Soil Survey

Series 1932, No. 32. Issued November 1938

Athens County Ohio

By
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Ohio Agricultural Experiment Station

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
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SOIL SURVEY OF ATHENS COUNTY, OHIO

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COUNTY SURVEYED

Athens County is in southeastern Ohio (fig. 1). The southeastern corner touches Ohio River. Athens, the county seat, is about 75 miles southeast of Columbus, Ohio, and 40 miles west of Parkersburg, W. Va. The county includes an area of 506 square miles, or 323,840 acres.

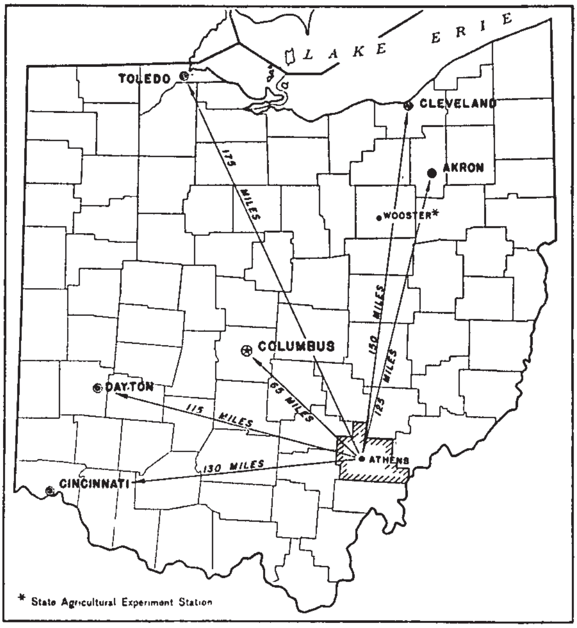

FIGURE 1.—Sketch map showing location of Athens County, Ohio.

Athens County lies in the region of the Appalachian Plateaus and has the physiographic features characteristic of that region. Although this part of the plateaus is highly dissected by streams, the ridge tops are generally even and uniform. The county is broken only in the north-central and northeastern parts by conical hills rising from 100 to 150 feet higher than the general level. In several places, especially in Ames, Carthage, Lee, and Troy Townships, are flats and benches from 100 to 200 feet below the general level of the plateau. These are valley floors of streams of an earlier period.

The great dissection of the plateau by streams gives a sharp relief. Ridge tops are narrow, and slopes are steep. The slopes have a maximum gradient of 70 [1] percent, about 40 percent being the average, but in places perpendicular cliffs of massive sandstone range from 60 to 80 feet in height. Remnants of undulating or gently rolling old val-

[1] Percentage of slope is the number of feet of vertical rise in a horizontal distance of 100 feet.

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ley floors and flood plains break the continuity of the slopes and in places, as at Albany and Coolville, are wide enough to form conspicuous features of the landscape.

According to United States Geological Survey topographic sheets, elevations range from 593 feet above sea level at Hockingport on Ohio River to 1,055 feet on Mount Nebo near Chauncey. For the most part, the elevation of the ridges ranges from 900 to 980 feet. A few hills along the northern part of the county are more than 1,000 feet high. Elevations of some of the towns and villages are: Albany, 774 feet; Amesville, 631 feet; Athens, 740 feet; Coolville, 700 feet; Glouster, 680 feet; and Torch, 720 feet.

Natural surface drainage is good, and in places run-off is excessively rapid. Internal drainage is good except on a few broad level areas where heavy subsoils prevent the downward movement of water.

The main drainage is supplied by Hocking River and its tributaries. Most of the tributary streams enter Hocking River from the north, but Margaret Creek and Factory Creek enter from the south and west, respectively. Side streams of the tributaries are dendritic, with the exception of Federal Creek, which is an axial stream in the form of an open circle. Its tributaries are arranged radially on the northern side. Lodi and Carthage Townships are drained by the headwaters of Shade River, which flows south to Ohio River.

The original vegetation was a forest of beech, yellow poplar, white oak, sugar maple, black walnut, basswood, shagbark hickory, white ash, northern red oak, chestnut, and red maple (*5*).[2] Much of the original cover has been removed, but sufficient remains to show considerable variation, which, in a general way, corresponds with variations in the soil types.

The area from which Athens County was formed was organized as the Northwest Territory in 1785. Two years later Congress granted permission for the sale of lands in the territory to companies or individuals. The Ohio Land Co., organized by men from the New England States, contracted for 1,500,000 acres of land. Sufficient funds could not be raised to handle the full amount of the contract, so only half that amount was bought. The whole tract, comprising what is now Washington, Morgan, Athens, Hocking. Vinton, Meigs, Gallia, and Lawrence Counties, was organized as Washington County. In 1805 Athens County was formed. Athens became the county seat. The county originally contained 1,053 square miles, or about 30 townships. This included not only the present county of Athens but also three townships now in Hocking County, seven townships in Vinton County, five townships in Meigs County, two townships in Morgan County, and a strip of land 10 miles long and 1 mile wide in Washington County.

Most of the officers of the Ohio Land Co. were graduates of Harvard or Yale Universities and were much interested in education and religion. Section 16 in every township was reserved, therefore, as school land, and all revenue derived from it was used to support the township schools. Section 29 was reserved for religious institutions.

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[2]Italic numbers in parentheses refer to Literature Cited, p. 39.

In addition, two complete townships, Athens and Alexander, were set aside to help start Northwestern University, now Ohio University.

