

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Survey
of
Licking County, Ohio

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In cooperation with the Ohio Agricultural Experiment Station

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SOIL SURVEY OF LICKING COUNTY, OHIO

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COUNTY SURVEYED

Licking County is just east of the central part of Ohio (fig. 1). Newark, the county seat, is near the center of the county and about 36 miles east of Columbus, by road. The county is approximately rectangular in shape, extending about 23 miles north and south and 30 miles east and west. The total area is 685 square miles, or 438,400 acres.

In its broad relationships, Licking County lies in two physiographic provinces. The eastern third is a part of the Allegheny Plateau, and the rest lies in the great central lowland. The line between these broad divisions may roughly be described as extending from a point just west of Jacksontown, thence northwest to a point about a mile east of Granville, and thence northward to a point a short distance west of Utica.

In the eastern part, or plateau section, the surface features are widely diversified. Deep narrow valleys, terraces, moderately undulating uplands, and rounded hills are responsible for this diversification. There are abrupt and marked differences in elevations from the level flood plains, where little change in gradient occurs for a distance of several miles, to the tops of the narrow ridges. The ridges range from 200 to 300 feet above the stream valleys. Although the imprint of ice sheets in this section of the county has not been so pronounced, it has, in general, influenced and modified many of the slopes and tops of ridges, thereby producing a rolling, hilly, and broken relief.

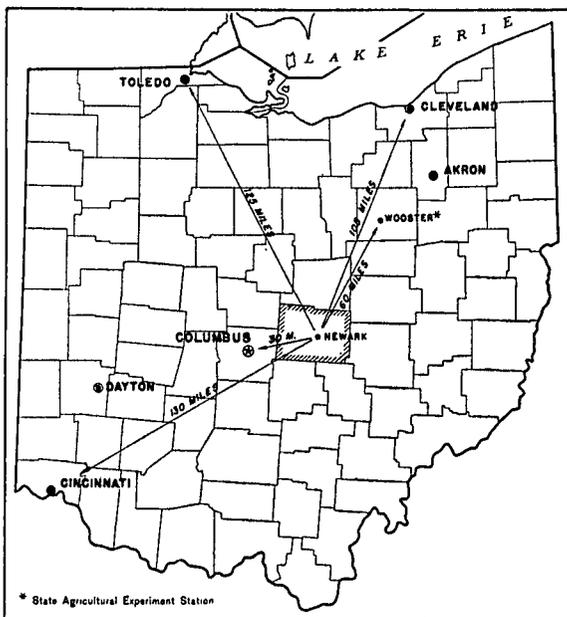


FIGURE 1.—Sketch map showing location of Licking County, Ohio.

In many places small belts of land are sufficiently steep and hilly to preclude practical attempts at cultivation. Many of the hills are rounded or elliptical, and many of them break abruptly to steep slopes. In places the valleys are bordered by small belts of high, steep bluffs. The main interstream ridges are fairly broad and extend in different directions. Some have an east-and-west trend and others a north-and-south trend. In these divides are many narrow, winding, smaller ridges whose slopes were changed to some degree by glacial action.

The appearance of the country changes toward the east side of the county. The eastern boundary marks the approximate limit of the ice sheet in this part of the plateau. A number of ridge tops and some of the adjoining steeper slopes show no marked evidence of glacial action. Arms or small lobes of the ice sheet, however, extended along the valleys and up their feeders, scouring, grinding, and depositing materials they carried or pushed ahead, until the character of the lower elevations was altered considerably from the original form.

In distinct contrast to these topographic inequalities is the relief in the western part of the county. Here the land consists of a broad plain which has been changed but slightly. It is designated a "till plain", as it is covered with weathered glacial debris known as "till." There are broad stretches of gently undulating land. Glacial erosion has so rounded and mellowed the outline of hills that the preglacial surface features have been greatly modified. In a few places, deposits were piled up in small low hills and ridges, producing an uneven, irregular surface.

Derangement or obliteration of some of the preglacial drainage courses was brought about by glaciation. A general filling of the old valleys took place, not only in the main lines of drainage but also in the tributaries. Consequently the present streams are in a new cycle of cutting and widening their valleys. The stream valleys are shallow, generally lying only a few feet below the level of the flood plains.

In the western part of the county drainage is not well established. The run-off is carried by only a few streams which have few side branches or feeders, extending back only short distances from the main valleys. In the central part are large broad interstream areas, in which no development of natural drainageways has taken place. The stream bottoms range from narrow trenches along minor branches to as much as 2 miles in width along the larger streams. The widest bottoms are in the valley of Licking River, a stream formed by the union of several forks at Newark, which flows eastward into Muskingum River. The valley floor widens considerably toward the junction point of the Licking with the Muskingum. It includes well-defined terraces lying at several levels. The original course of Licking River, together with some of its tributaries, was changed by glacial action.¹ A glacial dam at Hanover created a diversion, and the river cut a deep, narrow gorge in Black Hand Narrows.

¹ LEVERETT, F. GLACIAL FORMATIONS AND DRAINAGE FEATURES OF THE ERIE AND OHIO BASINS. U. S. Geol. Survey Monog. 41, 802 pp., illus. 1902.

There is a wide variation in the thickness of the glacial accumulations. Leverett has noted that a well at Hanover passed through 400 feet of drift. Near Appleton, a well was sunk 167 feet and did not strike rock, and near Lock a well was drilled 123 feet without reaching bedrock. At Newark, when borings were made for natural gas, a large amount of drift was penetrated, which in one place was 235 feet thick, in another 189 feet, and in still another 147 feet. On some ridge tops and slopes, outcrops of bedrock are common, and in such locations the glacial till ranges from less than 3 to more than 25 feet in thickness.

The Baltimore & Ohio Railroad Station at Newark is 819 feet above sea level. Ridges in the eastern part of the county have an altitude of more than 1,100 feet. One of the highest points is about 5 miles west of Johnstown where the recorded elevation is 1,360 feet. Many elevations in the western half of the county range between 1,100 and 1,200 feet. In the southwestern section, elevations range from 950 to 1,050 feet. Here changes in elevation are more gradual and not so frequent or abrupt as in the eastern half.

The original forest included such deciduous hardwoods as maple, beech, hickory, basswood, white oak, chestnut, ash, and elm, as the principal trees, and ironwood, dogwood, sycamore, butternut, wild cherry, hemlock, and pine, as the less important ones. Poverty grass, broomsedge, reedtop, bluegrass, mosses, weeds, briars, numerous shrubs, and herbaceous plants establish themselves as the timber growth is removed or as the land is withdrawn from cultivation.

Licking County was created from a part of Fairfield County March 1, 1808. The first settlement in this section, attempted soon after the Wayne Treaty of 1795, was made about 5 miles below Newark on Licking River. A mixed population, coming in from Pennsylvania, New Jersey, Virginia, the New England States, Wales, and Germany, soon scattered over the country.

Extending across the entire length of the southern part of the county is a narrow strip of territory which is included in the area known as the "Refugee Tract." During the Revolutionary War a number of people from British provinces, who sympathized strongly with the cause of the American Colonies, were forced finally to abandon their homes and property. Some sought refuge in the colonies and even entered the Continental Army. Afterward a number became permanent citizens of the United States. To reward these people for their loyalty, Congress set aside 100,000 acres of land extending through parts of Licking, Perry, and Fairfield Counties. The area in Licking County was divided into tracts ranging from 160 to 2,240 acres in size and distributed among the people. The old National Road, now United States Highway No. 40, extends for a distance of about 48 miles within the Refugee Tract.

Of historic interest is Flint Ridge in Hopewell Township, about 3 miles north of the National Road. This ridge was a source of supply for arrowheads and other flint implements used by the Indians. These artifacts, from the large workshops established on the ridge, had a wide distribution throughout the country.

A number of prehistoric earthworks are scattered throughout the county, the largest in the vicinity of Newark. They are among the most interesting and diversified in the State and attract considerable attention and interest from tourists.

The Ohio State Canal, now abandoned, at one time traversed the county and passed through a large swamp in the southern part. It was built in the valley of Licking River and its South Fork. A dike was constructed around the western end and a part of the northern side of the swamp in 1838. This caused a rise of the water and the formation of Buckeye Lake, which acted as a reservoir for the canal.

In 1930 the total population of the county was 59,962, of which 49 percent was classed as rural. The density of the rural population was 43.9 persons a square mile. A large part of the so-called rural population is located in the towns and trading centers. The more important towns and villages, aside from Newark, are Utica, Hartford, Hanover, Kirkersville, Johnstown, Pataskala, Hebron, Toboso, Brownsville, St. Louisville, Perryton, Linnville, Alexandria, and Granville. Granville is the site of Dennison University. The western part of the county maintains the largest population. The valleys and areas along the main roads are the most thickly populated sections of the eastern part. In this part a number of farms have been abandoned during recent years. Newark, the county seat, is located at the junction of the three branches forming Licking River. The city was platted in 1801 after the plan of Newark, N. J. It supports many manufacturing establishments and railroad shops. In 1930 the population of this city was 30,596.

An oil field has been established in the eastern part of the county. Gas wells occur in this and other sections. A number of farmers have gas for light and fuel from wells on their farms.

Transportation facilities are exceptionally good. Main lines of the Baltimore & Ohio and the Pennsylvania Railroad systems traverse the county, affording frequent fast freight and passenger service. The Toledo, Bucyrus, and Thurston branch of the New York Central Railroad, although used primarily as a coal-carrying road, furnishes transportation to a number of small communities located along the line.

Paved highways connect all the towns, and many good graveled roads connect farming areas situated away from centers of travel, with the main roads. A large mileage of good roads has been constructed in the western part of the county. A large proportion of the rural roads in the eastern part consist of graded dirt roads, with only short stretches covered with crushed local stone or gravel. When dry, most of these roads are smooth and suitable for automobile travel. Much of the farm produce sold is transported to market by auto truck. Because of its proximity to Columbus and short distance from Cincinnati, Cleveland, Pittsburgh, and other large cities, Licking County has good markets for all farm products.

CLIMATE

The climate is favorable to the general agricultural practices followed. It is characterized by fairly cold winters, mild pleasant summers, moderate precipitation, an average annual snowfall of 30 inches, low wind movement, low evaporation, 54 percent of possible sunshine, and moderately high humidity.

The principal climatic influences affecting crop growth are precipitation, temperature, and sunshine. In this section, precipitation is rather evenly distributed throughout the year and is sufficient for the

normal growth of crops. Although there may be rather wide annual and seasonal variations and marked differences in the moisture content of soils under the same amount of precipitation, total failures of crops are seldom caused by deficiency of moisture. Snowfall may be depended on to furnish some protection to fall-sown grain, but, as the cover may not be continuous, damages from freezes are to be expected. Hailstorms sometimes occur during the summer, but they seldom cause much damage to crops. The prevailing winds are from the southwest. As they rarely attain high velocity, there is little danger to crops from this source.

There are no very marked variations in climate within this county. The average winter temperature, however, may be several degrees colder at the higher elevations than in the stream valleys. Local differences in the susceptibility of crops to frosts are observed, and there may be some differences in orchards, depending on the situation and direction of slope.

Table 1, compiled from the records of the United States Weather Bureau station at Granville, located near the center of the county, gives the more important climatic data.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Granville, Licking County, Ohio

[Elevation, 960 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1856)	Total amount for the wettest year (1855)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December.....	30.8	68	-22	3.15	2.94	5.04	6.3
January.....	27.7	73	-23	3.27	1.39	2.77	10.7
February.....	28.9	67	-25	2.80	1.50	1.90	6.8
Winter.....	29.1	73	-25	9.22	5.83	9.71	23.8
March.....	39.3	84	-3	3.62	.71	5.50	3.8
April.....	49.8	90	17	3.15	1.65	2.55	1.4
May.....	60.3	97	26	3.73	3.25	3.22	(¹)
Spring.....	49.8	97	-3	10.50	5.61	11.27	5.2
June.....	69.1	99	32	4.02	5.40	7.84	0
July.....	73.3	105	40	3.88	2.23	7.67	0
August.....	71.2	104	40	3.31	3.12	3.15	0
Summer.....	71.2	105	32	11.21	10.75	18.66	0
September.....	65.3	98	27	2.91	.45	6.64	0
October.....	53.1	90	15	2.63	.50	1.70	(¹)
November.....	40.7	77	9	3.06	2.49	6.90	1.0
Fall.....	53.0	98	9	8.60	3.44	15.24	1.0
Year.....	50.8	105	-25	39.53	25.63	54.88	30.0

¹ Trace.

Crops seldom are damaged seriously by killing frosts, but sometimes considerable damage occurs in low and wet situations. Hay and grain may begin and continue growth before and after the dates of killing frosts. Heavy spring rains and the poor drainage of some soils sometimes delay the starting of a rapid growth of corn after planting. The average dates of the last and first killing

frosts are April 30 and October 11, respectively, giving an average frost-free season of 164 days.

AGRICULTURE

Since the earliest settlement in Licking County, agriculture has consisted of general farming. Of necessity, pioneer farmers produced the crops required for domestic use and home consumption, and to a great extent they were self-sufficing people. Settlement continued at a steady rate, and a rapid increase in the acreage of land placed under cultivation took place until about 1880. From that time until recently there has been little change in the rural population, but the urban population, centered in Newark, has increased rapidly. Changed economic conditions and the expansion of nearby industrial and commercial enterprises have been responsible for the abandonment of some farms, and a slight decrease in acreage of cultivated land between 1920 and 1930 resulted.

During the early period of farming, corn, hay, small grains, and potatoes were the important staple crops, and cattle, sheep, and hogs were raised.

The most important crops, based on acreage, indicated by census figures since 1879, have been corn, oats, wheat, and hay. The relative importance of these crops has undergone little change. Live-stock production plays an important role in the agriculture. Dairying, particularly, constitutes a large part of the farm enterprise and has expanded to a place of importance.

Agriculture, throughout most sections, continues to be of the general type. It is modified to some degree in the eastern side of the county, where the production of hay and the raising of sheep are important. On small farms a specialized type of farming is carried on. This includes the production of truck, fruit, poultry, and flowers.

During the last few years there has been a gradual trend toward decreasing the area of land put into general crop production. Some of the uncultivated land is allowed to revert to pasture, thereby increasing the large area already utilized for that purpose. Some fields formerly cultivated are allowed to remain idle or are neglected and grow up in weeds. As a consequence of lessened agricultural activity, the acreage of pasture land in 1930 exceeded the total crop land. The proportion of pasture land is greater in the hilly section than elsewhere.

Table 2 gives comparative data indicating the distribution of land as reported by the census.

TABLE 2.—*Classes of land, according to use, in Licking County, Ohio, in stated years*

Classes	Acreage			Classes	Acreage		
	1924	1929	1934		1924	1929	1934
Crop land, total.....	182, 163	170, 959	179, 590	Pasture land, total.....	179, 207	182, 444	193, 693
Harvested.....	174, 248	150, 576	167, 932	Plowable.....	120, 889	106, 329	123, 576
Crop failure.....	3, 133	1, 937	3, 315	Woodland.....	24, 530	23, 155	27, 653
Idle.....	4, 782	18, 446	8, 343	Other.....	33, 878	49, 960	42, 464
				Woodland not in pasture.	15, 630	13, 699	15, 930
				All other land.....	19, 550	19, 792	18, 120

Table 3, compiled from United States census reports, shows the acreage devoted to the principal crops in stated years.

TABLE 3.—*Acreage devoted to the principal crops in Licking County, Ohio, in stated years*

Crop	1899	1909	1919	1924	1929	1934
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Corn.....	60,886	60,708	56,691	40,280	44,287	50,467
Oats.....	10,492	11,836	9,568	10,823	12,773	5,746
Wheat.....	50,282	29,471	58,570	28,580	24,529	36,205
Rye.....	414	3,146	2,012	544	933	1,296
Hay.....	58,937	70,517	63,421	76,673	53,145	1 61,336
Timothy.....	.....	44,381	41,900	33,102	.....	.....
Timothy and clover.....	.....	23,475	18,577	37,918	44,417	.....
Alfalfa.....	.....	169	766	565	836	.....
Potatoes.....	1,698	2,555	1,283	884	1,167	1,624

¹ Includes other forage.

Table 4 gives the number and value of domestic animals on the farms and ranges in 1900, 1910, 1920, 1925, 1930, and 1935.

TABLE 4.—*Number and value of the principal domestic animals in Licking County, Ohio, in census years*

Year	Cattle		Horses		Sheep		Swine		Mules	
	<i>Number</i>	<i>Value</i>	Number	Value	Number	Value	Number	Value	Number	Value
1900.....	36,413	.....	14,692	.....	133,978	.....	62,286	.....	157	.....
1910.....	32,511	\$879,684	14,771	\$1,494,691	156,613	\$532,741	46,178	\$288,935	238	\$27,530
1920.....	35,931	2,003,994	12,793	1,123,820	94,515	755,293	43,481	652,431	282	32,119
1925.....	36,377	1,609,764	10,169	775,663	90,350	937,223	33,896	326,483	320	27,658
1930.....	36,386	2,011,947	7,906	805,797	90,155	503,952	36,787	373,163	319	31,656
1935.....	42,695	.....	8,156	.....	99,491	.....	30,366	.....	395	.....

According to Federal census figures for 1935, the number of farms increased from 4,027 in 1930 to 4,453 in 1935, and during the same period the average size decreased from 96.1 acres to 91.5 acres. The percentage of farms operated by owners in 1935 was 73.8 percent; by managers, 0.7 percent; and by tenants, 25.5 percent.

The largest acreage of crop land is devoted to hay and forage crops, the area in hay constituting about 19 percent of the total acreage of land available for crops. The average acre yield of hay is a small fraction higher than 1 ton. Hay crops consist principally of timothy and clover either grown separately or mixed. Alfalfa comprises a small total acreage, but where it has become established, yields average a little more than 2 tons an acre. Coarse forage, consisting mainly of corn, is grown extensively, and small grains are sometimes cut green for hay. Many areas of hill-land pasture in the eastern part of the county are covered with poverty grass, broom-sedge, and weeds, which afford poor pasturage or hay. Sweetclover has been sown on a small acreage in recent years and, where used on adapted soils or where accompanied by proper lime applications, has given satisfactory results.

Corn is grown on a larger area than any other cereal crop and occupies about 15 percent of the land available for crops. The largest acreage is in the western half of the county. Average corn yields

differ in different townships, depending on the character of the predominant soils. Some soils, especially certain types in bottom lands, produce yields ranging from 70 to 100 bushels an acre. A part of the crop is cut for silage, and in 1929 corn was cut from 5,020 acres for this purpose.

The acreage in wheat varies from year to year, depending largely on prevailing economic conditions. It is an important crop in the scheme of farm operations. The average yield shows annual fluctuation.

The acreage devoted to oats showed comparatively little change over a period of 50 years, but the 1934 acreage was only 5,746 acres. The average yield is around 25 bushels an acre, but seasonal and soil conditions lower or raise this average.

