil.
2. 6 to 10 inches, light-gray firm but not compact smooth silt loam with a faintly phylliform structure.
3. 10 to 20 inches, highly mottled silty clay loam with an imperfectly developed prismatic structure. The mottles are yellow, brown, and gray.
4. 20 to 30 inches, olive-gray dense tight clay with a definitely developed blocky, prismatic structure.
5. 30 to 50 inches, light-gray dense clay containing numerous lime nodules and concretions. It has a distinct prismatic structure. Roots penetrate along the breakage surfaces.

The first and second layers are acid, the third layer neutral, and carbonate of lime is present at a depth ranging from 30 to 36 inches.

Very poorly drained valley soils without well-developed profiles are included in the Wayland and Holly series and in depressions included on the map with Lorain soils. The first-bottom soils developed from alluvium are of too recent origin to have developed distinct profiles, but segregation of iron compounds gives them a mottled appearance.

The organic deposits of muck and shallow muck are usually permanently wet and, aside from a difference in state of decomposition, do not show much development. As mapped, each includes more or less true peat.

SUMMARY

Cattaraugus County is in the southwestern part of New York. The area comprising the county consists of a maturely dissected plateau with broad flat-bottomed valleys and rolling uplands. The southern part is rough to mountainous in character and is the only part of New York that was not covered with ice during some part of the glacial period.

The climate is continental and is characterized by wide extremes between winter and summer temperatures. The rainfall is sufficient for all the crops commonly grown and is uniformly distributed throughout the year.

The agriculture has always been based on the production of live-stock and livestock products. This county is one of the most important dairy sections of the State, and the crops grown consist mainly of forage and grains, in support of this industry. The relief, geographical location with respect to markets, and soil characteristics are the factors responsible for the type of agriculture practiced.

The soils are grouped broadly into upland and lowland soils, on the basis of their topographical positions. They are divided into subgroups of soils with good, imperfect, and poor drainage.

The first group, designated as the well-drained soils of the uplands, is composed of members of the Wooster, Lordstown, Bath, Dekalb, Leetonia, and Cattaraugus series. The best soils of this group are those of the Wooster series, followed by those of the Lordstown and Bath series. Soils of the other three series are largely nonagricultural because of roughness. The most important crops grown are hay, oats, and corn for silage, in support of the dairy industry.

Poorly drained soils of the uplands are members of the Volusia, Fremont, Erie, Hornell, Aurora, Ernest, and Chippewa series. The last three are either nonagricultural or very poor agricultural soils. The others are so-called hardpan soils and are used for the production of hay, oats, buckwheat, and silage corn. Yields are much less than those obtained on the better soils of the well-drained group.

Imperfectly drained soils of the upland include soils of the Mardin, Canfield, and Langford series. They have good surface drainage, but internal drainage is impeded by the development of a compact layer at a depth ranging from 18 to 24 inches below the surface. The crops grown are the same as those grown on the poorly drained soils, but yields are consistently higher.

In the first division of soils of the lowland are the well-drained soils of the older outwash materials and lake deposits, which include the choice agricultural soils of the county. Yields are higher, and a greater diversity of crops is possible. Members of the Chenango, Unadilla, Mentor, and Otisville series comprise the group. Imperfectly drained soils of the older outwash materials are represented by Braceville silt loam. This soil is only slightly inferior to the better drained soils. Poorly drained soils of heavy till, older outwash materials, and lake deposits include soils of the Mahoning, Caneadea, Lorain, and Tyler series. They have a low productive capacity and are best suited to the production of hay and pasture, owing to their heavy textures and poor drainage.

Other soils of the lowlands are those occurring in first-bottom positions, which also are grouped on the basis of their drainage characteristics. The well-drained members are those of the Tioga, Genesee, Pope, and Chagrin series, all of which are highly fertile and are capable of producing high yields of silage corn, oats, and hay. They are also excellent pasture soils. With the exception of the high-bottom phases, however, they are all subject to periodic flooding. Middlebury silt loam is the only first-bottom soil characterized as being imperfectly drained. It is used for the same purposes as the well-drained soils, but yields are somewhat less. The subgroup of poorly drained soils includes the Holly, Wayland, and Atkins soils, all of which are inferior soils with heavy textures and extremely poor drainage. They are used mainly for pasture.

Miscellaneous soils and land types comprise alluvial soils, undifferentiated, muck, with a shallow phase, and rough stony land. Most of the areas included in these categories are nonagricultural because of poor drainage or roughness.

All the soil types are classified in table 6, according to their productive capacity for the most important crops grown in this section.

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