The surveyor for the Ohio Land Co. intended that the first settlement should be made on "The Plains", but his directions were misunderstood, and the first settlement was made on the present site of Athens.

The first settlers were New Englanders, mainly officers and soldiers of the Revolutionary War. Their education is shown by the names of some of the townships, such as Athens, Rome, Carthage, Canaan, and others. A large part of the present population is descended from these people. The opening of coal mines brought an influx of immigrants from Europe—about equal numbers of Hungarians, Germans, Czechoslovaks, and English—but they are a comparatively small part of the population. In Bern and Rome Townships are many Negroes.

According to the Federal census for 1930, Athens County has a population of 44,175, of which 28,698, or 64.9 percent, are classed as rural. There are no large cities. Athens has a population of 7,252; Nelsonville, 5,322; and Glouster, 2,903. The rural population increased to a maximum of 70.7 persons a square mile in 1920. In 1930 it was only 68.9 persons a square mile.

Transportation facilities are excellent. A network of railroads covers the county. These include the St. Louis division of the Baltimore & Ohio Railroad, the Hocking Valley branch of the Chesapeake & Ohio Railroad, and a branch of the New York Central Railroad from Columbus and Toledo to Charleston, W. Va. In addition, the Federal Valley Railroad, a coal and freight line, connects Amesville and Lathrop with the New York Central line at Corning.

State and national highways traverse the county so thoroughly that no part is more than 4 miles from an improved road. One of the main through highways, United States Highway No. 50, crosses the county in an east-west direction. Many of the county roads are graveled and maintained in good condition.

There is very little shipping by barge lines on Ohio River, although that means of transportation is available. Transportation by air is handicapped because few level areas are large enough for landing fields.

Telephone and electric services are good in the cities and villages but limited in the outlying regions. Gas lines serve the towns and several farming communities, especially in the vicinity of Stewart.

There are several new modern centralized schools, but the one-room school is still used in several townships. The number of rural churches has decreased.

The earliest industry was saltmaking, which centered around Chauncey and Beaumont. This industry long ago went out of existence, however, as it could not compete with more efficient plants elsewhere. At present the principal industry is coal mining, Nelsonville and Sunday Creek Valley being the center of the most important coal fields in Ohio. Keen competition from outside the State, however, has caused a decline in this industry. The number of small wagon mines that sell by truck direct to the consumer has increased in recent years.

CLIMATE

The climate of Athens County is continental and favorable for a variety of crops. There is a considerable variation between summer and winter temperatures, and winter temperatures are not favorable for the growth of winter crops. The average frost-free season of 160 days is between May 4 and October 11. The earliest frost date recorded is September 19, and the latest is May 28. Early crops are occasionally damaged by frosts, especially along stream valleys. Precipitation is fairly uniform throughout the year, and is relatively reliable from year to year. Late spring rains often cause floods that damage crops along stream flood plains.

Table 1, compiled from the records of the United States Weather Bureau station at Amesville, gives the important climatic data.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Amesville, Athens County, Ohio*

[Elevation, 630 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1895)	Total amount for the wettest year (1890)	Snow, average depth
	°F.	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	33.5	72	−21	3.25	3.49	3.37	4.6
January	31.4	75	−32	3.74	4.14	4.59	8.7
February	32.9	73	−20	2.74	.70	5.37	6.1
Winter	32.6	75	−32	9.73	8.33	13.33	19.4
March	42.8	88	−6	3.53	2.43	6.38	2.2
April	52.3	94	12	3.15	1.55	2.71	.9
May	62.1	99	24	3.71	2.07	5.29	(1)
Spring	52.4	99	−6	10.39	6.05	14.38	3.1
June	70.6	100	34	4.19	2.88	2.91	.0
July	74.5	106	40	4.39	1.56	2.92	.0
August	73.0	110	40	4.36	3.79	5.60	.0
Summer	72.7	110	34	12.94	8.23	11.43	.0
September	66.9	98	28	2.77	1.74	6.46	.0
October	54.7	94	16	2.94	1.46	3.84	.3
November	42.4	79	8	2.58	2.13	2.58	1.3
Fall	54.7	98	8	8.29	5.33	12.88	1.6
Year	53.1	110	−32	41.35	27.94	52.02	24.1

[1] Trace.

AGRICULTURE

Athens County is one of the oldest agricultural counties in the State. The early settlers were interested in establishing homes and making a living from the soil. They cleared the land and planted corn, wheat, and fruit trees to provide for their own needs. As the production of crops increased, it became necessary to market the surplus. Grains were fed to livestock, and fruit juices were made into brandy; these products were either taken overland to markets in the East or sent by flatboats to New Orleans. At present the chief market products are livestock, dairy products, fruit, and some corn and wheat.

Table 2, compiled from reports of the Federal census, shows the development of the land for farm use since 1880.

TABLE 2.—*Statistics on farm land in Athens County, Ohio, in stated years*

Year	Farms	Average size	Total land in farms		Improved land	
					In farms	Per farm
	Number	*Acres*	*Acres*	*Percent*	*Percent*	*Acres*
1880	2,469	119.0	294,807	94.6	69.4	82.8
1890	2,630	105.0	276,175	88.6	75.7	79.5
1900	3,004	98 9	297,166	95 3	77.2	76.4
1910	2,726	105 3	286,923	92.1	70.3	74.0
1920	2,503	102.7	256,974	82.4	73.1	75.1
1930	2,009	113.4	227,874	73.1	39.5	44.8
1935	2,658	93.4	248,283	79.7	31.5	29.4

Table 2 shows that the county reached its maximum agricultural development about 1900. The decrease in improved land since 1900 may be accounted for by the reversion of steep slopes and other undesirable lands to brush and timber.