Rye is a minor cereal crop, and it is grown only on a small acreage on certain farms. Its average acre yield is about 12 bushels. Barley is grown on 1- or 2-acre fields by some farmers. Buckwheat is given very little consideration, and only small patches, most of them less than an acre in size, are used for this crop.

Potatoes are grown on a commercial scale by only a few farmers. A few acres are planted to this crop on most farms, with an annual average acre-yield of about 90 bushels. Vegetables, including onions, cabbage, peas, beans, tomatoes, sweet corn, asparagus, and some others, are grown on a small total acreage. Most of the onions and cabbage are grown intensively near Kirkersville. Small patches of strawberries, raspberries, and blackberries are grown in all parts of the county, principally for home consumption, and the excess is sold in nearby markets or trading centers.

Other important agricultural products are orchard fruits, dairy products, poultry products, and livestock. The agricultural income of the county is derived largely from these sources, supplemented to a slight extent by the sale of hay and grain.

A number of commercial fruit orchards are established throughout the county. The most important orchard fruit is apples. Peaches, plums, pears, and cherries are grown in a small way with fair success. A few fruit trees are planted around many farmsteads, but where little care or attention is given them, diseases have killed or injured many of them. Sugar maples, for the production of maple sugar and sirup, are scattered throughout the county.

Dairying is carried on, in connection with other farm operations, on nearly every farm. It is not engaged in generally as a specialty, but the sale of dairy products has increased steadily for a number of years, and on many farms these products form a very important source of the farmer's income. In 1919, the value of dairy products, excluding those for home use, amounted to \$1,490,093; in 1924, to \$1,282,222; and in 1929, to \$1,614,137. The size of dairy herds varies. About 5 dairy cows is the average number on the small farms, and on some of the larger farms the herds range from 25 to 40 in number. The dairy herds are composed chiefly of both grade and purebred Jerseys and Holstein-Friesians. Milk and cream are shipped to collecting centers, chiefly by autotruck. A large proportion of the milk is marketed in Columbus.

According to the census figures for 1935, Licking County ranks first among Ohio counties in numbers of cattle and sheep. Beef cattle are

raised or are purchased for winter feeding on many farms, and a large number of hogs are raised and fattened annually. Sheep raising is important, and large flocks are kept, especially in the eastern or more hilly section of the county. The sale of poultry and eggs, although considered a side line, furnishes a considerable part of the annual farm income. On a few small farms the farmers specialize in poultry raising, chiefly for the production of eggs.

Commercial fertilizers of high-grade or concentrated formulas have come into wide use. In 1929, 2,399 farms reported the purchase of fertilizer and lime at an expenditure of \$199,567, or \$83.18 a farm. This was an increase of 35 percent over that spent in 1924. In general, the larger applications are made on soils in the uplands. Barnyard manure, so far as it is available, is used to maintain soil productivity, but it is supplemented by the commercial product. Complete fertilizers as well as single ingredients are used. The most popular formulas are 2-12-2 or 2-12-6.² Other combinations also are used, which run high in percentage of phosphate and low in potash and nitrogen. Most of the nitrogen additions are made through the growth of leguminous crops. The use of lime has been limited in the past, but it is coming into more general favor. The most common forms are ground limestone or hydrated lime.

Labor presents a serious problem to a large number of farmers, and the amount and kind available frequently influence the extent of farm operations. Owing to high wages and other inducements presented in large industrial centers, good farm help is scarce. Many farmers of necessity have added tractors to their horsepower and have overcome their labor difficulties with modern up-to-date labor-saving farm machinery. Farm labor, where available, is white and native born. In 1929 there was an expenditure of \$416,306 for labor on 1,639 farms, an average of \$254 a farm.

The greater number of farms range in size between about 50 and 174 acres. The usual form of rental is on a cash basis. Another method is for the tenant to pay rent for the farmhouse, furnish the livestock, and pay for one-half of the fertilizer, in return for which he receives one-half of the crops. In some cases, the owner furnishes one-half of the seed, in addition to the land, and receives one-half of the crops.

The value of farm lands varies in different parts of the county and from time to time, but farms in the western part in general rank higher in value than those in the hilly sections. The 1930 census estimated the average value of all farm property per farm at \$6,962 and the average land value (including buildings) at \$72.46 an acre, but in 1935 these figures had decreased to \$4,561 and \$50.85, respectively.

Buying, selling, and other types of cooperative organizations for handling the many branches of the farmers' business have been established throughout the county. Elevator companies have been organized for the purchase of grain, hay, and wool, and these companies also furnish such supplies as feed, coal, fertilizer, lime, and fencing. Collective buying of supplies and selling of farm commodities is carried on by some farm organizations, such as the grange and the farm bureau. Threshing groups, equipped with machines, move

² Percentages, respectively, of nitrogen, phosphoric acid, and potash.

from farm to farm in harvesting time to thresh wheat and oats. Silo filling is handled in a similar manner. These methods of handling various crops utilize time and labor, and they operate to a better advantage than if undertaken by individual farmers.

SOILS AND CROPS*

Farming in Licking County is neither extremely intensive nor extensive. The farmer depends on average results, and much the same methods are followed with the same types of crops year after year. Corn, wheat, oats, and hay—the principal crops—are grown at present on a large number of soils with only slight regard to their adaptation. An examination of the soil map shows a large number of soil types. They occur in a number of small belts in which one type may predominate, but each type contains inclusions of a number of other kinds of soils. In some sections, particularly the southwestern part, the association of soils forms a very complicated pattern. Although certain soils dominate this section, the included soils reflect their influence on agricultural practices and the results obtained.

A large number of farms in those areas where agriculture is actively followed are made up of a number of different kinds of soils. Yet to a large degree and regardless of the character of the soils, essentially the same system of farming is established on them and the same kinds of crops cultivated. Results on the different kinds of soils vary considerably, owing, not only to the response of the soil to the crop, but also to its management.

In view of the complexity of soil conditions, which is general throughout the county, and the different results obtained on the different soils, the question occurs, "Why do the same practices and systems of farming prevail?" It will be interesting to note the position Licking County occupies agriculturally as regards the systems of farming prevailing within the State as a whole and to note what bearing or influence these systems may have on farm practices in this county.

The county lies along the eastern edge of the Corn Belt in Ohio. In this section the soils on which corn produces the best yields are those that have a high humus and moderately high lime content. Such soils, however, do not occur everywhere in the States where the production of corn is concentrated, but the success obtained in the productive belt or section of high-average yield will exercise an influence in extending the acreage to other soils.

The area best suited to corn is confined to the western part of the county, and production diminishes toward the east. Corn forms not a dominant but a very important part of the farming system in the well-developed agricultural sections. Few areas approach the character of the dark-colored soils, where production of corn runs high, although there are some sections in which the inherent re-

*In a number of places along the Licking-Muskingum County line, Huntington silt loam in Muskingum County adjoins Chagrin silt loam, Pope silt loam, and other soils of the stream bottoms in Licking County. These discrepancies are due to the fact that, since publication of the Muskingum County soil survey report, the Huntington series has been redefined and the name restricted to material derived chiefly from limestone residuum, which definition eliminates it from this part of Ohio. Similarly, a few other very minor differences appear along the county line, due to further refinement of soil definition and mapping.

quirements of the plants are satisfied. The dark-colored soils in parts of Hartford, Monroe, Harrison, and Lima Townships, and some of the rich bottom soils in the flood plains supply the elements conducive toward maximum yields. Corn is an important crop in places where it can be grown. Its acreage is widespread throughout the western part but the heaviest yield is confined to a few townships. Many soils used for corn must be fertilized and made fit for the plant.

Instead of feeding corn to hogs, as is the main method of utilizing the grain in the Corn Belt proper, it is fed to both hogs and dairy cattle. As dairying is an important source of the farm income, some of the corn is made into silage for cows.

Wheat also is an important cereal crop. Throughout the State it is a crop used primarily for local consumption and does not enter seriously into competition for outside markets. Acre yields are heaviest in the northern part of the State, and the average yield runs a little lower in this county. It is interesting to note that the crop is centered in the same general part of the county as corn. This is because the farmers have discovered that it does not pay to grow corn continuously, and wheat conveniently serves as a nurse crop for hay in the crop rotation. The acreage devoted to wheat differs from year to year, owing to such influences as unfavorable weather conditions, disease, and selling price. Some soils have physical properties suitable for the production of wheat, but they require fertilization for best results; others require thorough drainage before they can be made suitable for this crop.

The oat belt of Ohio, as regards production, is in the northern half of the State. Licking County is marginal to this section. The oat crop requires a cool climate accompanied by high moisture, and this environment is approached in this county. Oats enter well, also, into the crop rotation, and farmers have been using varieties that have proved suitable to existing local conditions. Oats thrive on moderately fertile soils, such as occur in this county, but the crop needs to be fertilized for the best results on many soils.

Hay crops are grown in all sections, and production is largest in the cereal belt. Such grasses as timothy have a widespread distribution and comprise the greater part of the hay crop in the hilly section. Some of the grasslands which have been neglected, either because of relatively inferior soil fertility or for economic reasons, produce low yields, and they require fertilization before higher yields can be produced. Many fields are reverting to briars, vines, and a shrubby growth of plants. Poverty grass and broomsedge have established themselves in a number of fields which produce a low quality of hay. Because of their fertility, a large number of well-drained and imperfectly drained soils are suitable for the production of good yields of hay.

Leguminous hay is grown mainly in places where the soils are still influenced by the weathering of limestone material. This hay is usually grown mixed with timothy. It does best on soils which have a neutral or alkaline reaction. Where the land is adequately drained it forms a medium in which nitrogen-fixing bacteria function normally and naturally. Many soils that are acid require the use of lime for red clover and alfalfa. There is a marked correla-

tion between the reaction of the soil and the production of clover which returns higher yields on less acid soils or those which have been limed. Some clovers grow on moist lands and do well where the soils are properly managed.

A general correlation exists between the soils devoted to the main crops and their yields and the peculiarities that distinguish the various soil groups. In discussing this relation and the several soil belts, it will be well to mention certain geological occurrences that had much to do with the physical and chemical character of the soils. The greater part of the county, in common with a vast area of the continent, was invaded in past ages by ice sheets, or glaciers, of immense extent and thickness, which modified the surface of the ground over which the ice passed. The moving ice collected, ground, and assorted soil material and rock fragments from one place and deposited them in new localities. Several different ice sheets entered Licking County. The last sheet left material that was carried only short distances, and much of the glacial debris includes only a few kinds of rocks common to the rock formations occurring in this and adjoining counties to the northwest and north, the direction from which the ice sheets came. More than 90 percent of the boulders, cobbles, or gravel produced by glacial action consist of a variety of sandstones and shales, with a little admixture of limestone and crystalline rock.

The eastern county line represents, in a general way, the limits of glacial action. Many of the higher ridges in the eastern part of the county were untouched, but projections of the ice moved up many of the drainageways and small creek valleys.

Biological, chemical, and physical forces acted on the glacial material, as well as on the rocks underlying those sections unaltered by the ice, with the consequence that the soils now covering the county were produced. These soils were developed under a dense forest cover that established itself on the retreat of the ice, and as a result most of the soils are light colored. There were no large grass-covered areas to favor the accumulation of large quantities of organic matter, but small local belts in wet situations supported such vegetation. These probably were in grass for only a brief time and eventually were covered with a tree growth.

Drainage conditions play an important part in the development of soil characteristics. In many smooth areas slight differences in elevation show marked changes in the moisture content and character of the soil. Nearer the stream valleys, where drainage becomes more thorough or excessive moisture less, so that leaching and oxidation of the soil material is not greatly impeded by ground water, a noticeable change may be noticed in the characteristics of the soil. This is particularly true of the soils in the western part of the county. In a generalized arrangement the soil belts bordering valleys are more thoroughly drained and have developed to greater depths than those occupying the broad interior stream divides.

There has been no uniform leaching of soluble matter, such as lime, from the soil. In the eastern part of the county the soils are derived mainly from the weathered products of acid sandstones and shales and therefore are naturally acid. In glaciated areas some influence has been impressed on the soils from limestone material.

In the better drained soils, where leaching has been most active, lime that originally existed in the upper layers has been removed to various depths, whereas in soils which developed under high soil moisture the part of the soil in which lime exists is much closer to the surface.

To better understand the character of the many kinds of soils in the county and their relationship to crop production it is best to arrange them into a number of groups having features in common. In a broad sense, there are two large soil divisions based on the origin and kind of material from which the soils have been formed. Briefly, this grouping consists of soils developed from glacial drift and soils developed from the weathered products of hard rocks. The inherent fertility and ability of the soils to stand up under normal cropping practices differ in each group. The separation classes the soils in the two general agricultural belts that prevail within the county.

In the one division the soils have developed from glacial debris. The glaciers not only picked up different kinds of weathered material but also dug into and ground up the various formations of bedrock, resulting in a heterogeneous mass which reflects to a certain degree the character of the rocks over which the glaciers passed. One distinctive feature of many of the soils developed from glacial debris is the presence of calcareous material. This has impressed its influence on some soils to a significant extent and improved their value for such crops as clover. Though the lime content is not high, it is sufficient for many crops that thrive better in such an environment. The surface soils range in texture from loamy sand to moderately heavy silt loam and silty clay loam. Most of the soils, however, are silt loams. In many soils, drainage is naturally good, as the water table is not high and the slope is sufficient to provide for free run-off. In some localities the soils are characterized by a high moisture content, and in order to become entirely suitable for agriculture they must be artificially drained. The fertility and productivity are about medium and, as a whole, of better grade than of the soils derived from sandstone and shale materials.

The soils developed from weathered shale and sandstone rocks do not contain carbonates of lime and are acid to great depths. Another distinction from the soils developed from glacial till is their comparative shallowness over the underlying rock formation. Most of these soils require more fertilizer for the same results with crops than those derived from glacial till, developed under the same conditions.

Subgroupings are made in each division, based on a number of soil factors, the most important of which are size and arrangement of soil particles, color, relative order of soil layers, lay of the land, drainage conditions, and chemical peculiarities. They are separated further into soil types on the basis of texture of the upper soil layers. This is the unit of soil mapping. All areas of soil having the same essential features and properties are included in the same soil type.

In the following pages the soils of Licking County are arranged in various groups, and their relation to the present systems of agriculture is discussed; their location is shown 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 Licking County, Ohio*

Type of soil	Acres	Per- cent	Type of soil	Acres	Per- cent
Alexandria silt loam.....	51,392	11.7	Chenango loam.....	2,752	0.6
Alexandria silt loam, steep phase.....	1,600	.4	Chenango gravelly loam.....	1,920	.4
Fallsburg silt loam.....	7,872	1.8	Chenango fine sandy loam.....	384	.1
Fallsburg silt loam, steep phase.....	192	.1	Mentor silt loam.....	3,904	.9
Wooster silt loam.....	20,288	4.6	Chenango silt loam, mottled-sub- soil phase.....	1,728	.4
Hanover silt loam.....	6,080	1.4	Glenford silt loam.....	1,280	.3
Otisville gravelly loam.....	1,280	.3	Braceville silt loam.....	2,240	.5
Lordstown silt loam.....	1,856	.4	Tyler silt loam.....	1,408	.3
Lordstown silt loam, steep phase.....	10,816	2.5	Atherton silt loam.....	1,728	.4
Lordstown stony silt loam.....	8,832	2.0	Blago silty clay loam.....	1,920	.4
Zanesville silt loam.....	2,816	.6	Lobdell silt loam, dark-colored phase.....	832	.2
Muskingum silt loam, colluvial phase.....	16,192	3.7	Chagrin silt loam.....	8,768	2.0
Cardington silt loam.....	43,584	9.9	Chagrin fine sandy loam.....	5,760	1.3
Canfield silt loam.....	3,136	.7	Pope silt loam.....	256	.1
Hanover silt loam, heavy-subsoil phase.....	832	.2	Pope loam.....	832	.2
Marengo silty clay loam.....	41,088	9.4	Lobdell silt loam.....	11,328	2.6
Bennington silt loam.....	57,536	13.1	Killbuck silt loam.....	1,600	.4
Condit silt loam.....	3,008	.7	Luray silty clay loam.....	320	.1
Muskingum silt loam.....	35,136	8.0	Philo silt loam.....	2,688	.6
Muskingum silt loam, smooth phase.....	448	.1	Philo fine sandy loam.....	192	.1
Muskingum silt loam, steep phase.....	23,488	5.3	Atkins silt loam.....	1,600	.4
Muskingum loam.....	3,136	.7	Holly silt loam.....	3,968	.9
Muskingum loam, steep phase.....	640	.1	Papakating silt loam.....	5,760	1.3
Effort silt loam.....	5,056	1.1	Walkkill silty clay loam.....	384	.1
Barden silt loam.....	768	.2	Lake marsh.....	64	.1
Frankstown gravelly silt loam.....	1,088	.2	Riverwash.....	448	.1
Chenango silt loam.....	16,640	3.8	Muck.....	448	.1
Chenango silt loam, deep phase.....	8,592	1.5	Gravel pits.....	64	.1
Chenango silt loam, gravelly phase.....	2,432	.5	Total.....	438,400	-----

WELL-DRAINED LIGHT-COLORED SOILS OF THE UPLANDS

This is one of the most extensive groups of soils and includes soils of the Alexandria, Wooster, Hanover, Otisville, Zanesville, Fallsburg, and Lordstown series, and a colluvial phase of Muskingum silt loam. The soils of this group have certain common features. They are light in color, well drained, friable, occupy similar topographic positions, and are much alike in the arrangement of the several layers that comprise the soil. The surface soils are light grayish-brown light-textured material, generally of silty texture; the subsoils are brown or yellow, friable, and somewhat heavier than the surface layers. The substratum, or the basal layer, differs in certain characteristics in the several soils but for the most part consists of moderately light textured mixed materials, from which the soils have been produced. Rock fragments of different sizes and quantities form a part of the soil mass. They improve the physical condition of the soils but are not present in sufficient quantities to hinder tillage operations. Scattered over these soils are many wood lots, in which the timber is an association of beech and hard maple, with some white oak, chestnut, and tuliptree (yellow poplar).

The relief of the soils of this group is generally much the same, although there are some local differences. For the most part the land is smooth, undulating, or moderately rolling, and over most of it farming operations can be conducted easily with mechanized implements. The soils are sufficiently friable for root penetration and sufficiently porous to afford good drainage and aeration, but

they are also sufficiently retentive of moisture to supply normal demands for crop development. The free movement of water through the soils for long periods has tended to leach the upper soil layers of much of their soluble plant nutrients and carried them away or redeposited them at some distance below the surface. Consequently, these soils are not of high fertility, and they require fertilizers, manure, and good management to maintain profitable yields. Special treatments are required at times, such as liming for the purpose of obtaining good stands of clover and alfalfa.

Tests for determining the relative acidity of these soils indicate that there are some definite differences in them. They are all acid or moderately acid in their topsoils and upper subsoil layers. The substrata of some, however, contain lime near the top of these layers, but in others lime has been leached out to considerable depths and beyond the reach of plant roots or it does not occur at all.

With the exception of Alexandria silt loam, these soils do not occur in large continuous belts. In fact, some of them are not extensive and by themselves do not have an important part in the crop production of the county. In many places the soils occur as small areas or patches in complicated association with soils of other groups. As a result many farms are not uniform in soil characteristics but are composed of a number of different kinds of soils, a condition which may cause difficult problems for their satisfactory management.

Alexandria silt loam.—The topsoil of Alexandria silt loam, to about plow depth, is grayish-brown or brownish-gray mellow silt loam that has been influenced by mixing with crop residues or manure. It is underlain by yellowish-brown somewhat heavier silt loam that grades, at a depth ranging from about 15 to 20 inches, into yellowish-brown or deep brownish-yellow silty clay loam. This layer is much heavier in texture than the topsoil, but it is friable, well aerated, and easily penetrated by plant roots. The substratum, which lies at a depth ranging from about 24 to 30 inches, is light-brown friable gritty silty clay loam or silt loam, containing many small fragments of sandstone and shale (many of which are in process of decay) and, in places, a few limestone fragments. This soil, to a depth of about 25 inches, is acid, and beneath this it is neutral or alkaline in reaction. In fact some of the gray streaks in the substratum are limy.

In general characteristics this soil is rather uniform, but some differences occur in places. One variation, which is noticeable here and there in the Alexandria soil belt, is the development of a deeper color than typical. The texture is the same, but the topsoil is browner and the subsoil is rich brown or brown with a red hue, which is particularly evident when the soil is moist. In addition, the subsoil is slightly less permeable and offers a little more resistance to the penetration of roots and the movement of soil moisture. These differences are more evident along breaks of valleys, where drainage is well established and oxidation has probably been more active. The agricultural value of the land is about the same as that of the typical soil.

In some cultivated fields are eroded sloping lands, from which the surface soil has been washed away and small patches of the underlying "clay" exposed. The relief is knolly or ridgy and is

marked by fairly long narrow depressions, many of which range from only 15 to 20 feet in width. Wash from surrounding slopes has been deposited in these places, and the soil in many areas that are of slight gradient and have restricted movement of soil moisture resemble the Marengo and Cardington soils. These narrow strips are included with the typical soil. The soil differences, however, have an influence on crop yields, and in places where a large amount of soil material has been deposited, yields are in general higher than in other parts of the field, provided seasonal conditions have been favorable.

Practically all of Alexandria silt loam has been developed in a belt of land occupying parts of Washington, Burlington, McKean, and Liberty Townships. Several small areas occur along South Fork Licking River and Raccoon Creek. With the exception of about 3 percent in wood lots, Alexandria silt loam has been cleared for farming. In general, about three-fifths of the cleared area is kept in hay and pasture and the rest is used for corn, oats, and wheat. Corn and wheat occupy the largest acreage of the grain crops. The area in wheat and oats, especially in wheat, fluctuates from time to time, depending on the preceding season's yield and price of the grain.

On the average farm, from 30 to 35 acres are in hay or pasture. The hay consists of timothy and clover, generally mixed. Much red clover and alsike are sown with the timothy. Yields of hay range from 1 to 1½ tons an acre, corn from 60 to 85 bushels, wheat 10 to 30 bushels, and oats 40 to 70 bushels. Some potatoes are grown with yields ranging up to 175 bushels. Dairy cows, a few hogs, chickens, and from two to four horses are kept on most farms.

About 60 loads of manure and rotted straw are usually available on the average farm each year. Rather large quantities of commercial fertilizer are used for field crops. Most farmers use a 2-12-2 mixed fertilizer or superphosphate at the rate of 200 pounds an acre broadcast before or with both wheat and corn. The most satisfactory results, however, are obtained from an application ranging from 100 to 150 pounds of a 2-12-6 fertilizer in the row for corn and 300 pounds drilled in with wheat. A rotation of corn, oats, wheat, and hay is generally followed, but in some instances either the wheat or oats is omitted.

Almost all the hay, oats, and corn produced are fed to livestock. Occasionally potatoes are the only field crop yielding a cash return. The chief income is derived from the sale of dairy products, supplemented to some extent by the sale of eggs.

During the last few years, owing to a slump in the price of farm products, scarcity of labor, and some abandonment of farms, farming activity on Alexandria silt loam is below that of former years. Curtailment in acreage for cereals is noticeable, and there has been an increase in the acreage of idle land. Many fields are growing up in weeds, and briars, vines, and low-grade grasses are establishing themselves. In places the land has been robbed of its potential fertility by overcropping and misuse by tenants. Improvements of farm conditions on this soil will hinge largely on the prospects for further development of agriculture in this section.

Alexandria silt loam, steep phase.—The steep phase of Alexandria silt loam is a topographical separation from the typical soil. It occupies narrow long slopes adjoining some areas of the related soil, which are too steep for normal agricultural practices. Some areas occupy abrupt bluffs bordering valleys. In essential features this soil has layers similar to the typical soil, but, owing to its position, there are some variations in the thickness and stage of development of the several soil layers.

The surface soil is thicker in some places than in others, or it may be removed because of erosion, where the land has been poorly managed. The subsoil also is irregularly developed. In cleared areas "gall" spots have been formed. None of this land is cultivated. It is utilized for grazing or is maintained in timber.

Fallsburg silt loam.—Fallsburg silt loam in color, texture, and structure is essentially like Alexandria silt loam. The topsoil is grayish-brown mellow silt loam underlain by light-brown or yellowish-brown slightly heavier silt loam, and the subsoil is yellowish-brown gritty light silty clay loam grading, at a depth ranging from about 30 to 35 inches, into light-brown lighter textured material. The distinguishing difference between this soil and Alexandria silt loam is that the Fallsburg soil is acid to a depth of 5 feet or more and has been derived almost altogether from sandstone and shales, which were moved only short distances by the glaciers. The substratum is stained somewhat with brown, yellow, and gray, caused by the decay of rock fragments.

Fallsburg silt loam is confined mostly to a few small belts in the north-central part of the county. Some areas occur in association with Alexandria silt loam and with Lordstown stony silt loam near Utica and St. Louisville. Small scattered bodies are mapped in the south-central part.

Only a few farms consist entirely of this soil, and it is usually cultivated with the adjoining soil types. Approximately 65 percent is in pasture and hay land. Clover does not respond well, and yields are lower than those obtained on Alexandria silt loam, because of the greater acidity of the Fallsburg soil. One farmer applied manure to his land for several years attempting to grow a clover crop but was not successful. Then he applied 2 tons of ground limestone an acre. In the fall of 1926 he sowed the field to wheat and in the spring of 1927 sowed red clover. He had a successful catch and obtained 1¾ tons of hay an acre from the first cutting, and a good crop was obtained at the second cutting.

The general farming practices applied on Alexandria silt loam are followed on this soil. Results are approximately the same where a good farming system prevails.

Fallsburg silt loam, steep phase.—Those areas of Fallsburg silt loam too steep for practical cultivation have been separated as a steep phase on the soil map. The few small areas in this county are used for wood lots or for grazing purposes.

Wooster silt loam.—The cultivated surface soil of Wooster silt loam consists of about 6 or 8 inches of grayish-brown friable silt loam. It is underlain by light yellowish-brown or light-brown silt loam. The subsoil proper, which in most places occurs at a depth

of 12 or 15 inches, is yellow or brownish-yellow gritty friable heavy silt loam. Characteristically it is only slightly heavier textured than the overlying layers, but it does not develop the same structure as the corresponding layer in Alexandria or Fallsburg silt loam. The substratum is composed of light-brown or brown gritty silty material mixed with rounded and angular fragments of sandstone and shale. This soil is devoid of lime and is acid to great depths.

Some fields that receive frequent clean cultivation and areas along slopes are subject to erosion, and the subsoil is exposed in places. Some bodies contain considerable coarse sandstone in the substratum, the weathering of which produces a less silty, more loamy soil than typical. Included, because of their small extent and irregular development, are soils of silty texture, which in the lower part have gravelly strata, pockets of sand, or thin-bedded strata of smooth gritless silts.

In general, the surface soil is distinguished by its silty texture. The subsoil does not differ greatly from the topsoil. It is open and porous but not to so great an extent as to make the land droughty as in sandy soils. This soil seems to retain moisture fairly well in dry weather. It differs from the Alexandria and Fallsburg soils in the lighter texture of its subsoil.

Wooster silt loam is mapped principally in a number of areas in the central part of the county, but there are no continuous large bodies. The most extensive area is in Eden Township. Many small bodies are widely scattered. In some localities this soil occurs in association with other soils, the whole making an intricate pattern.

A large part of this land is under cultivation. Corn, wheat, oats, hay, and other staple crops are grown. Yields of hay average about a ton an acre, but higher yields are obtained at times. The acreage in hay exceeds that of other crops.

This soil is one that deteriorates under improper management, but experiments conducted on Wooster silt loam on the experiment farm at Wooster indicate that, with correct treatment and crop rotation, the land can be brought to a state of profitable production.

Although the greater part of Wooster silt loam is under cultivation, a considerable acreage is idle, a condition influenced by present economic conditions. Such land, in many cases, has been depleted of its fertility, and much care will be required to restore it to a proper condition for good crop yields.

Farms under cultivation are managed and cropped like those composed of other soils of this group. Yields are only slightly less than on Fallsburg silt loam. Some farmers report yields of corn ranging from 25 to 30 bushels an acre and others from 40 to 60 bushels. Wheat yields range from 6 to 15 bushels and oats from 30 to 40 bushels. Wheat and oats receive the greater part of the commercial fertilizer, usually 200 pounds of superphosphate or a 2-12-2 mixed fertilizer. The 2-12-6 is a less extensively used but more satisfactory analysis.

Hanover silt loam.—The 7- or 8-inch topsoil of Hanover silt loam is grayish-brown or brownish-gray mellow silt loam containing a small quantity of gritty material. It is underlain by a layer of light-brown or yellowish-brown heavier silt loam which in places contains fine streaks of gray. At a depth ranging from about 12 to 15

inches is the slightly compact subsoil of brown, friable heavy silt loam or light silty clay loam. At the base of this layer is brownish-yellow or brown light clay loam or heavy silty material. Pebbles and small rock fragments, chiefly from sandstone and shale, form a part of the soil mass.

The texture of the several layers is fairly uniform, but in places the color of the subsoil is similar to that of Wooster silt loam. In fact, in mapped areas, there are some inclusions of the Wooster soil, as well as of Zanesville silt loam. Hanover silt loam bears a relationship to Wooster silt loam in texture, but the subsoil differs in that it is slightly heavier and is brown. The subsoil shows a tendency to tightness which renders its water-holding capacity better than that of the Wooster soil. Like that soil, the Hanover soil is acid to great depths.

Hanover silt loam is of comparatively small extent. It is confined to a narrow broken belt in the extreme southeastern part of the county. It occupies the lower parts of slopes in places, and some deposits occur on lower ridges.

Practically all the land is cleared of its timber growth. Its agricultural value is about the same as that of Wooster silt loam, and the soil-management and farming systems conducted on it are the same.

Otisville gravelly loam.—To plow depth, Otisville gravelly loam consists of grayish-brown friable or loosely coherent gravelly loam. This layer is underlain, to a depth ranging from about 10 to 25 inches, by light yellowish-brown or brownish-yellow gravelly loam having little or no color from organic matter. Beneath this is an irregular layer of sand and gravel, held together by reddish-brown clay and underlain abruptly, at a depth ranging from about 18 to 30 inches, by a mass of sand, sandy clay, gravel, and boulders, more or less stratified in their arrangement. Some utilization is made of the gravel for roads.

A distinguishing peculiarity of Otisville gravelly loam is the reddish-brown "clay" layer. Although the proportion of clay may be small, sufficient is present to bind the coarser material into a coherent mass and render the layer less pervious and more retentive than the material above or below it. It is developed in fingerlike projections extending into the sand and gravel below. These projections give a thickness to the layer that ranges from 4 to 30 inches.

The texture of the surface soil is not uniform, and small patches of sandy loam and gravelly silt loam are included. The substratum is composed almost entirely of sandstone and shale gravel, and in a few places limestone is present.

The relief in the longer bodies is choppy, billowy, wavy, and ridge-like. Small bodies occupy slopes and small knolls. This is an inextensive soil scattered in small areas in various parts of the county.

As the surface soil contains only a moderate quantity of organic matter, this soil is not so durable as other soils for farming. The soil is acid throughout. It is of only medium fertility and is more droughty than other soils of this group.

Little utilization for general farming is made of this land. Small bodies are farmed in connection with the surrounding soils, mainly for the production of corn, wheat, and potatoes, and crops receive the same kind of treatment and management, but yields are compara-

tively low. The principal use of the soil is for hay or pasture. In many places the grass cover is sparse, spotted, or lacking. The pastured areas include land with a sparse cover of clover, broomsedge, mullein, bluegrass, blackberry vines, sumac, and small trees.

Lordstown silt loam.—The 7-inch surface layer of Lordstown silt loam in cultivated fields consists of light-brown, grayish-brown, or yellowish-brown silt loam which grades into a subsurface layer of lighter colored silt loam. The subsoil, which occurs at a depth of about 12 or 14 inches, is brownish-yellow or yellow crumbly slightly compact heavy silt loam. At a depth of less than 3 feet the soil rests on bedrock. A small proportion of small rock fragments or gravel is mixed with the soil material.

On a few narrow ridges and the upper parts of slopes, the surface layers are like the corresponding layers of the typical soil, but the subsoil, at a depth ranging from 16 to 20 inches, is brown heavy silt loam or light silty clay loam, having a definite red tinge, or it is light-brown material with small aggregates or masses of reddish-brown or brown material, that has developed, through the processes of weathering, from fragments of the underlying sandstone. Along the county line in Eden Township and elsewhere, are small areas of Lordstown sandy loam which are included with this soil type in mapping.

Some of the soil is farmed with adjoining land, and in this connection it is used for the hay and cereal crops commonly grown. The fields receive the same management regardless of soil differences. Most of the land has been kept in pasture or hay, owing to the fact that the surrounding soils are used for this purpose. Yields on this soil vary, depending to a large extent on the thickness of the soil material. They average a little below the average for soils of this group as a whole.

Lordstown silt loam, steep phase.—The characteristic feature of the steep phase of Lordstown silt loam is its position on steep, broken slopes. In numerous places the soil includes land too hilly to be classed as cultivable. It occurs in close association with Lordstown stony silt loam. The surface material of the lower slopes is in many places washed down from higher elevations. Bluffs along some valleys are very steep, and in many places the degree of slope is in excess of 20°. A large proportion of the soil mass consists of flat, angular fragments of shale and sandstone. There is little uniformity in the thickness of the soil layers, because of the many fluctuations in degree of weathering and erosion.

This soil remains for the most part in timber. Where cleared it affords fair pasturage, but its best utilization is for forestry.

Lordstown stony silt loam.—Lordstown stony silt loam is like Lordstown silt loam, except that it contains a large number of stone fragments mixed with the soil material. The stones are flat angular and subangular fragments of sandstone which measure up to 3 inches or slightly more in diameter. Small rounded pebbles and cobbles of sandstone, shale, conglomerate, and crystalline rock also are present. The soil material is like the silt loam in texture and color, and it is underlain at a depth of less than 40 inches by bedrock of sandstone or shale.

On some of the ridges east of St. Louisville is a phase of Lordstown stony silt loam, the total extent of which is about 1 square mile.

The topsoil and subsoil are like the typical stony silt loam, but at a depth ranging from about 18 to 30 inches there is a thick mass of stones, ranging up to 4 inches in diameter, which are slightly weathered on their surfaces and mixed with a small quantity of silt. The undisturbed bedrock occurs at a depth ranging from 4 to 5 feet.

Lordstown stony silt loam is more extensive than the silt loam type. Its characteristic position is the upper part of slopes and ridge tops, on which the deposit of glacial drift is thin. Bedrock, for the most part, lies at a slight depth, but it is not sufficiently near the surface over any considerable area to hinder cultivation. This soil occurs principally in scattered bodies of less than 1 square mile each in the eastern part of the county.

Dairying and general farming are the principal types of farming on this and adjoining soils. Wood lots comprise less than 5 percent of the land. About 75 percent is utilized for the production of hay or as pasture land for sheep and cattle. Corn and oats are the main cultivated crops, and wheat is produced on a small acreage. These crops are fertilized with about 200 pounds an acre of a 2-12-2 mixed fertilizer applied with the grain when drilled. Yields vary over a field, according to depth of soil and moisture conditions.

Zanesville silt loam.—The topsoil of Zanesville silt loam is brownish-gray or light-brown floury smooth grit-free silt loam underlain by light-brown slightly heavier silt loam which also is smooth and gritless. At a depth ranging from 15 to 18 inches is buff, brown, or yellowish-brown moderately tight heavy silt loam which in spots is streaked lightly with gray. This layer grades downward to lighter textured material and at a depth between about 28 and 32 inches becomes lighter brown mellow smooth flourlike silt loam streaked lightly with gray and brown. This material, in turn, continues downward to a variable depth, in some places reaching a depth of more than 10 feet and in others only 4 or 5 feet. This soil is acid throughout.

Almost 95 percent of the land is cleared and utilized for cultivated crops or for pasture. In only a few places does a field consist entirely of this soil. Pasture lands are covered with a fair stand of grasses suitable for grazing. This soil is easy to handle and is used mainly for growing corn, wheat, oats, and hay. Corn yields from 35 to 60 bushels an acre, oats 25 to 40 bushels, wheat 10 to 18 bushels, and hay averages a little more than 1 ton. Fertilizer applications are the same in kind and quantity as those used for the same crops on other soils of the group.

Muskingum silt loam, colluvial phase.—The surface layer of Muskingum silt loam, colluvial phase, is light-brown or grayish-brown fine smooth floury silt loam, the upper 2 or 3 inches of which is slightly darkened by organic matter. It is underlain, at a depth of about 8 or 10 inches, by brown heavy smooth silt loam which is moderately tight and free of gritty material. The silt loam extends downward with little change to a depth ranging from about 25 to 35 inches, where lighter brown fine smooth floury silt loam occurs, that is somewhat streaked with gray and yellow. The substratum, which in most places lies at a depth of more than 6 feet, consists in many places of material having the characteristics of the substratum of Wooster silt loam.

Over the surface are fragments of shale and sandstone, but below a depth of 2 or 3 inches the soil material is practically free of these stones and is marked by a lack of gritty material as far down as the underlying substratum. In places the surface layer is loam in texture, but it grades below into mellow silt loam like the typical soil.