Table 3 shows the acreages of the important crops in 1879, 1889, 1899, 1909, 1919, 1929, and 1934. The total acreage in crops reached a maximum about 1900, and had decreased markedly by 1934.

TABLE 3.—*Acreage of the important crops in Athens County, Ohio, in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn	23,761	19,482	22,713	20,300	18,799	13,222	14,926
Oats	2,544	3,137	986	1,858	3,122	1,776	369
Wheat	19,508	9,933	18,077	7,313	11,154	2,820	5,208
Hay (all kinds)	20,474	32,758	25,017	29,360	27,638	24,047	23,792

Although the acreage has decreased, the total production has not declined, proportionally, as improved farm methods and practices have increased yields. Table 4 shows the average yields of four crops in 10-year periods from 1850 to 1929.

TABLE 4.—*Average yield of crops per acre in Athens County, Ohio, in stated periods (4, 6)*

Crop	1850–59	1860–69	1870–79	1880–89	1890–99	1900–09	1910–19	1920–29
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
Corn	31.0	35.6	32.1	33.8	28.6	32.3	36.0	38.7
Oats	11.6	21.3	17.2	16.8	17.7	20.0	23.8	28.3
Wheat	10.6	8.2	9.1	10.1	13.1	12.3	14.5	13.6
	Tons	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Hay	1.29	1.24	.98	1.08	1.04	1.07	1.02	1.4

During the early history of the county, fruit was a very important crop. In the last three decades the number of trees has declined materially, but yields have not decreased correspondingly. Today apple growing is centered in Troy Township. Until 1915 Ames Township was the center of peach growing, but at present this crop is produced in small and widely scattered orchards.

The average acre value of farm land and buildings was $29.45 in 1910, $42.05 in 1920, $36.41 in 1930, and $25.88 in 1935.

The farms are usually operated by one man, and little money is spent for labor except during rush seasons. In 1910, 49 percent of the farms reported labor expenditures totaling $105.96 a farm. By 1930, the number of farms reporting labor costs had decreased to 36.6 percent, with an average expenditure of $203.22. The increased cost of labor is due in part to higher wages.

In 1935, 71.7 percent of the farms were operated by owners, 5.2 percent by part owners, 0.5 percent by managers, and 22.6 percent by tenants. About one-third of the tenant-operated farms are worked on a cash-rental basis and the remainder on a share basis.

The productivity of the soil is reflected in the buildings, equipment, and animals on the farm. In an area with relatively good soils the buildings are large, modern, and in good condition. Machinery is modern and maintained in good condition. Work animals are high-grade horses and mules. Dairy cattle are purebred Jerseys or Holstein-Friesians or high-grade animals, many of which are crosses between one of these breeds and beef cattle. Most of the beef cattle are Herefords or Shorthorns. In poorer, less productive areas the buildings are small, old, and in poor condition. Farm equipment is light, out-of-date, and in need of repairs. Work animals are small and old. Most of the beef cattle are small and have been crossed with dairy cattle.

Most of the farm income is derived from the sale of livestock or livestock products. For the most part, two or more kinds of livestock are raised.

Nearly every farm has some dairy cattle. The largest dairy farms are maintained along the good roads, especially in the vicinities of Albany and Amesville. The farmers sell whole milk at Athens or at Parkersburg, W. Va. Farmers at some distance from the main road sell cream in Columbus or make butter to be retailed in some nearby town or village.

Some farmers in Ames and Bern Townships raise beef cattle to be fed or to be sold as feeders. As the supply of beef cattle locally raised is not sufficient for the county, many steers are shipped in to be fed. The largest herds of feeders are in Ames, Bern, Rome, Canaan, and Lodi Townships. Many farmers raise only two or three steers to be sold each year. These cattle are usually sold to local commission men who ship them from Guysville, the main shipping point, to Pittsburgh and Cincinnati.

At one time, sheep raising was an important industry, but since 1890 it has declined considerably. White and Cooper (*9*) attribute the decline to the depredations of dogs. At present there are no large flocks. Most of the sheep raised are of the medium-wool breeds, mainly Shropshire, but some are of the combination wool and mutton breeds. Wool is sold through a State cooperative association.

Some poultry is raised, chiefly chickens of the egg-producing breeds, but poultry raising is not important. Eggs are sold locally or to commission men who ship them to Pittsburgh.

Table 5 shows the average number of domestic animals on farms in 10-year periods from 1850 to 1929.

TABLE 5.—*Average number of domestic animals on farms in Athens County, Ohio, in stated periods (4, 6)*

	1850–59	1860–69	1870–79	1880–89	1890–99	1900–09	1910–19	1920–29
Horses	4,694	6,040	5,844	4,849	5,227	4,580	6,846	4,935
Cattle	14,547	14,004	14,943	13,265	12,171	10,103	14,901	15,925
Sheep	31,138	59,489	51,702	90,239	54,365	43,906	35,500	24,238
Hogs	16,404	14,432	13,747	6,679	4,668	2,732	5,171	4,904

Market gardening is not important. Many farmers sell their surplus garden vegetables and fruits, but only two or three, in the vicinity of Albany, make a business of growing small fruits and vegetables.