Muskingum silt loam, colluvial phase, occupies a definite topographic position. It occurs in draws, on steep and moderately steep slopes, and as small alluvial fans at the mouths of draws. It has been derived in part from surface wash from the Lordstown and Muskingum soils, and it is mapped in association with those soils.

Only a few small areas, which are marginal to other soils, are cultivated. A large proportion of the land is in timber. Unless preventive measures are taken, the cleared areas become gullied or eroded. The soil is used to some extent as pasture land.

LIGHT-COLORED SOILS OF THE UPLANDS, HAVING DEFICIENT DRAINAGE

The soils of this group comprise Cardington silt loam, Canfield silt loam, and the heavy-subsoil phase of Hanover silt loam. The Cardington and Canfield soils show most typically the characteristics of the soils of this group.

These soils are distinguished especially by the properties of their subsoils. Their surface soils are grayish-brown silt loams, and the upper layers of the subsoils are yellow. In this respect these soils are like the soils of the preceding group, but certain markings or characteristic mottlings, caused by inadequate drainage, have developed with depth.

The relief is moderately undulating or slightly uneven over most of these soils, and in places it is knolly or sloping. Differences in relief have influenced the movement of soil moisture. Because of the slight change in grade, the flow of ground water is comparatively slow through the lower part of the soil. The retention of water has hindered oxidation and leaching within the soil and has produced an abundance of gray streaks. Drainage of the surface layers, however, is adequate. As regards drainage, these soils are intermediate between soils of the preceding group and those of the following group.

The many wood lots on these soils are composed mainly of beech and maple, and they include, to less extent, elm, white oak, ash, walnut, and hickory.

The soils of this group occur most extensively in the western half of the county and to only a limited extent in other parts. Areas occur in irregular broken small belts, and many individual bodies are only a few acres in size. In many localities there is a complicated association with soils of other groups. In such associations one kind of soil may not contribute conspicuously to the total crop yields because of its limited extent, although, locally, single bodies are important on certain farms. In places where a number of these small bodies are developed close enough together to form a broken or intermittent belt, they dominate the agricultural practices and reflect possible yields for such a combination of soils.

General farming in conjunction with dairying, which is the system generally practiced throughout the county, is followed on the soils of this group. These soils are of moderate productivity, as

compared with the more fertile well-drained soils. They require special methods of handling for best results. Inadequate drainage is the major difficulty to be overcome. Excessive moisture that affects the lower part of the soil must be conducted away, by means of tiles and ditches, in order to allow normal growth of crops. The soils warm more slowly in the spring than the well-drained soils, and as a result crops are later in starting vigorous growth. These soils are friable, mellow, and readily penetrated by plant roots. Unless the land is drained, however, plant growth is stunted and impeded by the more than normal amount of water, and in wet seasons such crops as corn become yellow unless artificial drainage is well established.

Like the well-drained soils, these soils require the use of fertilizers to overcome a deficiency of plant nutrients. The texture of the soils and their low content of organic matter cause them to run together when wet. This tendency necessitates plowing them under proper moisture conditions; otherwise clods are formed, which do not pulverize readily. The subsoils when dry are hard or tight.

The heavy-subsoil phase of Hanover silt loam presents many variations, owing to erosion, drainage conditions, and the influence of weathering agencies. For the most part this soil occupies depressions and the lower parts of slopes, which have been subject to wash from bordering soils and to seepage of water from higher elevations. An overwash of silt has been deposited over the soil to various depths. Below this covering are layers of soil material that bear the distinguishing characteristics of the soils of the group. As a result of being the recipient of fertile material from other soils, potentially this soil is somewhat more productive than the areas from which the material came. The influence this material exercises on crops is counteracted to some degree by varying moisture conditions. The response of crops to the soil is thus affected similarly as in typical developments, and the soil requires improvement of drainage before satisfactory results can be obtained.

Cardington silt loam.—The topsoil of Cardington silt loam consists of brownish-gray or grayish-brown mellow friable gritty silt loam underlain at a depth of 7 or 8 inches by yellowish-gray, light-brown, or yellowish-brown slightly heavier silt loam. The subsoil, which is developed at a depth ranging from 9 to 14 inches, in most places comprises two layers. The upper part is brownish-yellow or yellowish-brown heavy silt loam or light silty clay loam, in places containing gray mottlings. The occurrence of the mottling depends on the height of the water table, and this, in turn, is influenced by the character of the terrain. The lower part of the subsoil has a variegated coloring that changes within short distances. Basically it is dull grayish yellow or dull yellow, shaded to different degrees with gray, brown, dark gray, and yellow. The material is heavy silty clay loam which breaks into angular particles. The substratum, which is reached at a depth of 28 or more inches, is brown heavy silt loam or silty clay loam, that contains mottles of gray and rust brown. Fragments of shale and sandstone in different stages of decomposition are conspicuous in the several layers of the soil.

The soil in the upper layers is acid, but the substratum and, in some places, the lower part of the subsoil contain a little lime,

enough to make the material neutral or slightly alkaline. Some gray streaks in the substratum, produced by poor drainage, are high in lime. A strong relationship exists between the position of the soil and the degree of mottling. The relief is wavy, choppy, or undulating, and the land includes many shallow depressions in which drainage is not so thorough as in the higher areas. Consequently ground waters come closer to the surface and produce gray mottles nearer the surface than soils at slightly more elevated positions. The movement of soil water is hindered to some degree by the character of the soil material, owing to the tight or compact structure of the soil particles in some layers.

Cardington silt loam is the dominant soil of this group. It is most extensive in the western part of the county and is developed to some extent in all sections. There are no very large continuous bodies, but the soil occurs in broken belts, in many places associated with Alexandria silt loam. In degree of drainage the soil is intermediate between Alexandria silt loam and Bennington silt loam.

At least 95 percent of the land is cleared and is used either for general farm crops or for pasture. Some farms consist largely of Cardington silt loam, but many are a mixture of this soil with the Bennington and Alexandria silt loams or Marengo silty clay loam. Corn, wheat, and oats are grown indiscriminately on all these soils which receive similar treatment and handling. Corn occupies the largest acreage of the cultivated land, with wheat and oats following in turn. About 50 percent of the cleared land is devoted to hay and pasture land. Some land is idle and allowed to grow up in weeds.

Tiling is one of the requisites in order to obtain profitable yields of cereals, and seasonal variations in climate also influence yields. Some farmers claim that the increased yields resulting after fields have been tilled will pay for the cost of the tile in 2 or 3 years. Over a given field there is frequently a discrepancy in the appearance of the crop and the yield, as influenced by the soil type and drainage. In normal seasons corn produces higher yields on Marengo silty clay loam and the least on Bennington silt loam, with an intermediate production on Cardington silt loam, but in wet seasons better yields are obtained on Cardington silt loam than on Marengo silty clay loam. Under normal conditions wheat and oats produce higher yields on Cardington silt loam than on other soils in the same field. Yields fluctuate so markedly from one season to another that only very general averages are possible. Corn yields range from 25 to 60 bushels an acre; wheat from about 10 to 20 bushels; oats 20 to 50 bushels; and hay, generally timothy and alsike clover alone or mixed, 1 to 1½ tons. From 200 to 250 pounds of a 2-12-2 fertilizer or other mixture high in phosphate, and superphosphate are used for corn and small grains. On many farms potatoes cover only a very small acreage (about 2 to 4 acres), but in some places larger areas are devoted to this crop.

Canfield silt loam.—The topsoil of Canfield silt loam is brownish-gray mellow silt loam underlain at a depth of about 7 inches by light-brown or brownish-yellow gritty friable heavier silt loam. The upper part of the subsoil, beginning at a depth ranging from about 12 to 18 inches, is dull grayish-yellow or yellowish-brown

moderately compact heavy silt loam which contains some mottles in places. The lower part of the subsoil consists of mottled gray, yellow, and brown compact or hard heavy silt loam. At a depth ranging from 22 to 33 inches is dull-brown or yellowish-brown light clay loam, silt loam, or loam, streaked lightly with rust yellow and gray.

The color of the surface soil bears some resemblance to that of Cardington silt loam. The subsoil is lighter textured, and it is deficient in lime material to greater depths. A larger quantity of sandstone fragments occurs in this soil than in the heavier soil, and in places clay lenses from decayed or rotted shale are present.

Most areas of Canfield silt loam are less than one-fourth square mile in extent. They occupy positions similar to those occupied by Cardington silt loam and are associated with that soil and with Bennington silt loam.

This is not an important soil agriculturally because of its small total area. It is considered as productive as Cardington silt loam and is managed in the same way. The light texture makes it easy to till, but, owing to the tightness of the subsoil, relief, and slowness with which soil moisture percolates, it requires tiling for satisfactory results.

Hanover silt loam, heavy-subsoil phase.—The heavy-subsoil phase of Hanover silt loam includes many variations as regards the character of the topsoil and subsoil, but they all resemble, in a general way, the features of typical Hanover silt loam.

Near Jacksontown the surface soil is grayish-brown mellow silt loam that grades at a depth of about 6 inches into yellowish-brown slightly heavier silt loam. The subsoil, which begins at a depth of 10 inches, is medium-brown heavy silt loam or silty clay loam, and, at a depth of 16 or 18 inches, becomes dull-grayish brown heavy compact silty clay loam containing rust-yellow and gray mottles. The substratum is brown light clay loam slightly mottled with gray and yellow. The soil is acid to a depth of 5 feet or deeper.

This heavy-subsoil phase is associated with typical Hanover silt loam and, for the most part, occupies the lower parts of slopes, where in many places an irregular cover of silty material is deposited on it. This feature and the tightness of the subsoil are the distinguishing characteristics of this soil.

This soil is of little agricultural importance because of its small extent. At least 95 percent of the land is cleared and used for the same general farm crops as those grown on Hanover silt loam. Over a period of years yields average about the same as on that soil.

IMPERFECTLY DRAINED SOILS WITH HEAVY SUBSOILS

A few soils in the county are characterized by smooth or gently undulating relief or slight slopes where movement of drainage is very slow and is impeded by a heavy subsoil that has some degree of compaction. In their natural condition they remain wet for a long time following heavy rains. The surface layers are lighter textured than the underlying material which is heavy to a depth of several feet. The surface layers are shallow and grade rather abruptly into the heavier layers below. The materials in the topsoil and subsoil are acid and continue more or less so to the layer where lime is present. In general, the soils are neutral or alkaline at much

slighter depths than are other soils in the county. In places limy material occurs at a depth of 15 or 18 inches, but in some localities it lies deeper.

Most of the soils of this group have light-colored or gray surface soils. In some of the more depressed localities, however, the surface soil has been darkened considerably by an accumulation of organic matter. Such soils, where properly drained, produce excellent yields of corn which responds to a soil having a high content of humus and well supplied with lime. Other soils of this group have been rendered comparatively infertile because of frequent waterlogging or long saturation by soil water.

The soils of this group are used mainly for growing corn, oats, and hay and to less extent for wheat, potatoes, and barley. When drained they make good grasslands, and they must be drained before they can be used for cereals. The soils puddle and clod unless plowed at the proper time, and, in places where they lack organic matter, they tend to run together when wet. The subsoils, because of their heavy character, inhibit freedom of water movement. They remain wet and cool for a long time following spring rains, and in most years crops are slow in starting growth. The land is plowed in the fall in order to obtain the benefits of alternate freezing and thawing and to improve its physical condition. These soils require careful management and the control of soil moisture.

The gray soils are not well suited to small grains. The dark-colored soil, although one of the excellent soils of the county for corn and used mainly for that purpose, when sown to small grains produces too much straw in proportion to seed. The prevailing type of agriculture is practically the same as that over most of the county. The largest acreage is in pasture and hay. Wood lots vary in size, but most of them cover tracts ranging from about 5 to 20 acres.

The soils of this group occur almost entirely in the western part of the county. They occupy several medium-sized belts which, in places, are broken into an intricate design by soils of this and other groups. Very few farms consist of one of these soils alone, but one kind may predominate over the farm area. Members of this group include Bennington silt loam, Marengo silty clay loam, and Condit silt loam.

Marengo silty clay loam.—To plow depth Marengo silty clay loam consists of very dark grayish-brown or nearly black friable silty clay loam, and at a depth of about 7 inches it is granular very dark grayish-brown silty clay loam stained with rust yellow. This material is underlain rather abruptly, at a depth ranging from 8 to 15 inches, by bluish-gray plastic fairly compact heavy silty clay loam containing light-gray and rust-yellow mottles. This material, in turn, gradually gives way to lighter colored material, also mottled, which is comparatively impervious and heavy but has a similar texture. In places, it shows an influence of lime at a depth of about 15 inches, and within short distances it is moderately acid to a depth ranging from 25 to 30 inches. In most of the typically developed areas, lime is present in the lower part of the subsoil.

Some variations occur in both color and texture of the surface soil. In parts of Union Township the texture is heavy silt loam, and throughout the same area parts of the soil have a deeper or more nearly black color. The thickness of the dark-colored layer is not

uniform. It is shallow in places—only 3 or 4 inches thick—whereas in some localities it is a foot or more to the gray layer. Only a small quantity of grit or gravel is present in the soil mass, and some areas are free from stones. Some strata, at different depths, are composed of smooth gritless impervious heavy silty clay. In some places where the soil has developed in short narrow depressions, within areas of Cardington and Alexandria silt loams, the color of the surface soil is lighter than normal, and there is some intermixing with the silt material washed on top of it.

The characteristic feature of this soil is the conspicuously dark-colored heavy surface layer resting on a heavier drab or mottled yellow and gray subsoil. The movement of soil moisture is greatly restricted by the texture of the soil.

Approximately 95 percent of the land is cleared for cultivation. The largest bodies are in the far-western side of the county. Many are narrow, short strips, from 50 to 150 feet wide, that occupy more depressed situations than the adjoining soils. Many areas have an intricate, irregular association with Bennington silt loam and are farmed with that soil for the same crops. Where conditions warrant, the Marengo soil is used mainly for corn, and it is one of the best corn soils in the county. In the rotation of farm crops, however, it is often planted to oats and sometimes to wheat. It is excellent hay land and produces high yields of timothy and alsike clover. A single field presents variations in growth, depending mainly on drainage conditions. In adequately artificially drained ground, corn produces as much as 100 bushels an acre. In many years oats and wheat produce a high yield of straw. This soil is seldom manured, but it receives an application of superphosphate when the corn is planted, and when the ground is drilled for oats or wheat the same kind of mixed fertilizer is used as is applied on other soils of the field. Tiling is a necessity in this soil. Some farmers advocate the use of 6- or 8-inch tiles, spaced every 2 or 3 rods. The main tiles range from 15 to 18 inches in diameter.

Bennington silt loam.—The topmost layer of Bennington silt loam in cultivated fields is medium brownish gray or gray friable silt loam which rests on light brownish-gray or yellowish-gray heavy silt loam containing light-gray and rust-colored mottles. At a depth ranging from about 10 to 15 inches, the material merges into varicolored heavy silty clay loam or plastic comparatively impervious light clay. The color includes dull shades of yellowish gray, brownish yellow, or brownish gray, together with numerous thin streaks of light gray or small stains of rust brown and yellow. The soil material also contains some small dark-colored soft concretions. Fresh road cuts indicate clearly the rapid changes in color and in the degree of mottling within short distances, as well as some variation in texture. At a depth of about 30 inches, the soil becomes somewhat lighter textured and consists of light-brown, grayish-brown, or brownish-yellow silty clay loam streaked to various degrees with gray mottles.

Some difference occurs in the depth to the zone where lime is present. In the northwest part of the county, there seems to be a slightly larger quantity of carbonates in the soil than elsewhere, as evidenced by gray streakings of lime.

One of the distinguishing features of this soil is the slight depth to the zone of mottling. In this respect the soil is intermediate between the Cardington and Condit soils. Narrow strips of Condit silt loam, too small to map, are included with the Bennington soil.

Some soils associated with Canfield silt loam and occurring locally within areas of Bennington silt loam are lighter textured and acid to greater depths than the typical soil. They are light colored and mottled like Bennington silt loam but are silty to a depth ranging from 25 to 30 inches and in places contain pockets of sandy material. All the included areas are underlain by a heavy mottled substratum.

Bennington silt loam occurs only in the poorly drained more level areas of the till plain in the western part of the county. Some large belts of this soil have developed, but they are broken into irregular patterns by intervening soils. Numerous small single bodies are complexly associated with Cardington and Marengo soils, and on many farms these soils form parts of the same field. Such fields are used as a unit in farm operations without special recognition or adaptation being made of the separate soils.

About 10 percent of Bennington silt loam is in timber, and the rest is in pasture, idle, hay, or crop land. Pasture and hay lands cover approximately 65 percent of the total area. The acreage devoted to corn is greater than that devoted to oats or wheat. Potatoes are grown on a small scale, primarily for local consumption.

Without tiling this soil produces very low crop yields. Even when tilled, seasonal weather conditions tend to create variations in the yield and maturing of crops. Local differences in fertility and drainage cause a spotted and irregular crop growth in the same field. As compared with Cardington, Marengo, and Alexandria soils, the Bennington soil occupies a position that, under normal conditions, usually averages lower in crop yields. Corn yields from 20 to 40 bushels an acre, wheat 10 bushels, and oats from 25 to 30 bushels. The same fertilizers as those applied to associated soils are used on this soil.

Condit silt loam.—The 3- or 4-inch surface layer of Condit silt loam is gray or light brownish-gray fine silt loam slightly mottled with brown. This material grades into gray or light-gray silt loam containing rust-brown and yellow mottles. At a depth of about 10 or 12 inches is the subsoil of yellow with gray splotching or mottled yellow and gray heavier silt loam that becomes still heavier with depth and at a depth of 18 or 20 inches is mottled dull brownish-yellow and bluish-gray plastic heavy tight silty clay loam containing dark-colored soft concretions. The substratum, which occurs at a depth ranging from 30 to 35 inches, is dull-brown or brownish-yellow light silty clay loam with moderate staining of gray mottles. This layer is the zone of limy material, whereas the layers above are acid.

Condit silt loam occupies, in drainage position, a stage below that of Bennington silt loam. Many narrow strips of the Condit soil, that are essentially transitional developments between the Bennington soil and Marengo silty clay loam, are included with Bennington silt loam in mapping. Such areas are farmed with the adjacent soils.

Most of the largest areas remain in timber or are used as pasture land. This is an inferior soil with limited possibilities unless drained, and naturally it is of comparatively low productiveness. Where farmed the results from corn, wheat, and oats are lower than those obtained from associated soils. Some patches are used for buckwheat and beans.

LIGHT-COLORED SOILS OF THE HILL LANDS

In the eastern part of the county is a hilly section which was not modified by the ice sheet. The soils of this section and their reflection on agriculture are different from soils of the groups already discussed.

This group includes the Muskingum, Eifort, Frankstown, and Rarden soils. Their light color is a result of development under a timber growth, which is not conducive to the accumulation of organic matter. There is a lack of uniformity in the thickness of the surface layers and in the characteristics of the subsoils, brought about by unfavorable topographic position, erosion, and character of the substratum.

In general, these soils have light-colored light-textured surface layers that grade at irregular depths to subsoil layers which are heavier in texture than the soil material above. These layers are friable, mellow, and have a structure that favors freedom of movement of soil moisture. For the most part they are well drained. These physical characteristics make a condition favorable for root penetration of plants. The soil materials were accumulated, through the processes of weathering, from underlying local formations—mostly shales and fine-grained sandstones.

Topographically, these soils comprise the more hilly parts of the county. The ridge tops are narrow, rounded, and bordered on the upper slopes by fairly steep inclines. Drainage is well established, owing to the favorable relief and soil structure. The soils of this group occur in a number of belts which are fairly broad but are broken at the lower elevations by intervening areas of other soils.

Large tracts of land have been cut over, but a number of wood lots remaining furnish a supply of second-growth timber including hickory, chestnut, white oak, dogwood, maple, beech, and balm-of-Gilead poplar. Cleared areas on the steeper hillsides become gullied or eroded in places.

Agriculture is not so extensive on these soils as in other parts of the county. A large proportion of the soils is unsuitable for farming because of the unfavorable relief. Such areas, under present economic conditions, as well as from a practical point of view, have limited possibilities for crop production and in general are allowed to remain in timber. Additional tracts, because of their inferior soil qualities, could advantageously be given over to tree crops.

Farming operations are confined principally to the ridges having good relief. The soils are not so productive or naturally fertile as are the light-colored well-drained soils developed from glacial drift. They are low in humus and consequently nitrogen, as they are derived from materials that do not possess those elements in sufficient quantities for high crop yields. They are acid from the surface down to a great depth.

Where subject to erosion, the surface material, containing some organic matter and plant nutrients, is carried away, and exposures of the raw subsoil occur. Such spots are a poor medium for crop growth. Under long-continued cultivation, the soils are depleted of available plant nutrients. Unless these soils are managed and fertilized with the idea of building up and maintaining a fertility sufficient for ordinary crop demands, they will not support a very profitable agriculture.

Hay, corn, oats, and some wheat constitute the more important crops. Dairying is carried on to a slight extent, and some land is utilized for grazing sheep. A larger area is maintained in hay and pasture than the combined acreage of all other crops. Redtop, bluegrass, and timothy are some of the grasses grown for hay. Owing to the naturally acid condition of the soils, clover yields are very low. In worn-out fields poverty grass, broomsedge, briars, and weeds soon crowd out the grasses. Corn and small grains are grown in small fields on a small total acreage. Corn, oats, and hay constitute the most common crop rotation. Little difference exists in the production on the various soils of the group.

Muskingum silt loam.—The topsoil of Muskingum silt loam is light-brown or brownish-gray mellow silt loam underlain by brownish-yellow slightly heavier silt loam. Below a depth ranging from 7 to 12 inches, the material is yellow or brownish-yellow heavy silt loam or light silty clay loam, mixed with fragments of fine-grained sandstone and shale. At a depth ranging from 20 to 40 inches, this material rests on bedrock of shale or sandstone. At the point of contact with the lower layer of soil, the rocks are in different stages of disintegration and are easily crumbled. Small angular fragments of rock material form a part of the soil mass throughout.

Muskingum silt loam is a soil in which the several layers are irregularly and imperfectly developed. In the southeastern part of the county the parent rock consists of thin interbeddings of shale and sandstone, with the result that in the process of weathering many variations occur within short distances, particularly down a slope where alternate layers of the two kinds of rocks influence the soil. In those places where shale has been the main contributor to the soil material, the soil is heavier and contains streaks of gray in the subsoil. The weathering of sandstone produces a more friable, lighter, porous material. On slopes and in draws, where erosion has deposited accumulations, the soil shows many variations in depth to bedrock. On some ridges, the soil is thin and bedrock lies only about 10 or 15 inches below the surface.

The land is used principally for hay and pasture. Pasture grasses in many places are sparse and include some of inferior quality. The acreage devoted to corn, oats, and wheat is limited to small fields. In recent years some of the land has been abandoned because of the development of an oil district in the locality.

Corn yields from 25 to 30 bushels an acre, wheat 10 to 12 bushels, oats 25 to 35 bushels, and hay 1 ton or less. Superphosphate, which is the chief fertilizer used, is applied at the rate of about 200 pounds an acre to oats or wheat. Lime is used by some farmers desirous of establishing a stand of clover.

Abandoned farm homes are common on this land, giving mute evidence to the difficulty some farmers have experienced in maintaining a home under prevailing economic conditions.

Muskingum silt loam, smooth phase.—The smooth phase of Muskingum silt loam differs from the typical soil in that it has smooth fairly level relief. It occupies the crests of some narrow short ridges where the topsoil is rather uniform in thickness, and the subsoil may be slightly compact. In some areas large numbers of small angular rock fragments occur throughout the soil. The total extent of these smooth areas is less than 1 square mile. Nearly all, or about 95 percent, of the land is farmed, as the relief renders it favorable for farming operations and the use of power machinery. The same kinds of crops are grown and the same system of management prevails on this soil as on typical Muskingum silt loam. Crop yields average higher than on the typical soil.

A few small included areas show one outstanding difference. Several such bodies are in Hopewell Township, north of Gratiot. In this variation the soil consists of light-brown or grayish-brown mellow floury silt loam underlain, at a depth of 7 or 8 inches, by brown or buff crumbly moderately tight heavy silt loam which, at a depth ranging from about 25 to 30 inches, grades into mellow and smooth lighter silt loam stained to a varying degree with light gray. This material extends downward to a depth ranging from 40 to 60 inches, where it rests on shale and sandstone rocks.

There are few stones in the upper part of the smoother soil, and the subsoil is comparatively stone free. This soil differs from typical Muskingum silt loam in the comparatively gritless character of the soil, the greater depth to bedrock, the much smaller quantity of stone, and the deeper brown color of the topsoil and subsoil.

Muskingum silt loam, steep phase.—The steep phase of Muskingum silt loam includes the rougher and steeper areas of Muskingum silt loam, which are unfit for the ordinary cultivation of crops. It comprises abrupt and very steep slopes which in some places have a gradient of as much as 30° or more. This soil averages more shallow to bedrock than the typical soil and contains a larger proportion of stone fragments. Where influenced by seepage waters the surface soil is darker, approaching dark gray in color, and it is underlain by pale-yellow or grayish-yellow silt loam with light-gray mottles. The soil of the lower parts or bases of slopes includes variable quantities of surface wash from higher points. Only a few selected patches are cultivated, about 60 percent of the land remains in timber, and the rest is cleared and utilized to some extent for pasture. One of the most practical uses for hilly steep land of this character is the production of timber.

Muskingum loam.—Muskingum loam is derived mainly from the weathering products of coarser sandstone than that giving rise to Muskingum silt loam.

The 5- to 7-inch surface layer is light grayish-brown or brownish-yellow loose mellow loam. It is underlain by brownish-yellow or yellowish-brown loam that, at a depth of 12 or 15 inches, becomes rather heavy loam which is compact in place and contains sandstone fragments. At a depth ranging from 20 to 25 inches there is some

partly disintegrated medium- or coarse-grained sandstone. In places layers of decomposed material alternate with strata more resistant to weathering. Some inclusions of patches having a sandy loam texture occur in places.

Muskingum loam is developed in a number of scattered isolated knobs and narrow ridges in the eastern part of the county. In places the surface soil is silty, but it is underlain by heavy sandy loam at a slight depth. In a few patches stone fragments are a hindrance to tillage operations.

Approximately 10 percent of the smoothest areas is included in fields containing other soils, but they are farmed as a unit. The rest of the land is used for pasture or is covered with timber. The same crops are grown and similar management prevails as on Muskingum silt loam. Owing to the comparatively lower fertility and more droughty soil, yields are somewhat lower.

Muskingum loam, steep phase.—The steep phase of Muskingum loam is a topographical separation made to include the steeper areas of Muskingum loam. This soil differs slightly from the typical soil in that it contains more rock fragments and in the greater variation in depth of soil to bedrock. Areas of this kind are unsuited for cultivation and as a whole are better adapted to forestry and permanent pasture. This steep soil is developed in a few small areas in the eastern part of the county.

Eifort silt loam.—Eifort silt loam, to a depth of 6 or 7 inches, is grayish-brown or light-brown silt loam that grades into lighter colored heavier silt loam. At a depth ranging from about 10 to 16 inches this material rests on yellowish-brown or grayish-brown silty clay loam that is underlain by heavy sticky impervious bluish-gray clay containing yellow splotches. The substratum is known as "fire clay", a fine smooth dull-brown or drab heavy clay. Small pockets or lenses in the subsoil are conspicuously mottled with red in places, in this respect resembling Rarden silt loam.

The depth to the heavy clay layer varies, and in some places this layer is very close to the surface. The outer borders of some areas, especially at heads of ravines, are covered by a few inches of silty material washed from Wooster silt loam. Areas associated with Muskingum loam have an overwash of loam in places. The Eifort soil also includes patches of Muskingum silt loam too small for separation on the soil map.

Eifort silt loam occupies many small bodies in the northeastern and southeastern corners of the county. About 85 percent of the land is cleared, but only about 15 percent is farmed. The rest is used as grazing land. Corn, oats, and hay are the principal crops. Corn yields from 25 to 40 bushels an acre, and hay, consisting principally of timothy with some redtop and bluegrass, makes from four-fifths to 1 ton an acre. Wheat is sown at times, but it has a tendency to winter-kill. Clover is not successfully grown because of the acid condition of the soil. Sheep raising is of some importance, and some farmers devote their efforts to the production of hay and sheep raising.

The soil has a low supply of organic matter, and the material runs together when wet. Surface drainage is good, but internal drainage is only fair, as it is restricted by the heavy clay. In places where

the surface soil is shallow the land is hard to handle except under proper moisture conditions.

Rarden silt loam.—The topsoil of Rarden silt loam is light-brown or grayish-brown gritty silt loam underlain at a depth of about 6 inches by brownish-yellow crumbly silt loam that becomes heavier with depth and in places approaches light silty clay loam in texture. At a depth ranging from 15 to 18 inches is yellowish-brown or reddish-brown silty clay loam stained red and gray. This material grades, at a depth ranging from 20 to 25 inches, into smooth plastic silty clay or silty clay loam, containing gray and reddish-brown splotches. In places, shale or clay rock is reached between depths of 30 and 35 inches.

Rarden silt loam occupies several small bodies, mainly in the northeastern part of the county. The relief is level or slightly undulating. Surface drainage is good, but internal drainage is restricted.

The cleared areas are utilized for pasture, grain, and corn. About 10 percent of the land is tilled. Methods of cultivation and fertilization employed on this land are the same as on Eifort and Muskingum silt loams. Acre yields of corn average about 25 bushels, hay three-quarters of a ton, and oats 30 bushels.

Frankstown gravelly silt loam.—To a depth ranging from 10 to 15 inches, Frankstown gravelly silt loam consists of light brownish-gray or grayish-yellow silt loam containing a large quantity of flint fragments. This layer is underlain by light yellowish-brown or yellow heavy silt loam, the lower part of which, in places, is light reddish-brown clay loam or silty clay loam resting abruptly on flint rock at a depth ranging from 15 to 30 inches. Flint fragments, which are a characteristic feature of this soil, are scattered thickly over the surface, and a large proportion of the soil material is composed of them. On the larger smooth areas, the soil is deeper to the rock and the fragments are not so numerous. In places large boulders and outcrops of the unweathered flint are on the surface.

The principal development of this soil is on Flint Ridge or in that vicinity. The total acreage is small, and the soil contributes little to the agriculture of the county. The greater part of the land is in timber or is used for pasture. Some is unsuitable for cultivation because it is so steep and has so much rock over the surface. A few acres in the smoother areas are used for corn and hay. This is considered a good soil for apples, but very little use has been made of it for this crop.

WELL-DRAINED SOILS OF THE STREAM TERRACES

A number of soils developed from stratified deposits occur on terraces and outwash plains, and they constitute some important agricultural land. Some comprise a large part of the valley lands. They have developed under different moisture conditions which have influenced not only the characteristics of the soils but also their utilization for farming purposes. The materials from which the soils are derived were laid down by water.

This group, made up of Chenango and Mentor soils, is the most extensive and important group of the terrace lands. All these soils have excellent surface and internal drainage. They have light-col-

ored surface layers which are underlain by heavier but friable layers that, in most places, rest at different depths on stratified water-laid materials.

Although these soils are considered productive, like all soils of this section they have been influenced by leaching, which tends to reduce their fertility. They do not contain a large percentage of organic matter and consequently have a small nitrogen content. The original materials were derived largely from soils that had developed chiefly from sandstone and shale. Some of the soils are moderately acid, but others are influenced by limestone material which reflects itself in the growth of legumes. The subsoils are friable and easily penetrated by plant roots. The retention of soil moisture is aided by the structure of the subsoil. The soils, because of their well-aerated condition and physical features, warm quickly and become workable early in the spring. Crops on these soils generally start a little in advance of those on soils in the upland districts. The soils are easy to handle under a fairly wide range of seasonal conditions. They respond readily to good management and can be maintained in a productive condition for crops.

General farming, in connection with dairying, is the prevailing type of agriculture. Crop rotations that include corn, oats, wheat, and hay are followed. Some land is reserved for pasture, but most of the fields are utilized for crop production. Farms on these lands are prosperous and are well maintained.

Chenango silt loam.—The 7-inch surface soil of Chenango silt loam consists of grayish-brown mellow silt loam. The upper part of the subsoil, to a depth of 15 inches, is light-brown or yellowish-brown gritty silt loam. Below this and continuing to a depth ranging from 25 to 35 inches is brownish-yellow moderately heavy silt loam or silty clay loam, which rests rather abruptly on a thin stratum, 1 to 4 inches thick, of light-textured gravelly loam containing just sufficient clay to cause it to cohere. The substratum is composed of loose gravel.

Some difference in the depth to the gravel substratum occurs from place to place, but practically everywhere it lies at a depth of less than 40 inches. The material throughout the soil profile contains a small quantity of pebbles and gravel.

On some of the higher levels or terrace benches where the material has remained longest, the surface soil and subsoil layers have developed a little deeper brown color. The subsoil also is slightly more compact but not enough so to hinder drainage. In some localities the soil material has a smooth velvety feel and contains very little grit and few pebbles.

The largest development of Chenango silt loam is in the vicinity of Newark and Utica along Licking River and its several tributaries. Small scattered bodies lie along some of the small streams.

This is a valuable agricultural soil. Because of its favorable surface features, ease of cultivation, and fertility, practically all the land has been cleared and put under cultivation. It is ready for plowing and planting earlier in the spring than most of the upland soils. It is well adapted to the staple crops of the county and with proper management produces yields higher than the average. The gravelly patches, however, cause differences in plant growth and yields. Corn

produces 50 to 75 or more bushels an acre, wheat 15 to 30 bushels, oats 25 to 40 bushels, and hay about 1½ tons. Alfalfa and clover do well when the soil is limed. Mixed commercial fertilizers, of various formulas, and superphosphate are in general use and are applied at a rate ranging from 200 to 300 pounds an acre.

A number of areas included with Chenango silt loam, which differ from the typical soil, occur in the vicinity of Alexandria, Pataskala, and Kirkersville. In them the surface soil consists of grayish-brown or brown gritty silt loam to a depth ranging from 7 to 10 inches. The succeeding 5 to 8 inches are medium-brown or brown slightly heavier silt loam which grades, at a depth ranging from 10 to 15 inches, into light reddish-brown, chocolate-brown, or medium deep brown heavy slightly plastic and gritty gravelly clay loam. The substratum, which occurs at a depth ranging from 30 to 40 inches, is composed of unconsolidated grayish-brown sands and gravel. The gravel is chiefly sandstone and shale, together with a little limestone. Some gravel is scattered through the soil mass: In most areas near the outer edges of terraces and in small patches elsewhere, gravel comprises a large percentage of the soil. The distribution of such areas is very irregular.

In places a rich-brown surface soil has developed. A distinguishing peculiarity of this included soil is the reddish-brown gravelly clay layer, in which the clay content is sufficient to bind the coarser matter into a coherent mass and render the material in this layer less pervious and more retentive of moisture than the material above or below. As developed there is a pronounced difference in the thickness of this layer.

Chenango silt loam, deep phase.—The deep phase of Chenango silt loam has a 7- to 9-inch brown or grayish-brown mellow floury silt loam surface layer underlain by light-brown silt loam of similar character but containing thin gray streaks in the lower part. At a depth of 12 or 14 inches this material grades into a subsoil of brown heavy moderately tight, yet friable, smooth silt loam which, when moist, has a red tint. This heavy-textured layer grades, at a depth ranging from 20 to 30 inches, into medium-brown or light-brown mellow flourlike silt loam streaked with light gray, the markings becoming more pronounced with depth. This layer, which is unusually thick, continues downward to different depths. At a depth ranging from about 4½ to 5½ feet, there is, in most places, brown, light reddish-brown, or rich-brown gravelly sticky moderately heavy clay loam that ranges in thickness from 6 to 18 inches. Below this are stratified layers of gray gravel, silt, and sand. In some places, instead of the underlying gravelly strata, are layers of fine silt and very fine sandy loam, extending to a depth ranging from 8 to 10 feet. Gravel deposits are exposed or lie close to the surface on slopes of terraces or along narrow draws that have been cut down into the soils.

This deep soil differs from Chenango silt loam in the unusual thickness of the soil to the stratified substratum, the smooth and gritless condition of the soil material, and the deeper brown color. It retains moisture to a better degree than the silt loam, because of the fineness of the soil particles.

This is an excellent soil, and nearly all the land is cleared and farmed. Yields of wheat range from 20 to 30 bushels an acre, corn from 40 to 65 or more bushels, and mixed timothy and clover 1½ to 2 tons. Alfalfa is grown on a small acreage, and in places where the soil has been limed and fertilized it produces high yields. Superphosphate or mixed commercial fertilizers are usually applied to grain crops at a rate ranging from 200 to 300 pounds an acre.

Chenango silt loam, gravelly phase.—The gravelly phase of Chenango silt loam is similar to typical Chenango silt loam, except in the higher proportion of small shale and sandstone fragments in the surface soil and upper subsoil layers. These fragments render the soil slightly more permeable but are not sufficiently numerous or large to interfere materially with cultivation. The gravelly areas have approximately the same agricultural use and value as typical Chenango silt loam.

Chenango loam.—Chenango loam is in many respects like Chenango silt loam, but it contains a higher proportion of sandy particles which make the material coarser textured, more porous, and friable. The gravelly substratum lies a little closer to the surface than in the silt loam. This soil is retentive of soil moisture. The subsoil when dry becomes moderately hard but does not hinder penetration of plant roots.