The use of fertilizers is increasing. In 1910, 39.9 percent of the farms spent an average of $24.37 for fertilizers. In 1930 the average expenditures for fertilizers by 45.7 percent of the farms was $47.09. Lime is applied at the rate of 1 to 3 tons an acre for red clover and alfalfa.

All uncropped farm land and nearly all wood lots are used for pasture. Pasture land receives very little attention. Practically none of it is fertilized, and on only a few farms are weeds and brush cut each year. This accounts for the large percentages of brushland on the steep soil types.

Crops are grown on the gentle slopes and stream bottoms, and the uplands are used for pasture. In some sections, however, especially where the steep phase of Muskingum silt loam predominates, it is not unusual to find crops on the steep hillsides.

On some farms strip cropping is practiced on steep hillsides; that is, strips of grass are grown between strips of cultivated crops. This practice should be encouraged.

On the upland soils a crop rotation of corn, oats or wheat, and then hay for 2 to 4 years is the rule.

Corn is seldom grown for more than 1 year in the uplands, but on the flood plains it is frequently planted on the same fields year after year. Corn does not receive much fertilizer. As a rule, it is planted on sod land enriched by manure. On the flood-plain lands, applications of 100 to 200 pounds of 16- or 20-percent superphosphate an acre are not uncommon. On a few farms a complete fertilizer is used at the rate of 100 to 125 pounds an acre.

Wheat follows corn in the rotation. The land is seldom plowed but is usually run over two or three times with a disk. From 100 to 200 pounds of 16- to 20-percent superphosphate an acre or a complete mixed fertilizer is used.

Clover and timothy are sown on the wheat ground in the early spring or are sown with oats as a nurse crop.

The ordinary farm orchard receives little or no care. Commercial orchards are pruned each year. The trees are sprayed four times each year, in "the pink", at "petal fall", 2 weeks later, and in the middle of July. Fertilizers, such as sodium nitrate and ammonium sulphate, are applied at the rate of 3 or 4 pounds for a large tree.

SOIL-SURVEY METHODS AND DEFINITIONS

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

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called collectively the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil[3] and its content of lime and salts are determined by simple tests. The drainage, both internal and external, and other external features, such as the relief or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

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

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

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

A phase of a soil type is a subgroup of soils within the type which differ from the type in some minor soil characteristic that may,

[3] The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity. The following terms are used to describe the reaction of soils of known pH: Extremely acid, below pH 4.5; very strongly acid, pH 4.5–5.0; strongly acid, pH 5.1–5.5; medium acid, pH 5.6–6.0; slightly acid, pH 6.1–6.5; neutral, pH 6.6–7.3; mildly alkaline, pH 7.4–8.0; strongly alkaline, pH 8.1–9.0; very strongly alkaline, pH 9.1+.

nevertheless, have an important practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. Thus, for example, within the normal range of relief for a soil type there may be portions which are adapted to the use of machinery and the growth of cultivated crops and other portions which are not. Even though there may be no important differences in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance the more sloping portions of the soil type may be segregated on the map as a sloping or hilly phase. Similarly, soils having differences in stoniness may be mapped as phases even though these differences are not reflected in the character of the soil or in the growth of native plants.

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

SOILS AND CROPS[4]

Soils of this county may be classed in the following five groups, based on the material from which they were developed: (1) Soils of the rolling uplands developed from sandstone and shale; (2) soils of the rolling uplands developed from limestone, sandstone, and shale; (3) soils of the rolling uplands developed from red clay shale, sandstone, and shale; (4) soils developed from alluvial material on terraces; and (5) alluvial soils on flood plains. Soils developed from residual materials, from sandstone, shale, clay shale, and limestone, cover a large proportion of the area and are markedly influenced by the character of the rocks from which they were formed. In some places these rocks are so thin-bedded and so interbedded that the soils derived from them are too intimately mixed to be shown separately on a small-scale map. Soils developed from alluvial material on the terraces can be divided into two subgroups on the basis of the character of the substratum: The first group is underlain by silts and clays, and the second, by sands and gravel. The alluvial soils on flood plains can be divided also into two subgroups: The first group includes soils with acid reaction; the second, soils with neutral or alkaline reaction.

In the following pages the different soils are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 6.

[4] A number of areas mapped as Muskingum loam, steep phase, and Meigs silty clay loam, steep phase, in Athens County, join areas mapped in Washington County as steep broken land. In Athens County, as in other more recent soil surveys, areas of rough land that might have been mapped as steep broken land or rough broken land in earlier work have been indicated as steep phases of certain soil types, such as Muskingum loam, which normally occur on steeply sloping land. Such nomenclature, although it cannot indicate uniform or consistently developed soil types on these steeply sloping lands does show the distribution of the different kinds of soil and rock materials significant in forestry and other land uses.