The soil is of medium fertility and is used for the same crops as the silt loam, with comparable yields. About 85 percent of the land is under cultivation. It is associated with the silt loam, and the same general methods of cultivation and fertilization are followed on both soils.

Chenango gravelly loam.—Chenango gravelly loam is closely related in physical features to Chenango loam. It differs from the loam in its higher content of gravel and pebbles. The soil layers are not so deeply developed as in the silt loam, and in many places the gravelly material in the substratum occurs at a slight depth. Its characteristic position is in broken, narrow strips bordering the outer edges of different bench levels and terrace slopes. Some areas occur within bodies of silt loam. The largest developments are in the vicinity of Newark.

The quantity of gravel mixed with the soil reflects itself in the growth and yields of crops, which are less than those on heavier soils. The gravel itself does not constitute a tillage difficulty. This land is used mainly for general farming crops.

Chenango fine sandy loam.—Chenango fine sandy loam occurs chiefly along Licking River west of Hanover. The 6- or 7-inch surface layer consists of light-brown or grayish-brown fine sandy loam, which is underlain by yellowish-brown fine sandy loam or sandy loam containing small gravel. This material grades into deeper yellowish brown sandy loam or loam, below which are the usual strata of gravel and sand.

All the land is cleared, and a large part is utilized for cereal crops and hay. Small patches are devoted to truck crops and poultry raising.

The sandiness of the soil allows rapid drainage, and it does not retain moisture well. Lack of moisture and organic matter are the factors limiting crop yields. The soil warms early in the spring,

and tillage operations can be started at an early date. Farm procedures are essentially the same as on all Chenango soils.

Mentor silt loam.—In cultivated fields the surface layer of Mentor silt loam is grayish-brown fine mellow silt loam. It is underlain by light grayish-brown or yellowish-brown silt loam which is slightly heavier than the topsoil. The subsoil, at a depth ranging from about 12 to 15 inches, is brown, yellowish-brown, or bright-brown tight heavy silt loam. This grades, at a depth between 20 and 25 inches, into brown soft silt loam streaked somewhat with gray and rust-colored stains. The soil is predominantly silty and comparatively free from gravel throughout. The substratum, below a depth of 4½ feet, in most places has a gravelly clay loam layer resting on stratified layers of gravel and sand. This soil resembles the deep phase of Chenango silt loam except for the tightness of the subsoil, light color, and less depth to gravel.

In some places the soil contains sufficient sandy material to make it more friable and give it a somewhat coarser or loam texture. Such developments are of small extent.

The soil retains moisture well, warms early in the spring, and is comparatively easy to till. It occurs chiefly on the east side of the county in small scattered tracts. A number of the areas are kept for pasture land, and parts of others are cultivated with adjoining soils for general farm crops. The value of this land, as regards fertility and crop production, is about the same as that of the deep phase of Chenango silt loam.

INADEQUATELY DRAINED SOILS OF THE STREAM TERRACES

A number of soils in bench or terrace positions are subject to diverse drainage conditions which have a direct influence on their crop-producing power. Some of the soils are fertile and easily tilled, whereas soils of inferior quality may be nearby.

Based on color, these soils may be placed in two general subgroups—one including soils with light-colored or gray surface soils and the other soils with dark-gray or nearly black surface layers.

The lighter-colored soils are not particularly fertile, and crops respond to applications of commercial fertilizers. Farm manures, particularly, improve them, as they are low in organic matter. The degree of drainage and shallowness of the soils affect their extensive use for all crops. Some of the soils, modified to only a slight degree by the inequalities of soil moisture, have essentially the same capabilities as the well-drained soils.

The quantity of water and the rapidity of its movement through the soil influence the utilization of these soils. Because of differences among them, only general statements can be made regarding their utilization. The gray soils have light-textured topsoils that grade into mottled heavier subsoils having some degree of tightness. With minor exceptions they have gravelly or silty subsoils influenced by a changing water table. Tiling or ditching to remove excess water improves their possibilities for agriculture. The timber growth has been removed, except from a few small wood lots. On some farms the combined acreage maintained in hay and pasture is greater than that devoted to the production of cereal crops. The system of farming is the same as that prevailing on well-drained soils.

The dark-colored soils have a higher content of organic matter, but they have poor internal drainage. When drained they are high-producing soils for hay and corn. Some of them are underlain by gravelly strata and others by heavy tight clays.

Chenango silt loam, mottled-subsoil phase.—To a depth of about 8 inches this soil is brownish-gray mellow silt loam. It grades into yellowish-brown or yellow heavy silt loam, the lower part of which is stained with gray. At a depth of about 18 or 20 inches the material is dull yellowish-brown or brownish-yellow gravelly gritty clay loam that contains gray and rust-colored mottles. The substratum consists of grayish-brown gravel and sand.

This soil occupies slightly depressed areas in association with Chenango silt loam. In such locations it contains some overwash on the edges from surrounding soils. The individual bodies are small and widely scattered in valleys. An intermittent water table has been high enough to saturate the lower part of the subsoil.

Nearly all the land is cleared and used principally for general farm crops. It is somewhat later in warming in the spring, and crops are slower in maturing on it than on the typical soil. In dry seasons its higher moisture content renders crops less susceptible to wilting. It is farmed in the same manner as Chenango silt loam.

Glenford silt loam.—The 6- to 9-inch surface soil of Glenford silt loam consists of brownish-gray mellow silt loam which grades downward into brownish-yellow or light yellowish-brown silt loam of heavier texture. At a depth ranging from about 12 to 15 inches, the material is mottled with yellowish brown and gray and has a moderately compact silty clay loam or tight heavy silt loam texture. Below this the material is brownish-yellow smooth mellow silt loam containing a conspicuous quantity of gray and rust-yellow mottles.

Mapped areas of this soil show considerable variation. The soil has developed in an intermediate drainage situation. In places the material in the silty subsurface layers becomes mottled, and different shades of brownish gray appear in the topsoil. Some variation in degree of mottling occurs in the lower part of the subsoil. This layer is underlain by assorted gravelly material.

In places along Rocky Fork the topsoil is brownish-gray loam or silt loam, grading into light yellowish-gray or pale-yellow silt loam or heavy loam, which becomes mottled in the lower part. At a depth of about 30 inches the material is mottled yellowish-brown and gray gritty clay loam, and this is underlain by gravel and sand. On some low terraces, brownish-gray silt loam overlies yellow or brownish-yellow heavy silt loam or silty clay loam, which grades, at a depth ranging from 20 to 25 inches, into yellow sand mottled with gray.

Normally, the lower part of the soil has a high content of moisture. The surface soil is acid. About 80 percent of the land is devoted to corn, wheat, oats, and timothy. This soil is considered medium in fertility, and it has a comparatively low content of organic matter. Crop yields are only fair.

Phosphatic fertilizers are used on land for small grains and corn. Improvement of internal drainage is important for the growth of crops, and tile drainage has been installed in places.

Braceville silt loam.—The 5-inch surface layer of Braceville silt loam is light brownish-gray or gray silt loam which, when dry,

appears light gray. This grades into yellowish-gray fine silt loam stained with light gray. Between depths of 10 and 30 inches is the subsoil of dull-yellow silty clay loam or light-gray material containing yellow mottles. Below this is an irregular stratum of dull brownish-yellow gravelly clay loam. The substratum is composed of assorted gravel, silts, and sands. The soil is acid throughout. The water table frequently lies at the depth of the gravelly material, and in ordinary seasons the soil has a high moisture content.

Some areas of Braceville loam are included, in which the chief difference from Braceville silt loam is a lighter texture caused by a greater proportion of sand. In a few small bodies a small accumulation of organic matter has imparted a dark-gray color to the surface soil.

This soil occurs in flat and depressed areas not reached by natural drainageways, and it is subject to underground seepage from other soils. There are no large, continuous belts, but the soil occurs in a number of small bodies scattered on valley terraces. The main developments are in the vicinities of Newark and Kirkersville. Most of the bodies range from 20 to 50 acres in size, with only a few larger than 125 acres.

About 95 percent of the land is cleared, but only about 60 percent of the cleared land is devoted to cultivated crops. Where properly drained, the soil produces yields of staple general farm crops that are about or a little below the average for the county. It affords good pasture, and a large part of the land is utilized for this purpose.

Tyler silt loam.—To a depth of about 7 or 8 inches, Tyler silt loam is light brownish-gray or light-gray silt loam. In meadows or undisturbed areas this layer is streaked faintly with gray, rust brown, and yellow, and the upper part is darkened by organic matter. The underlying material is gray or grayish-yellow heavy silt loam, containing gray and rust-colored stains. This layer grades, at a depth ranging from 18 to 22 inches, into mottled gray and rust-brown heavy tight silty clay loam. The texture becomes somewhat lighter in places and heavier in others. Below a depth ranging from 45 to 50 inches the material consists of layers of clays and silts that are grayish brown, mottled with yellow. Gravel and sand beds occur in some parts of the substratum.

In the area northeast of Toboso the soil is shallow in places and rests on dark bluish-gray silty clay strata, some of which are interbedded with gray material. The surface layers are acid, but the material becomes less acid with depth.

Drainage in this soil is very poor, owing to the nearly level relief, the tightness of the subsoil, and its hindrance to the movement of soil water.

This is an inextensive soil and is of little agricultural importance. Only parts are tilled or ditched, and the greater part remains in pasture land. Occasionally patches are used for the common farm crops. Small areas, however, which with other soils comprise a farm unit, are cultivated with those soils. Most of the land that is cultivated continuously is drained by tiles or ditches. The soil is difficult to handle because of its susceptibility to saturation by water and the slowness with which the soil moisture drains away.

The average yield of corn is about 30 bushels an acre; hay, 1 ton; oats, 35 bushels; and wheat, 8 or 10 bushels.

Atherton silt loam.—The 8- to 10-inch surface soil of Atherton silt loam is very dark brownish-gray or nearly black moderately heavy silt loam. The upper part of the subsoil is very dark grayish-brown or dark brownish-gray heavy silty clay loam or clay loam, stained with bluish gray and a little red. At a depth ranging from about 12 to 16 inches the material becomes dull-yellow gravelly heavy clay loam, mottled with gray and rust yellow. With depth this material gradually becomes lighter in texture, not so compact, and contains more gravel. The substratum, which lies at a depth ranging from about 40 to 80 inches, consists of stratified beds of grayish-brown gravel, silt, and sandy material. In most places the water table is so high that the gravelly material is waterlogged.

The color and texture of the topsoil change from one place to another. In depressed areas the topsoil is darker and somewhat heavier, and the ground water level is high. The soil has a neutral reaction at a depth ranging from 15 to 25 inches, and some limestone is present in the gravel. The subsoil is plastic and sticky when moist, but contains sufficient gravel to cause a fairly open structure. In places the gravel beds are underlain by heavy impervious bluish-gray silty clay, which is one feature causing poor drainage of the land.

Areas of Atherton silt loam lie in the valleys of South Fork Licking River and Raccoon Creek. In most places this soil is associated with Chenango silt loam. Most of the land is cleared, tilled, and farmed. It is excellent cornland, and some farmers grow corn 2 years in succession on some fields. Only a few areas are in pasture and timber. The soil ranks high for the production of hay which consists mainly of timothy and alsike clover. Soybeans and oats do well and form a part of the crop rotation.

Blago silty clay loam.—The 5- to 12-inch surface layer of Blago silty clay loam is dark-gray or black crumbly silty clay loam rich in organic matter. It grades into bluish-gray silty clay having a few dark-brown stains and a moderate spotting of yellow. The upper part of this layer, in places, is somewhat darker. The subsoil is smooth, impervious, moderately plastic when moist, heavy, and free of grit. At a depth ranging from 25 to 30 inches, the material becomes lighter in color and contains fewer mottles, but the texture remains the same. At a depth of about 5½ feet, the soil material is tough, tight, and dry, although water lies above it.

The surface layer is acid, but this condition decreases with depth, and the material becomes neutral in reaction at a depth ranging from 18 to 25 inches.

The largest development of Blago silty clay loam is west of Buckeye Lake, and scattered areas in small, narrow, irregular depressions are mapped elsewhere. Surface drainage in most places is inadequate, and internal drainage is poor. In some places the lower part of the soil is waterlogged for a long period each season, and in many places the ground-water level lies at a depth ranging from 40 to 60 inches. Tiling or ditching is necessary before the land can be farmed satisfactorily. When dry the soil shrinks, cracks are formed, and crop roots may be injured. This soil is difficult to handle and must be cultivated when it is neither too wet nor too dry.

Owing to its small total area, this is not an important soil in Licking County, but, because of its high humus content and fertility, it is naturally a valuable soil, especially for the production of corn. Wheat, oats, and timothy and clover hay are grown on some of the better drained areas. Variations in yield occur over a field because of differences in drainage. Commercial fertilizers, mainly superphosphate, are applied to grain crops.

Lobdell silt loam, dark-colored phase.—The 5- to 8-inch surface layer of Lobdell silt loam, dark-colored phase, is dark grayish-brown or dark-brown mellow silt loam. It grades into dark-brown or dark grayish-brown heavier silt loam which becomes slightly compact in the lower part. At a depth ranging from about 25 to 30 inches, the soil material is brown silt loam showing irregular streakings of gray and rust yellow. In a few areas this mottling is not present. The substratum, which lies at a depth of 45 or more inches, consists of assorted gravel, silt, and sand.

This soil is not uniformly developed. On slight elevations the soils are lighter colored than those in depressions. In some bodies the surface soil is dark grayish-brown silt loam from 8 to 18 inches thick, and it grades into a thin layer of brown silt loam which, in turn, is underlain by dull brownish-yellow silt loam containing rust-colored mottles. The soils occupying areas on the higher benches are more acid and show more staining than those in the lower areas, which are of more recent deposition. The surface soil is of medium acidity, but at a depth ranging from 10 to 15 inches in some places and from 10 to 40 inches in others, the soil is neutral or alkaline.

All this soil is farmed, as it is friable, mellow, and easily prepared for crops. It is excellent cornland and produces 75 or more bushels of corn an acre, even from successive plantings. Good yields of clover and wheat are obtained. This soil occurs in small areas and frequently is farmed with other soils. It receives similar applications of fertilizer. It can be cultivated at almost any time during the growing season.

SOILS OF THE ALLUVIAL FLOOD PLAINS

Although the aggregate acreage of these soils is small, many of them are of agricultural importance because of their naturally high crop-producing power. They are composed of sediments deposited in flood plains and are subject to frequent inundations, at which times fresh accumulations of soil material are laid down on the older deposits. As a consequence, the soils show many changes within short distances, and even within the same soil fluctuations of many kinds are common. The soils are subject to varied drainage conditions which influence their value for farming, but fertility also is a factor. The source from which they have been derived and their mixing and assorting before deposition also enhance or decrease their desirability for crops. Saturation and waterlogging have rendered some of them comparatively unproductive.

The bottom lands are favored for growing corn and grass. Some areas are utilized only for grass or legumes. Permanent pastures for dairy cattle are maintained on some of the less fertile, imperfectly drained areas which provide an economical source of feed, especially during the summer.

Based on their characteristics, as determined or influenced by normal moisture content, the soils of this group may be divided into three general subgroups, as follows: Well-drained light-colored friable and easily tilled soils, including the Chagrín and Pope soils; poorly drained soils, or those influenced by a high ground-water level, which are leached to some degree of plant nutrients and have grayish-brown surface soils and heavy subsoils, including the Holly and Atkins soils; and soils having similar drainage but influenced by an accumulation of organic matter, which are dark colored in the topsoil—the Papakating soils. Between the last two classes are a number of soils that occupy an intermediate position in regard to drainage. They are included in the Lobdell, Philo, Luray, Walkkill, and Killbuck series.

Chagrín silt loam.—Chagrín silt loam consists of brown or rich-brown mellow silt loam which becomes slightly heavier in texture at a depth ranging from 12 to 18 inches. In places the subsoil changes to light brown or yellowish brown, and it may be somewhat tight. In most places the soil profile shows some stratification, in which layers of different shades of brown silt loam are present. Some patches of silty clay loam and loam, too small to map separately, are included with this soil. The thickness of the soil material varies, but it is greatest along the larger streams.

Chagrín silt loam is derived mostly from glacial shale and sandstone upland soils which have received some influence from limestone. The soil is slightly acid or neutral and well drained but is subject to overflow. It lies mainly along Licking River and its branches, and small strips are developed along many of the minor streams.

About 90 percent of the land is utilized, largely for the production of corn which can be planted after danger of spring floods is past. Because the land is enriched somewhat at each overflow, little fertilizer is used. Yields of corn ranging from 75 to 100 bushels an acre are reported. The soil is considered excellent for corn, and successive plantings are common in some fields. Wheat and oats are sown on the higher benches which are not so subject to flooding, except during times of unusually high water. The small-grain crops generally receive applications of superphosphate. Wheat produces from 18 to 35 bushels an acre and oats from 40 to 50 bushels. Some of the narrow strips along small streams are used for pasture, and they support a good natural cover of white clover and bluegrass.

Chagrín fine sandy loam.—Chagrín fine sandy loam consists of brownish-gray medium-textured slightly acid or neutral sandy material. Predominantly it is fine sandy loam, but variations are common and of irregular occurrence. The soil is developed from recent deposits of sandy sediments, and both the surface soil and subsoil may contain strata of silty material.

The main developments of this soil are irregular, narrow strips, some of which are broken, along the banks of the major streams. The land occupying benches lying higher than the land bordering the stream channel is cultivated most, because of less likelihood of flooding. It is used for corn, wheat, oats, clover, and pasture. Some farmers plow under sweetclover for green manure. The low areas along the streams may be used for hay and pasture land. Corn

yields from 60 to 70 bushels an acre on some selected patches. Wheat and oats yields fluctuate according to the character of the soil material. Some of the very sandy areas are considered unsatisfactory for cultivated crops. This soil is managed in the same manner as Chagrin silt loam.

Pope silt loam.—Pope silt loam consists of brown or light-brown mellow silt loam which grades at different depths into lighter colored material of slightly heavier texture. In places the color is yellowish brown. The soil is acid. The sediments are derived from noncalcareous residual shale and sandstone material. The soil includes some small bodies of different textures, in which the soil material is modified by sand and gravel beds in the subsoil.

Under average moisture conditions, the land is easily cultivated and worked into an excellent seedbed. It is well drained and can be cultivated soon after an overflow. It has a patchy occurrence along some of the streams which carry wash from the hilly uplands in the eastern part of the county. Some patches are used with adjoining soils for pasture, and a part of the land is farmed to corn and hay. Yields are similar to those obtained on Chagrin silt loam.

Pope loam.—The topsoil of Pope loam is brown mellow loam or silty loam, which is underlain at a depth of about 12 or 14 inches by lighter brown or medium-brown light loam or sandy loam, showing little change in color to a depth of several feet. In most places this is underlain by yellowish-brown sandy material and gravel. The soil is acid throughout. The wide variation in texture is caused by considerable interbedding of loam, sandy loam, fine sandy loam, and sand layers. In some places the texture of the surface soil is fine sandy loam, and in others the gravel content is sufficient to produce a gravelly loam soil.

The soil is not extensive. It occurs in small scattered bodies, principally along Wakatomika Creek and Rocky Fork. Selected bodies are cultivated for general farm crops and are farmed with surrounding soils. Corn and hay are the main crops. Corn is sometimes grown for 2 successive years on the same field. Yields range from 30 to 60 bushels an acre. The pasture land supports a growth of redbud, bluegrass, white clover, and alsike clover.

Lobdell silt loam.—Lobdell silt loam is characterized by a layer of medium dark grayish-brown mellow friable silt loam from 15 to 18 inches thick, underlain by brown or yellowish-brown friable silt loam which is slightly heavier in texture. This layer grades into brownish-yellow silt loam or silty clay loam mottled with gray, rust yellow, and rust brown, or in places is underlain by brownish-yellow light silty clay loam or gravelly clay loam mottled with gray and yellow. The substratum consists of assorted gravel, silt, and sand. The soil is neutral or alkaline throughout.

Lobdell silt loam is similar to Chagrin silt loam in color and texture of the surface soil and the neutral or only slightly acid reaction of the soil. Owing to imperfect underdrainage, however, the soil has become mottled in the lower part. The surface soil is well drained, and, as regards drainage, this soil occupies an intermediate position between the Chagrin and Holly soils. In places where the bottoms merge with the upland, there is included a narrow strip of colluvial material consisting of brown mellow silt loam to a depth

ranging from 10 to 20 inches, beneath which is yellow-brown friable silty clay loam. Variations in color and degree of mottling are produced by different drainage conditions, and some textural changes are common in the several strata of the soil.

This soil occupies some of the inadequately drained bottoms in the western part of the county. It is subject to overflow during periods of high water, but the upper layers drain rapidly and allow cultivation of the land within a short time.

There are some intricate inclusions of loam and small patches of Holly and Papakating silt loams. Bordering stream channels, the topsoil consists of browner silt loam and includes narrow strips of loam, and at some distance back from the stream more mottling is noticeable in the subsoil. This included soil is acid.

Practically all the land is cleared and is used mostly for corn, hay, and pasture. Spring rains and overflows keep the soil wet longer than the Chagrin soils, and tillage is delayed at times. Corn, the chief crop, produces yields ranging from 40 to 60 bushels an acre. Hay includes clover and timothy, and yields are about 1½ tons an acre. Some fields not subject to frequent overflows are sown to oats and wheat.

Killbuck silt loam.—The 10- to 14-inch surface layer of Killbuck silt loam is brown or grayish-brown mellow acid silt loam. The lower part of the layer is stained lightly with gray and rust brown. This layer is underlain rather abruptly by nearly black or very dark gray granular heavy acid silt loam which, at a depth ranging from about 20 to 24 inches, grades into very dark brownish-gray silty clay loam that becomes heavier with depth and grades into yellow clay loam or silty clay loam, containing gray and yellow mottles.

The surface soil is darker when moist, and in some areas the mottling is not developed. The substratum, which lies at a depth ranging from 50 to 70 inches, is gravelly silty material.

The distinguishing feature of this soil is the layer of comparatively light-colored silt deposited on contrasting darker material. The top layer, to a large extent, probably is material washed from upland areas since they were cleared and cultivated.

This soil occurs in small scattered bodies in the valleys in the southwestern part of the county. The surface soil is well drained, but the subsoil has a high moisture content, owing to such influences as the texture and structure of the material and the location of the land. As a consequence, the soil is slow in warming in the spring, and sometimes there is a delay in preparing the land for cultivation. When drained the land is easily handled and tilled, and it produces good crop yields.

All this land has been cleared of the timber growth, and most of it has been put into pasture or is used for growing hay and corn. Some wheat and oats are produced. Most of the cultivated land is farmed in connection with other bottom lands. The soil is of moderately high fertility and produces corn yielding from 40 to 65 bushels an acre. The land is usually given an application of superphosphate when the corn is planted. Bluegrass and clover, which form a part of the pasture grasses, do well. Hay yields from 1½ to 2 tons an acre.

Luray silty clay loam.—Luray silty clay loam is characterized by a layer of brown comparatively light textured soil of variable thickness over impervious smooth silty clay material.

The 4- to 20-inch topsoil is brown or grayish-brown heavy silt loam or friable silty clay loam, that rests abruptly on very dark brownish-gray tough plastic gritless heavy silty clay stained lightly with yellow. At a depth ranging from 24 to 30 inches the material is bluish-gray smooth plastic impervious silty clay mottled with yellow, which continues to a depth of 7 feet or more. In many places, on top of the dark-colored subsoil is a 1- to 3-inch layer of dark peat or muck.

The soil material is of peculiar interest, in that it indicates several definite periods of formation. The underlying deep deposits of silty clay probably were laid down in quiet waters. Aquatic vegetation growing in this material on decaying accumulated into a thin layer of organic matter that influenced the top part of the heavy soil. Subsequently, deposits carried by moving waters covered the underlying strata.

This soil occurs only in several small bodies in the vicinity of Kirkersville. Soil water moves away slowly because of the level relief and the impervious character of the subsoil. All the land is cleared and is utilized either for pasture or cultivated crops. Drainage has been established by a network of open ditches and tiles, but in some fields this has not proved adequate to carry away excess water.

A few acres are used for growing onions. Corn is planted, but its yield varies over a field and from one year to another because of differences in drainage. Under favorable conditions high yields of corn are obtained, ranging from 50 to 60 bushels an acre.

Philo silt loam.—The 10- to 18-inch topsoil of Philo silt loam is light-brown or brownish-gray mellow silt loam. The lower part of the layer is yellowish brown in places and grades into mottled gray and rust-brown silt loam. A few rounded, semihard concretions are disseminated through the soil. Along stream banks the surface soil is browner, and the mottles are less distinct. Differences in color shades and texture occur in this soil, and there are small narrow inclusions of Atkins silt loam in old meandering stream channels.

The origin of the material that composes this soil is the same as that making up the Pope soils. The most striking difference between this and the Pope soils is the mottled appearance of the subsoil, brought about by inferior drainage. The Philo soil occupies narrow strips and small benches in some of the narrow valleys on the east side of the county.

Most of the land is maintained in pasture composed of bluegrass, clovers, and moisture-loving grasses. Selected tracts on the higher benches are used for growing general farm crops, mainly corn and hay. Yields of corn range from 25 to 40 bushels an acre, and those of hay average about 1 ton. Commercial fertilizer, at the rate of about 200 pounds an acre, is applied to corn and small grains.

Philo fine sandy loam.—Associated with Philo silt loam are small bodies of Philo fine sandy loam which differs from the silt loam chiefly in the more sandy character of the surface soil. The fine sandy loam is a mixture of sandy loam, fine sandy loam, and loam, underlain by sediments ranging from silt loam to sandy loam, all of which are mottled to different degrees as in Philo silt loam. The

deposits are subject to change by floodings, and they increase in area each year. This soil is porous and open in the surface layer and is browner than the silt loam.

Only a few acres are cultivated. The chief utilization of the land is for pasture. Corn is grown on this soil in connection with adjoining soils.

Atkins silt loam.—Atkins silt loam consists of light brownish-gray or light-gray silt loam streaked with light gray and underlain, at a depth ranging from about 6 to 9 inches, by lighter colored silt loam containing yellow and rust-brown mottles. The subsoil is composed of slightly more compact silt loam or heavy silty clay loam, and the substratum is much the same kind of material. This is an acid soil. The greater part of the parent material was derived from uplands composed of residual sandstone and shale soils. Along stream banks there is, in places, a thin overwash of brown silt loam.

Drainage is very slow, and the substratum is frequently waterlogged. The land is inundated during heavy rainy periods.

This is not an extensive soil. Only a small acreage is used for growing corn and hay. Corn does poorly in wet seasons, but it may yield from 20 to 40 bushels in favorable years. Timothy and alsike clover respond well under suitable conditions.

Holly silt loam.—Holly silt loam is light-gray or light grayish-brown mellow floury silt loam, in places mottled with rust brown, which grades, at a depth ranging from 4 to 10 inches, into gray or light grayish-yellow floury silt loam or light silty clay loam containing rust-brown and yellow mottles. The substratum is stratified alluvium and has much the same appearance as the upper layers. This soil has been washed largely from glacial shale and sandstone uplands. The outer margins, where merging with the uplands, have a 3- to 5-inch surface layer of brownish-gray silt loam.

This soil occupies the upper parts of small stream bottoms. Its acidity and poorly drained condition make it naturally undesirable for cultivated crops. Some very wet areas are covered with common marsh grasses and water-loving plants. The land is utilized mainly for pasture. Small patches are used for corn, timothy, and alsike clover, and yields are variable as a result of different drainage conditions. They average less than the average yields for the county.

Papakating silt loam.—The surface soil of Papakating silt loam is dark brownish-gray or dark-brown acid silt loam or heavy silt loam, underlain, at a depth ranging from 6 to 10 inches, by granular friable acid darker silt loam. The subsoil is lighter in color and consists of mottled gray and rust-yellow slightly plastic silty clay loam which is interspersed in places with strata of lighter textured material. The subsoil continues downward, with changes in degree of mottling, color, and texture, to the substratum of silt and gravelly material. Narrow strips of loam along stream banks, as well as some silty clay loam areas, are included with this soil.

The soil occupies parts of naturally wet first bottoms in many of the narrow valleys in the western part of the county. The content of organic matter is greater in this soil than in the other flood-plain soils.

This soil is used principally as pasture land. It is a productive soil when drained, but if worked when too dry or too wet it becomes cloddy and hard to cultivate. A few acres are devoted to corn and hay. Corn yields, under suitable seasonal and drainage conditions, range from 50 to 75 bushels an acre. Very excellent timothy, alsike, and red clover hay is produced. Oats yield from 25 to 40 bushels and wheat from 10 to 20 bushels an acre. Superphosphate is used for corn and 2-12-2 fertilizer for small grains.

Walkkill silty clay loam.—The 6- to 10-inch surface layer of Walkkill silty clay loam consists of dark grayish-brown friable heavy silt loam or light silty clay loam. It has a neutral or slightly acid reaction. The material in this layer is abruptly underlain by very dark brown smooth laminated organic matter in various stages of decomposition, which continues downward without much change in texture or structure to irregular depths and in places becomes dark colored. The upper part of the organic matter contains a large quantity of plant roots which are undergoing some change through decay.

Included with this soil in mapping are some areas in which the surface soil is lighter colored. Such soils consist of a layer of grayish-brown heavy silt loam or silty clay loam 7 or 8 inches thick, grading into brownish-gray silty clay loam mottled with rust brown and gray. At a depth ranging from 20 to 24 inches are the characteristic strata of peaty material.

These soils occur only in a small section southeast of Kirkersville. The land is cleared of timber, but parts of it are grown up to weeds from 5 to 6 feet high.

The soil normally has a high water table. The greater part of the land is improved by drains or tiles and placed under cultivation or used as pasture. The largest acreage is devoted to the production of corn and hay. Corn sometimes is grown 2 years in succession. Yields of corn range from 50 to 90 bushels an acre, depending to some extent on seasonal conditions. Hay consists mostly of clover and timothy, and yields range from 2 to 3 tons an acre. Truck crops, chiefly onions and celery, but some beans, carrots, and beets, are grown intensively in a small way.

Superphosphate is used for general farm crops, and heavy applications of high-grade fertilizers are used for truck crops.

Lake marsh.—The term "lake marsh" applies to low-lying waterlogged land surrounding Smoot Lake and occupying Cranberry Island in Buckeye Lake. This land has no present agricultural value. The soil consists of silt, clay, or peat, most of which is covered with reeds, cattails, sedges, water plants, and broadleaved grasses, and on Cranberry Island, with cranberries and sphagnum moss. Such areas can be utilized for muskrat farms or as feeding grounds and refuges for wild fowl.

Riverwash.—Riverwash comprises a heterogeneous mass of gravel, silt, and sand scattered along the channel of Licking River. This material is of very recent origin and is subject to reworking and new accumulations. It is, in general, deposited as irregular-shaped bars on the inside bends of the stream. Most of it is devoid of vegetation, with the exception of a scattered sparse growth of small grasses. It has some utilization as a source of gravel for roads.

Muck.—Muck is composed dominantly of plant matter that accumulated in wet situations. The material was subject to changes brought about by the process of irregular, slow decay under excessive moisture. Differences occur in muck, occasioned by its stage of decomposition and the material from which it originated. The deposits vary in texture, structure, thickness, depth of water table, chemical characteristics, and age, but, on account of their limited extent, the several kinds of muck have not been separated on the soil map. They occur in widely scattered positions and altogether embrace only a comparatively small acreage. The longest area occupies a narrow basin in Washington Township north of Redbrush School. Near the central part of the marsh the plant matter is characterized by a very dark brown or black color, granular structure, and loamy texture, and the material is pasty when wet. This is a shallow deposit, from 4 to 8 inches thick, resting on dark bluish-gray smooth heavy silty clay. This stratum gives way, at a depth ranging from about 15 to 18 inches, to fine smooth laminated peat which is fairly uniform in texture.

These three layers persist throughout the area, but they vary in thickness, becoming less thick around the edges. At times, attempts have been made to cultivate the muck areas. Drainage conditions, however, prevent practical utilization of the land, except in unusually dry seasons. In normal times water covers the material, and sedges, reeds, and rushes grow on it. In 1930, an exceptionally dry season, part of the area was burned over, thereby destroying some of the top layer of organic matter.

Near Kirkersville are several bodies of muck, in which the accumulations are thick, extending to a depth ranging from 8 to 12 feet in many places. These areas originally had a forest cover of red maple, swamp ash, and other deciduous trees, together with an undergrowth of willow and bog shrubs. The 6- or 8-inch surface layer is black or very dark brown mellow loamy granular organic matter well advanced in decomposition. This material grades into fine smooth laminated disintegrated matter which becomes in places grayish brown in color. It is somewhat fibrous or felty and less decomposed than that in the layers above. This muck is generally neutral in reaction. Part of the land has been cleared and drained and is used for hay and sometimes for corn.

The area near Bloody Run Swamp, associated with Wallkill silty clay loam, at one time was covered with a deposit of silt, but this was removed and the underlying material exposed. The features of this area of muck are about the same as those of the peat under the Wallkill soils. At times the land furnishes pasture and hay, but it is not utilized continuously.

A few small rounded depressions and potholes in various parts of the county consist of very dark grayish-brown fine-granular well-decayed vegetable matter containing some silty material. This grades into darker fibrous or granular organic matter and rests on marl in places and grayish-brown clay in others. The material has a neutral reaction. Because of drainage difficulties, these small bodies are not cultivated.

GRAVEL PITS

Gravel pits, indicated on the soil map by symbol, are open excavations usually on stream terraces, from which gravel has been obtained for road material and industrial uses. These pits are, from the agricultural viewpoint, waste land.

SOILS AND THEIR INTERPRETATION

The soils of Licking County are characterized by a complexity of detail and by a change from one kind to another within short distances. They comprise a series of irregular broken belts, with only a slight semblance of orderly arrangement, and in each of them are inclusions of soils that are members of other belts. Over most of the county the soils have developed from glacial till material composed principally of sandstone and shale, together with a small fraction of limestone debris. In the eastern part of the county is a local section in which the soils have developed, through the processes of weathering, from beds of sandstone and shales.

The soils have developed in a humid region and under a forest cover of mixed hardwoods. They belong to the Gray-Brown Podzolic group of soils. The soil-forming processes have operated under various conditions of drainage.

The land forms throughout a large part of the county are young, as the result of glacial activity. During glacial periods there was considerable modification of the surface configuration. On the west side of the county, particularly, where glaciation was more pronounced, the streams have not had time to develop a complete dendritic system. There are large areas between the established drainageways, in which the soils were developed under conditions of excessive moisture. The various dry and wet soil conditions that prevail in these sections are not altogether the result of relief but are features influenced, within certain limits, by differences in texture or structure of the glacial debris.

Only a moderate amount of change in the surface configuration in the eastern part of the county was brought about by glacial action. Most of this section is thoroughly drained.

Oxidation, leaching, and eluviation of soil material have been controlled largely by drainage factors. On the basis of moisture content, the soils of the county may be grouped in two large divisions, as follows: (1) Soils with normal moisture content, and (2) soils subject to saturation for variable periods each year.

Soils occupying smooth well-drained areas, in which the normal soil-building processes are allowed to act undisturbed by local variations in drainage, produce a number of distinguishing features common to soils in such positions. These are the fully developed soils of the county and express the regional profile. Representative bodies of such soils are considered mature and in forested or virgin areas have a generalized sequence of well-defined horizons from the surface downward, as follows: (1) A thin layer of leafmold or accumulation of forest litter, one-half to 1 inch thick; (2) dark-colored material or humous soil, 1 to 2 inches thick; (3) grayish-brown or light-brown light-textured material, 6 to 15 inches thick and acid in

reaction; (4) the layer of greatest color intensity and heavier textured than the material in the layers above; and (5) the substratum, or parent material.

The accumulations of forest debris in few places exceed an inch in thickness. The organic matter does not become thoroughly incorporated with the mineral soil, but in the process of decomposition there is some intermixing with the upper part of the topsoil. The effect of this is to produce a dark-gray layer of mineral soil 2 or 3 inches thick, the A_1 horizon.

There is a striking uniformity of texture and structure in corresponding horizons of the well-drained soils. The surface layer is lighter textured than the one below. Much of the finer soil material has been removed to greater depths. The top, or surface, layer in many places has a platy or laminated appearance, and the material in the subsurface layer is fragmented or crumbly. The fragments are flattened, angular, and range from about one-sixteenth to one-eighth inch in diameter.

The fourth layer, or B horizon, is distinctly heavier than either the horizon above or the one below. This is the zone of concentration of clay particles and sesquioxides, translocated from the surface layer in the process of soil formation. The material in this layer has a deeper, more intense, color than that in any other layer, owing largely to coloring from ferric oxide. It breaks into angular structure particles ranging in diameter from one-eighth to three-fourths inch. In places where the fragments break along cleavage lines, a thin film of well-oxidized material is noticeable, which is deeper colored than the interiors of the fragments. In this layer also are casts and rounded pockets of dark-colored material, probably caused by insects. The material in this layer is acid in reaction. Calcium carbonate has been removed to different depths, depending on the heaviness of the soil material.

The substratum consists of unconsolidated deposits of shale and sandstone debris, together with a small percentage of limestone. The Muskingum soils, however, have developed directly from sandstone and shale residuum.