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TABLE 6.—*Acreage and proportionate extent of soils mapped in Athens County, Ohio*

Soil type	Acres	Percent	Soil type	Acres	Percent
Muskingum silt loam	41,728	12.9	Wheeling fine sandy loam	64	(1)
Muskingum silt loam, steep phase	70,144	21.7	Wheeling silt loam	128	(1)
Muskingum loam	4,544	1.4	Chenango loam	448	0.1
Muskingum loam, steep phase	13,824	4.3	Chenango silt loam	512	.2
Wellston silt loam	2,880	1.0	Pope loam	1,664	.5
Tilsit silt loam	8,192	2.5	Pope silt loam	6,080	1.9
Rarden silt loam	2,112	.7	Pope silt loam, alluvial-fan phase	1,216	.4
Rarden silt loam, eroded phase	64	(1)	Philo silt loam	12,864	4.0
Coolville silt loam	960	.3	Atkins silt loam	4,544	1.4
Brooke silty clay loam	256	.1	Atkins silt loam, alluvial-fan phase	64	(1)
Westmoreland silty clay loam	5,248	1.6	Atkins silty clay loam	384	.1
Westmoreland silty clay loam, steep phase	14,208	4.4	Atkins silty clay loam, high-bottom phase	64	(1)
Belmont silty clay loam	13,312	4.1	Moshannon silty clay loam	512	.2
Belmont silty clay loam, steep phase	31,488	9.7	Moshannon silt loam, alluvial-fan phase	256	.1
Upshur clay	128	(1)	Huntington silty clay loam	5,952	1.8
Meigs silty clay loam	19,712	6.1	Huntington silty clay loam, high-bottom phase	320	.1
Meigs silty clay loam, steep phase	39,680	12.3	Huntington silt loam	1,536	.5
Holston silt loam	256	.1	Huntington loam	3,712	1.1
Holston silt loam, high-terrace phase	128	(1)	Lindside silty clay loam	3,328	1.0
Holston loam	64	(1)	Lindside silty clay loam, high-bottom phase	384	.1
Monongahela silt loam	1,088	.3	Lindside silt loam	640	.2
Monongahela silt loam, high-terrace phase	3,584	1.1	Rough broken land	512	.2
Tyler silt loam	768	.2	Mine pits and mine dumps	704	.2
Tyler silt loam, high-terrace phase	640	.2	Total	323,840	-----
Vincent silt loam	576	.2			
Wyatt silt loam	768	.2			
Hocking silt loam	1,344	.4			
Hocking silt loam, poorly drained phase	256	.1			

[1] Less than 0.05 percent.

SOILS OF THE ROLLING UPLANDS DEVELOPED FROM SANDSTONE AND SHALE

Of the soils of the rolling uplands, those developed from sandstone and shale are dominant. They are characterized by grayish-brown surface soils, yellowish-brown subsoils, and substrata composed of shale or sandstone in varying stages of disintegration. The principal soils of this group are those of the Muskingum series. They are found in rolling and steep areas. Wellston silt loam occurs where the land is gently rolling and the soil material is deeper. Tilsit silt loam occupies level to flat areas, where underdrainage is imperfect. The parent materials of all these soils contain a large percentage of sandstone. Rarden silt loam and Coolville silt loam have surface soils and upper subsoil layers similar to the corresponding layers of Muskingum silt loam and Wellston silt loam, but they have variegated red, yellow, and gray heavy-textured lower subsoil layers rather than the characteristic yellowish-brown light-textured lower subsoil layers. The texture and color of the subsoil are produced in the process of weathering of the parent material, which is largely shale. Rarden silt loam occurs in rolling areas; and Coolville silt loam, in gently rolling areas. These grayish-brown soils developed from sandstone and shale occur mainly in the western part of the county, in Lee, Waterloo, York, Athens, Dover, and Trimble Townships, but they are also found in many other parts.

Muskingum silt loam.—Muskingum silt loam is on ridge tops and hillsides with slopes greater than 10 percent and less than 25 percent. It is found in all parts of the county. In Lee Township it constitutes the greater part of the agricultural land.

When cultivated, the surface soil of Muskingum silt loam is loose friable light grayish-yellow silt loam. Rock fragments are common both on the surface and throughout the soil. The subsoil is slightly compact yellowish-brown or bright yellowish-brown moderately heavy silt loam. The soil breaks into irregular lumps but does not have a definite structure. Sandstone and shale fragments are numerous. Below a depth of 20 inches is a mixture of soil and partly disintegrated rocks.

Erosion, especially sheet erosion, is active on cropped areas and keeps the soil shallow. The fine-textured material is constantly being washed away, leaving behind the coarser soil particles and rock fragments and in places exposing the subsoil.

About 95 percent of this soil has been cleared of its native vegetation—white oak, red oak, hickory, poplar, chestnut, beech, and maple. Abandonment of farms and poor farm practices have resulted in the reversion of 17 percent [5] of this soil to brushland covered with sumac, hickory, sassafras, briers, broomsedge, and poverty grass. About 23 percent of the area is pasture land which, in general, is poor, with a vegetation of poverty grass, broomsedge, wild carrots, and daisies. About 55 percent of the soil is in crops. Corn, the most common crop, is grown on about 10 percent of the land. Yields average about 25 bushels an acre, but with good management, yields of 40 bushels are common. Wheat is grown on about 6 percent of the soil. Yields range from 8 to 30 bushels an acre and average 14 bushels. Mixed hay and timothy are grown on about 12 percent of the soil. Yields average about 1 ton an acre. Red clover and alfalfa can be grown only after heavy applications of lime and manure. Soybeans do well; they yield 1 to 2 tons of hay an acre.

Muskingum silt loam, steep phase.—The steep phase of Muskingum silt loam differs from the typical soil in that it occupies slopes greater than 25 percent; as the surface layer and the subsoil layer are more shallow, the substratum in most places is at a depth of 15 to 18 inches; and rock fragments, both on the surface and throughout the soil, are larger and more numerous.

Some areas mapped as this soil might be classed as very steep, as they have a slope in excess of 50 percent. Most of these areas are in the vicinity of Mineral.

The native vegetation consists of white oak, red oak, chestnut, hickory, poplar, maple, beech, and basswood. Most of the land which has been abandoned after being cleared has a growth of broomsedge, briers, sassafras, sumac, and hickory.

Although the most extensive soil in the county, the steep phase of Muskingum silt loam is relatively unimportant in crop production. Cultivation allows erosion, and the surface is soon denuded of soil. At present, 10 percent of this soil is in crops, 20 percent in pasture, 40 percent in brush, and 30 percent in woods. Corn is grown on about 40 percent of the cropped area. Yields range from 10 to 35 bushels an acre. Wheat and hay are also grown. Wheat yields 8 to 12 bushels an acre. Hay yields average about half a ton an acre. Probably the best use for this soil is timber production. Although the soil and climate are not the best for the rapid growth of

[5] All figures for land use were obtained by measurements of fields and crops in selected representative areas.

trees, it is possible to obtain satisfactory stands of pines (white, red, and Scotch) and mixed hardwoods.

Muskingum loam.—Muskingum loam occurs in Dover, Athens, Lodi, and Bern Townships on areas with slopes less than 25 percent. The surface soil is light grayish yellow. The texture is variable, ranging from silt loam to sandy loam within a distance of less than 100 feet. The subsoil increases in sandiness with depth until the parent rock is reached, at a depth of about 20 inches. The upper part of the subsoil is yellowish brown, but with increasing depth the color becomes more like that of the sandstone parent rock.

The native trees are chestnut, white oak, red oak, and some maple and shellbark hickory. Brush does not immediately cover this soil after abandonment; a few years are required for a growth of briers, sumac, and shortleaf pine to cover the fields.

About 10 percent of this land is in forest, 10 percent in brushland, 20 percent in pasture, and 60 percent in crops.

Corn, timothy, and wheat are the most important crops, occupying 25, 10, and 7 percent of the soil, respectively. The average acre yields are corn, 15 bushels; hay, one-half to three-fourths of a ton; and wheat, 10 bushels. With proper treatment, these yields can be doubled. Buckwheat and oats are minor crops.

Muskingum loam, steep phase.—The steep phase of Muskingum loam is similar to typical Muskingum loam, except that it is more shallow to parent rock, rock fragments are more numerous, and the soil is on hillsides with slopes greater than 25 percent. As mapped, this phase includes some areas which exceed a 50-percent slope. These very steep slopes are used only for forest.

Some areas of Muskingum stony loam have been included with the steep phase of Muskingum loam because of their small extent. These areas are on narrow ridge tops and benches overlying sandstone. The surface of the soil is covered by rock fragments of various sizes, the largest being as much as 1 foot in diameter.

About 16 percent of Muskingum loam, steep phase, is in woods, 30 percent in brush, 15 percent in pasture, and 25 percent in crops. Some corn and wheat are grown, but timothy is the principal crop, covering one-third of the cropland. Yields are slightly less than the yields on the typical soil. Timber production is well adapted to this soil. In recent years red, white, and Scotch pines have been planted on abandoned fields.

Wellston silt loam.—The surface soil of Wellston silt loam consists of grayish-brown or dark grayish-brown silt loam. Beneath the surface soil is a layer of yellowish-brown silt loam which, at a depth of about 10 inches, grades into bright yellowish-brown or almost buff colored heavy silt loam or silty clay loam. Below 25 inches the soil is yellowish brown and slightly mottled with gray.

The substratum consists of partly weathered sandstone and shale fragments. Almost no rock fragments are on the surface or through the soil.

Wellston silt loam occupies a small area on gently rounded hilltops and on hillsides with slopes less than 10 percent. Crops cover 90 percent of its area; pasture and brushland cover the remainder. Corn is the leading crop, being grown on about 50 percent of the soil. Yields average about 25 bushels, but with good management, yields as high as 40 to 55 bushels are possible. Wheat is well adapted to this soil, yielding about 15 bushels an acre. A yield of 30 to 35 bushels an acre is possible under favorable conditions of management and weather.

Tilsit silt loam.—The nearly level relief of Tilsit silt loam prevents rapid run-off of surface water and retards underdrainage. The surface soil is grayish-yellow silt loam. At a depth of about 7 inches it grades into yellowish-brown silt loam. At a depth of about 18 inches the soil is mottled gray, dull-gray, and grayish-yellow silt loam. At a depth of about 22 inches it is mottled dull-gray, gray, and yellowish-brown silty clay loam. In place this layer is tight and compact, but it crumbles readily when removed. Below 36 inches it is gray, olive gray, and grayish yellow, and the texture is variable. Dark concretions are numerous in this layer. The substratum, consisting of sandstone and shale, lies at a depth of 4 feet.

In places, especially in the western part of the county, some of the broad level ridge tops are underlain largely by shale, producing a heavy clay lower subsoil layer. These areas have been included in Tilsit silt loam because of their small area.

The growth of hickory, red oak, and black oak has been cleared from all but 5 percent of the area. Eighty percent of the soil is cropland; the remainder is pasture and brushland. Hay is the principal crop; it is grown on nearly 30 percent of the area. The yield is about 1 ton an acre. Corn and wheat are grown to some extent, but the yields are not satisfactory except in favorable seasons.

Rarden silt loam.—Rarden silt loam resembles Muskingum silt loam in the upper part of the soil but differs in that it has a variegated red, yellow, and gray heavy-textured lower subsoil layer rather than the characteristic yellowish-brown light-textured subsoil layer of Muskingum silt loam.