The approach to uniform features, as color, texture, and structure, in the corresponding horizons of soils occupying similar positions indicates they have been acted on by similar forces. In the evolution of these soils from the parent material the dominant process has been leaching of soluble matter and the removal of fine particles from the upper layers to lower parts of the soil profile.

On steep lands, development of the regional profile has been prevented by the greater run-off, leaving less water for plant growth and soil formation, and by rapid removal of soil, accelerated by clearing and cultivation of the land. Erosion is most active in the hilly part of the county, where the material on the very steep slopes is removed nearly as rapidly as it is formed. The smooth ridge tops in the hilly section, however, develop normal profiles.

The mature upland soils may be differentiated into subgroups on the basis of texture, derivation, and soil characteristics of the successive layers. The largest, most uniform body of soil in this county, in which the regional profile is clearly developed, is correlated as Alexandria silt loam.

The successive layers of typical virgin Alexandria silt loam from the surface downward, as indicated in a profile of this soil in Liberty Township, one-half mile south of Center School, may be described as follows:

- A₁. 0 to 2 inches, dark grayish-brown silt loam mixed with organic matter from decomposed forest litter. Soil particles cling to the grass roots in small nodules. The pH value is 6.1.⁴
- A₂. 2 to 7 inches, light-brown or light grayish-brown silt loam which has a single-grain structure. The pH value is 4.5.
- B₁. 7 to 20 inches, yellowish-brown heavy silt loam which breaks into small angular fragments from one-sixteenth to one-eighth inch in diameter. The pH value is 4.6.
- B₂. 20 to 32 inches, yellowish-brown friable silty clay loam which breaks into angular clods from one-fourth to three-fourths inch in diameter. The cleavage faces of the lumps are brown or light reddish brown when moist, and the interiors are yellowish brown. The material in this layer is comparatively free from grit, except at the point where it merges into the layer below. The pH value is 5.8.
- C. 32 to 50 inches, light-brown friable unweathered or practically unweathered glacial till. The pH value is 7.9. A considerable quantity of sandstone and shale fragments occurs in the parent material, but there is sufficient lime carbonate to give a neutral or alkaline reaction.

In some areas the soils are derived altogether from weathered sandstone and shale accumulated by glacial action. These soils have profiles essentially like the profile of Alexandria silt loam, so far as texture and structure are concerned, but they are acid to a depth of more than 5 feet. Such soils are included with Fallsburg silt loam.

Other members of this group include the Wooster, Lordstown, Otisville, Zanesville, and Hanover soils. Although the Wooster soils have the regional profile, they differ from the Alexandria soil in the lighter texture of the B and C horizons and in that they are acid to great depths.

In Union Township, in a road cut 2½ miles east of Luray, Wooster silt loam shows the following layers:

- A₁. 0 to 3 inches, dark grayish-brown silt loam with a single-grain structure. The pH value is 6.9.
- A₂. 3 to 12 inches, light-brown or yellowish-brown silt loam of similar structure as the layer above. The pH value is 6.0.
- B. 12 to 21 inches, deep brownish-yellow friable heavy silt loam or light silty clay loam with a fine crumbly structure. The material breaks into small angular lumps from one-eighth to one-half inch in diameter. A thin coating of brown material appears on the outsides of the structure particles. The pH value is 5.0.
- C. 21 to 42 inches +, brown friable gritty heavy silt loam or light clay loam material which crumbles without definite structure. Some particles derived from shale contain more clay than others and assume a dull gloss when rubbed. The pH value is 5.1.

Leverett⁵ classifies the greater part of the glacial drift covering Licking County as of Wisconsin age. In the eastern part of the county are areas of material that he maps as Illinoian glacial drift. In the southwestern part areas of the Illinoian drift have given rise to Hanover soils, which resemble Wooster soils in texture but through a longer process of development have developed a deeper brown color, and the various layers of the soil are slightly thicker.

⁴The pH determinations given in this section of the report were made by J. G. Steele, of the Ohio Agricultural Experiment Station, by the quinhydrone method.

⁵See footnote 1, p. 2.

The original carbonates that may have been present have been removed to great depths.

The Lordstown soils occupy some ridges and slopes where glacial deposition was shallow, in most places less than 3 feet, and was left on top of consolidated sandstone and shale formations. Though there are many variations in the depth and in the layers comprising the Lordstown profile, these soils are somewhat analogous to the Wooster soils. One distinctive variation is a thin layer of material which has developed, through the process of weathering, from the underlying rock.

Another upland soil of minor extent that displays the profile of the well-drained soils is Zanesville silt loam. This soil is characterized by a freedom from gritty material in the well-defined A, B, and C horizons. The pH determinations for the different layers of this soil are as follows: 0 to 7 inches, 5.3; 7 to 17 inches, 5.5; 17 to 30 inches, 5.0; and 30 to 50 inches, 5.5.

Many soils of the terraces occupy drainage and topographic positions that have been favorable for soil-forming processes to impress well-defined characteristics on them. A number have taken on the features of a mature soil occurring in upland positions. Distinguishing differences from the upland soils are the smooth relief and the character of the parent material which is composed of assorted or stratified beds of gravel, silt, and sand. The Chenango soils are representative of this type of development.

Soil development has been retarded in many areas that are imperfectly drained, in which the soils are influenced by a high moisture content. They occupy smooth or depressed areas, and movement of soil moisture is slow. The effects of leaching, oxidation, and disintegration of the parent material and the translocation of soil particles differ considerably within short distances. A relationship exists between the stage of development and the degree of drainage. In flat, smooth areas, where the soils are waterlogged for long periods, soil development is retarded to about the minimum. Where drainage is being effected in the surface layers but retarded in the substratum an intermediate condition prevails between well-drained and poorly drained soils. Soils influenced by intermediate drainage have features that, within certain limits, resemble some characteristics of the well-drained soils. This relationship is exemplified in the character of the topsoil and upper part of the B horizon. The dynamic forces have been nearly as effective in these layers as in similar layers of mature soils.

In most of the poorly drained soils sublayers have developed which are heavier than any layer in the well-drained soils. The heavy texture of the subsoil is a feature that cannot be attributed altogether to the texture of the parent material, as in many instances this is about the same as that from which the well-drained soils are derived. In the wetter areas the surface layers of some soils contain a high percentage of organic matter and are very much darker colored.

Soils developed under imperfect drainage have the following general profile: (1) A dark-gray surface layer influenced to some degree by organic matter; (2) a light-colored light-textured layer; (3) a layer of maximum clay content, greatest degree of coherence, highest content of mottling, and greatest plasticity; and (4) the parent ma-

terial. Leaching is greatest in the second layer. Lime carbonate has not been so completely leached from these soils as from the well-drained soils.

A representative upland soil having inadequate drainage and which has been strongly influenced by organic matter is Marengo silty clay loam. A typical development of this soil occurs in Hartford Township, three-eighths of a mile east of Willison Corners. The profile shows the following layers:

- A₁. 0 to 8 inches, very dark brownish-gray granular silty clay loam. The pH value is 6.2.
- A₂. 8 to 14 inches, dark bluish-gray heavy silty clay loam which is slightly plastic when moist. On drying the material shrinks and breaks into small angular fragments that require moderate pressure to crush. The outsides of the particles are lighter in color than the insides. The pH value is 5.6.
- B. 14 to 30 inches, plastic heavy silty clay loam mottled with gray, yellow, and rust brown. Under average moisture the material breaks into large angular aggregates ranging up to 1 or 1¼ inches in diameter, which, on further drying, crumble into smaller fragments. The pH value is 6.5.
- C. 30 to 45 inches, mottled gray and dull yellowish-brown silty clay loam which is not so plastic or so heavy in texture as the material in the layer above. With depth it becomes more friable and somewhat lighter in color.

A light-colored poorly drained soil, in which organic matter has had little influence, is represented by Bennington silt loam. Following is a description of a profile of this soil observed in Jersey Township, one-fourth mile north of Rowe School:

- A₁. 0 to 6 inches, brownish-gray mellow silt loam having a single-grain structure.
- A₂. 6 to 11 inches, brownish-gray silt loam containing gray and rust-brown mottles, which is heavier than the surface soil. The material fractures into small angular lumps that crush with slight pressure. Dull-gray material coats the exteriors of the lumps, and the insides are yellow.
- B. 11 to 26 inches, dull yellowish-brown moderately heavy silty clay loam or clay loam streaked with rust yellow and gray. This layer contains small masses of dull brownish-gray or dark-gray material that are heavier in texture and have a higher clay content than the rest of the layer. The angular fragments, into which the soil crumbles, range in diameter from one-fourth to 1 inch. A thin coating of gray material on the facets gives way to rust-brown or yellow material on the insides. When bored with a soil auger, the material comes out with a high gloss.
- C. 26 to 41 inches, brownish-gray friable gritty silty clay loam mottled with gray and light gray. Gray veins of lime material are present in this layer. The upper part is softly plastic and sticky when wet. The layer contains fragments of sandstone and shale in different stages of decay.

Condit silt loam differs from Bennington silt loam in that it has gray mottles in the topsoil.

A soil developed under intermediate drainage conditions is illustrated by Cardington silt loam. It has an undulating relief. Surface drainage is fair, but internal drainage is poor. A description of a typical profile of this soil, observed in a pasture field 2 miles east of Johnstown, follows:

- A₁. 0 to 4 inches, dark-gray smooth mellow silt loam mixed with a small percentage of organic matter. The pH value is 6.0.
- A₂. 4 to 8 inches, light yellowish-gray heavier silt loam with a fine crumbly structure. The outsides of the structure particles, which range from about one-sixteenth to three-eighths of an inch in diameter, are coated

- with gray. When broken they show a yellow color. The layer contains a small percentage of gravel. The pH value is 6.1.
- B. 8 to 17 inches, heavy crumbly silt loam mottled with yellowish brown and light gray. The particles into which the material breaks are from one-eighth to 1 inch in diameter. Their outsides are veneered with dull yellow. There is some fracture of the soil along cleavage lines, where the color is dark gray. When dry, the fragments resist crushing under normal pressure. When they are powdered, the color is yellowish brown. Worm casts and root channels are lined with gray. The pH value is 5.8.
- B. 17 to 34 inches, heavy silty clay loam showing variegated colors caused by mottles of dark grayish brown and yellow. This material has an angular clodlike structure, and the separate fragments range from one-fourth to 1 inch in diameter. Some faces of the particles are specked with grayish black and some with dark gray or rust brown. The powdered material is yellowish brown. In the lower part of the layer are small lenses which are dull chocolate brown on the outsides and yellowish brown on the insides. The pH value is 5.3.
- C. 34 to 45 inches, heavy but friable silt loam mottled with dark grayish brown and yellow. When the material is crushed, the color is yellowish brown. Sandstone and shale fragments undergoing decomposition are part of the soil mass. The pH value is 8.1.

Canfield silt loam has similar color characteristics, but it differs from the Cardington soil in its lighter texture in the corresponding layers and in that it is acid to a great depth.

Soils composed of recent alluvium in the valleys of streams show no development of a profile. There are slight differences in color, however, in the several layers of sediments that comprise the soil. The alluvium is local in origin and is modified to some degree through differences in drainage conditions.

SUMMARY

Licking County is in the central part of Ohio. It includes an area of 685 square miles. It lies on the western side of the Allegheny Plateau. The greater part of the land has been modified by glaciers. The eastern part of the county presents a wide diversity of surface features and includes undulating and rolling country with narrow rounded or flat ridges bordered by steep slopes. The valleys are narrow and moderately deep. The western part is a broad undulating till plain with but slight differences in relief.

Drainage in the plains country is not thoroughly developed, as only a few streams traverse this section. The escarpments are broad and include many inadequately drained areas. In contrast, drainage on the west side is well established, and all the streams are fed by numerous tributaries. Licking River is the master stream and flows eastward into Muskingum River. Practically all the drainage of the county finds its way into Licking River.

Licking County was organized March 1, 1808. Its total population in 1930 was 59,962, and the urban population, centered in Newark, the county seat, represents 51 percent of this.

Main lines of the Baltimore & Ohio and the Pennsylvania Railroads furnish freight and passenger service to towns along their systems, and paved highways connect all the towns. A large part of the farm produce is transported to market by autotruck.

The climate is characterized by fairly cold winters, mild pleasant summers, and moderate precipitation. The average frost-free season includes a period of 164 days.

The most important farm crops, based on acreage, are corn, oats, wheat, and hay. Dairying is an important farm activity. The largest acreage of farm land is devoted to growing hay and forage crops. Hay consists principally of timothy and clover, and covers about 19 percent of the total acreage of farm land. Among the cereal crops, corn occupies the largest acreage—about 15 percent of the farm land. The acreage in wheat and oats fluctuates from year to year. Rye, barley, and buckwheat are grown on a small acreage. Potatoes are grown, chiefly in small fields, and the average yield is about 75 bushels an acre. A few farmers grow potatoes intensively for nearby markets. Vegetables are grown mostly for home consumption, and yields above requirements for the home are marketed.

A large part of the agricultural income is derived from the sale of dairy and poultry products, and a small income is obtained through the sale of livestock and orchard fruits. Sheep raising is an important pursuit on many farms.

The use of commercial fertilizer is widespread.

The average size of farms in 1935 was 91.5 acres. The greater number of farms range in size between 50 and 174 acres. The percentage of farms operated by owners in 1935 was 73.8 percent.

The soils of this county occur in a number of very generalized belts that include many different kinds of soils which are members of other belts. In some sections this has caused a complicated arrangement of the soils. Most farm units are made up of a number of different kinds of soils that usually are managed alike.

Drainage conditions are important factors that have influenced the utilization of the soils for farming.

The well-drained light-colored soils of the uplands include the Alexandria, Wooster, Hanover, Otisville, Zanesville, Fallsburg, and Lordstown soils. They have light grayish-brown light-textured surface soils overlying yellow or brown heavier subsoils. These soils are friable and of moderate fertility. The Alexandria and Wooster silt loams are the most extensive. The other soils, to some extent, may be the dominant soils on individual farms, but on many farms they occur in complicated association with soils of other groups. They are all utilized to some extent for the production of corn, oats, wheat, and hay. Dairying is an important branch of farming that supplements the general farm practices.

The light-colored soils of the uplands having deficient drainage include Cardington silt loam, Canfield silt loam, and the heavy-subsoil phase of Hanover silt loam. These soils occupy an intermediate drainage position. Their surface soils are grayish-brown silt loams, and the upper parts of their subsoils are yellow, but with depth they become mottled as the result of deficient drainage. There are few large areas of these soils, but collectively the bodies form irregular broken belts and occur in complicated combination with soils of other groups.

General farming, in conjunction with dairying, is followed on these soils. They are low in organic matter and require applications of fertilizers to overcome some deficiency of plant nutrients. They also need tiling or ditching to aid in the control of moisture.

The imperfectly drained soils with heavy subsoils are characterized by smooth or gently undulating relief, and movement of drainage is

very slow and impeded by a heavy subsoil. These soils have comparatively light-textured topsoils that grade rather abruptly into much heavier subsoils. They are acid in the surface layers, but the material becomes neutral or alkaline at some depth. Members of this group are Marengo silty clay loam, Bennington silt loam, and Condit silt loam. With the exception of Marengo silty clay loam, the soils have a gray topsoil. The Marengo soil is dark in the surface layer, owing to a high content of organic matter.

These soils are used mostly for corn, hay, and oats, and to a small extent for wheat, barley, and potatoes. The largest acreage is in hay or pasture land. When drained these are good soils for grass, but they require a system of artificial drainage before they can be utilized satisfactorily for cultivated crops. They remain wet and cool in the spring, and crops are slower in starting growth than on soils of other groups. Marengo silty clay loam is a very good corn soil when properly drained.

The light-colored soils of the hill lands, which are derived from sandstone and shale material, occur in the eastern part of the county. This is the hillier part which was not influenced by glacial activity. Drainage is well established. The Muskingum, Eifort, Frankstown, and Rarden soils are included in this group. These soils are low in organic matter and have grayish-brown surface layers. The topsoil for the most part is silt loam. The subsoil is heavier and friable but lacks uniformity of development. Because of its unfavorable surface relief, much of the land is subject to erosion and not suitable for farming. Some of the soils are of inferior quality for high crop production. Farming in general is confined to the smoothest ridges and slopes. General farming practices are followed to less extent than on the glacial soils. Sheep raising is important. Hay, corn, and oats form a common rotation. Yields average lower than on the well-drained glacial soils.

The well-drained soils of the stream terraces constitute some of the more important agricultural soils of the county and include the Chenango and Mentor soils. They respond readily to good management and can be maintained in a productive state for crops. Crop rotations include corn, oats, wheat, and hay. Dairying is important as a side branch of farming. These soils support a prosperous agriculture.

The inadequately drained soils of the stream terraces are subject to diverse degrees of drainage, which affect their crop-producing power. This group includes some soils having light-gray surface soils and some which are darkened from intermixing with organic matter. The light-colored soils produce low yields of crops. They require fertilizers and artificial drainage for their improvement. Chenango silt loam, mottled-subsoil phase, occupies intermediate drainage situations, whereas the Braceville and Tyler soils are poorly drained. The dark soils when adequately drained are good corn and hay soils. The Blago and Atherton soils contain a high percentage of organic matter in the surface layers. The Atherton soils have a gravelly substratum, and the Blago soils are underlain by thick heavy subsoils.

The soils of the alluvial flood plains are composed of sediments deposited by stream action, and they are subject to inundation. The

better grades of alluvium are used for the production of corn and hay, and permanent pastures are maintained on the less fertile imperfectly drained areas. The well-drained alluvial soils are members of the Chagrin and Pope series. The Chagrin soils are good corn soils. The Pope soils consist of materials washed from residual sandstone and shale soils. Pope silt loam is used to some extent for corn, but the greater part of the sandier soils are kept in pasture.

The gray alluvial soils comprise the Holly and Atkins soils which occupy poorly drained positions. They are of lower grade than the other alluvial soils and are used primarily for pasture. The dark-colored soils having drainage similar to that of the gray soils are the Papakating soils, the larger bodies of which are used for corn and hay and to some extent for oats. Most of the areas in the narrow valleys are pastured.

Alluvial sediments that are influenced by intermediate drainage conditions are included in the Lobdell, Philo, Luray, Wallkill, and Killbuck soils. They all, except the Philo soils, have been derived from alluvium washed from glacial deposits. The larger areas are used to some extent for corn and hay, but their chief utilization is for pasture.

The organic soils represent the remains of vegetation in various stages of decomposition. A few areas are used for truck crops and hay.

Authority for printing soil survey reports in this form is carried in the Appropriation Act for the Department of Agriculture for the fiscal year ending June 30, 1933 (47 U. S. Stat., p. 612), as follows:

There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than two hundred and fifty copies shall be for the use of each Senator from the State and not more than one thousand copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.



Areas surveyed in Ohio, shown by shading. Reconnaissance surveys shown by northwest-southeast hatching; cross-hatching indicates areas covered by both detailed and reconnaissance surveys.

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