The surface soil to a depth of 6 or 8 inches is grayish-brown or grayish-yellow silt loam. Below this is a 4-inch subsurface layer of bright yellowish-brown heavy silt loam with fine granular structure. The upper subsoil layer is yellow or pale grayish-yellow silty clay loam, which with increasing depth becomes heavier and mottled gray and yellow. The lower subsoil layer, at an average depth of 24 inches, is mottled red, yellow, and gray clay. The substratum consists of partly weathered shale and sandy shale.

As mapped, this soil includes some areas in which the lower subsoil layer is gray mottled with yellow instead of the characteristic mottled red, yellow, and gray clay. For the most part, this variation occurs in Trimble Township.

The land has been cleared of its original forest, but in late years abandonment of farms has allowed a growth of hickory, sycamore, and briers to overrun about one-third of the area. Corn and wheat are the principal crops grown, occupying 28 and 10 percent of the area, respectively. Yields average about the same as those on Muskingum silt loam.

Rarden silt loam, eroded phase.—The eroded phase of Rarden silt loam differs from the typical soil in that sheet erosion has removed the surface soil and exposed the heavier textured subsurface layer. Crops are grown, but yields are poor. The soil is in Alexander Township.

Coolville silt loam.—Coolville silt loam resembles Wellston silt loam in the upper part of the soil but differs in that it has a variegated red, gray, and yellow heavy-textured lower subsoil layer rather than the light-textured yellowish-brown subsoil layer of Wellston silt loam.

This soil occurs on gently rolling areas in Carthage and Troy Townships in the vicinity of Coolville. The surface soil is yellowish-brown or grayish-brown friable silt loam. This is underlain by a layer of yellowish-brown heavy silt loam, which at a depth of about 18 inches is slightly mottled with gray. At a depth ranging from 24 to 30 inches the soil is heavy silty clay loam more mottled than the layer above and showing an occasional red streak. Between 30 and 36 inches the soil is plastic clay. In places this layer appears to be solid red, but when removed it is mixed red and gray. Underneath the red layer the soil is yellowish-brown and gray silty clay loam. This extends to the parent clay shale which lies at a depth of 4 or 5 feet.

About 45 percent of the area is covered by crops, 10 percent by pasture, 30 percent by brush, and 15 percent by woods. Corn, wheat, and mixed hay are the chief crops. Corn yields range from 15 to 40 bushels an acre and average about 25 bushels. Wheat yields an average of 15 bushels, and hay yields about 1 ton an acre.

SOILS OF THE ROLLING UPLANDS DEVELOPED FROM LIMESTONE, SANDSTONE, AND SHALE

Thin beds of limestone interstratified with beds of sandstone and shale, in Ames, Bern, Canaan, Rome, Alexander, and Lodi Townships give rise to the limestone soils with dark-brown surface soils. Brooke silty clay loam is the only soil developed entirely from limestone material. Soils of the Westmoreland and Belmont series, so-called limestone soils, are a mixture of Brooke silty clay loam and one or more of the sandstone and shale soils.

Brooke silty clay loam.—Brooke silty clay loam is developed from the residual material derived from limestone. The surface soil is very dark grayish-brown silty clay loam with a fine-granular structure. Below this is a 6-inch layer of brownish-gray to olive-drab silty clay with a granular structure. The subsoil is olive gray. The texture is very heavy, and the soil is plastic. Limestone fragments are common both on the surface and through the soil.

Brooke silty clay loam is the most productive upland soil in the county. It produces excellent corn, oats, clover, and alfalfa. Wheat does well except that it is subject to winter-killing in unfavorable seasons. Corn yields about 40 bushels an acre, clover averages 2 tons, and alfalfa yields range from 3 to 4 tons.

Westmoreland silty clay loam.—Westmoreland silty clay loam is developed from mixed material derived from interstratified beds of sandstone, shale, and limestone. As a result of this interstratification of rocks, strips of Muskingum silt loam or Muskingum loam and Brooke silty clay loam alternate. This gives the areas of Westmoreland silty clay loam a belted or banded effect. Each of these soils is influenced somewhat by the proximity of the other. The limestone material of Brooke silty clay loam has so influenced the composition of part of the Muskingum soils that most of the soil is suitable for bluegrass.

The excellent stands of bluegrass on this soil make good pasture, for which about 75 percent of the land is used. Crops are grown on 25 percent of the area, corn, red clover, and alfalfa being the most important. Corn yields about 35 bushels an acre; red clover averages 1½ tons an acre, and alfalfa, 2½ tons.

Westmoreland silty clay loam, steep phase.—Westmoreland silty clay loam, steep phase, differs from typical Westmoreland silty clay loam in relief. It occurs on hillsides having slopes in excess of 25 percent.

Because of the good stands of bluegrass, erosion on this soil is not so serious as might be expected from the steepness of the slopes. Where excessive grazing has destroyed the bluegrass, however, sheet erosion, gullying, and destruction of the land are considerable.

Much of the native vegetation—of ash, chestnut oak, red oak, and elm—has been removed. Sixteen percent of the land is in woods, 12 percent in brush, 7 percent in crops, and 65 percent in pasture.

Belmont silty clay loam.—Belmont silty clay loam is a combination of Brooke silty clay loam, Muskingum silt loam, and Upshur clay, in varying proportions.

Over much of the area there is sufficient limestone material to make the reaction of the soil nearly neutral. About 64 percent of such soil is pasture land. Crops are grown on 29 percent of the soil, alfalfa and mixed hay being the most important. Alfalfa yields about 3 tons an acre, and mixed hay, about 1½ tons.

In other areas, a variation from typical Belmont silty clay loam has been included. Here Brooke silty clay loam constitutes from 10 to 15 percent of the soil, and in a few places it is almost entirely lacking. Where Brooke silty clay loam is lacking, some lime is always in the red soil. This soil produces fair pasture. In this respect it is intermediate between the Muskingum soils and the Belmont and Westmoreland soils. Fifty-four percent of the area is in pasture, 32 percent in crops, and 14 percent in brush and woods. The principal crops are corn and mixed hay. Corn yields average about 30 bushels an acre, and mixed hay yields range from 1 to 1½ tons an acre.

Belmont silty clay loam, steep phase.—The steep phase of Belmont silty clay loam is similar to typical Belmont silty clay loam, except in relief. The slopes exceed 25 percent in steepness.

Pasture grasses, especially bluegrass, do well on this soil. Nearly 47 percent of the soil is used for pasture. Woods cover 46 percent of the area, and 7 percent is used for crops. Alfalfa is the most important crop; yields range from 2½ to 3 tons an acre.

SOILS OF THE ROLLING UPLANDS DEVELOPED FROM RED CLAY SHALES, SANDSTONE, AND SHALE

Soils of the rolling uplands developed from red clay shale, sandstone, and shale are characterized by reddish-brown surface soils. They include the soils of the Upshur and Meigs series. Small areas of Upshur clay so intimately mixed with Muskingum silt loam that their separate mapping is impossible on the scale used constitute the soils of the Meigs series.

Upshur clay.—Upshur clay is derived from red clay shale. This soil is red clay throughout the profile. Because of the presence of organic matter, the 2- to 6-inch surface layer in places is slightly darker than the subsoil layer. At a depth of 24 or more inches, black stains appear on some particle faces. The soil has a heavy clay texture and very plastic consistence throughout the profile. The reaction is acid.

Much of the area has been cleared but later abandoned and allowed to revert to sumac, briers, and other brush. Hay is the most important crop; the soil supports a good timothy sod. Yields of hay range from 1 to 1¼ tons an acre.

For the most part Upshur clay occurs as small areas intimately mixed with areas of Muskingum silt loam.

Meigs silty clay loam.—Meigs silty clay loam is a mixture of Upshur clay and Muskingum silt loam. The ratio varies, but as a rule Upshur clay constitutes from 10 to 50 percent of the area.

About 95 percent of the area has been cleared, but a great deal of the farm land has been abandoned. At present 43 percent of the soil is in crops, 21 percent in pasture, and 36 percent in brush. The chief crops are corn and hay, corn covering 13 percent of the area and hay 15 percent. Wheat was formerly an important crop, but it is grown very little at present. Buckwheat, soybeans, and oats are grown to some extent. Yields average about the same as on Muskingum silt loam.

Meigs silty clay loam, steep phase.—The steep phase of Meigs silty clay loam differs from the typical soil in that the slopes are steeper than 25 percent.

Erosion, both sheet and gully, is active on this soil. A heavy cover of grass or trees is necessary to prevent serious damage to the soil.

Woods cover about 35 percent of the area and brush 31 percent. About 16 percent is used for pasture and 18 percent for crops. Hay is the principal crop. It yields three-fourths of a ton an acre.

SOILS DEVELOPED FROM ALLUVIAL MATERIAL ON TERRACES

The most important soils developed from alluvial material on terraces are those underlain by silts and clays. They comprise the soils of the Holston, Monongahela, Tyler, Vincent, and Wyatt series. The terraces on which they occur are along streams, except the upper end of Hocking River, and in valleys in the vicinity of Albany, New England, Lottridge, and Coolville. Because of their favorable relief these soils are important agriculturally.

Soils of the Hocking, Wheeling, and Chenango series have developed from alluvial material underlain by sand and gravel. The soils of the Hocking and Wheeling series are on terraces high above the valleys of streams, and the soils of the Chenango series are on terraces along Hocking River.

Holston silt loam.—The surface soil of Holston silt loam is grayish-brown or grayish-yellow silt loam. The soil becomes yellower with depth. At a depth of about 10 inches it is yellowish-brown heavy silt loam. The lower subsoil layer, below 24 inches, is yellowish-brown silt loam or loam. The substratum consists of stratified sands, silts, and clays. The total area of this soil is small.

The levelness of this soil is favorable for cultivated crops. All the land is cleared; 82 percent is in crops and 18 percent in pasture.

Mixed hay, corn, wheat, and soybeans are the most important crops. Average acre yields are: Mixed hay, 1 ton; wheat, 14 bushels; corn, 30 bushels; and soybean hay, 1½ tons.

Holston silt loam, high-terrace phase.—The high-terrace phase of Holston silt loam is similar to the typical soil. It is on terraces from 50 to 100 feet above streams.

The surface soil is grayish-brown or grayish-yellow silt loam. It becomes yellower with depth. At a depth of about 10 inches and extending to 16 inches the soil is yellowish-brown heavy silt loam. Some dark stains are on the particle faces. Below 16 inches the color is yellowish brown with a slightly red cast. From 24 to 32 inches is yellowish-brown silt loam. The particle faces are red with an occasional streak of gray. At a depth of 36 to 48 inches are stratified clay, silt, and very fine sand.

In places, especially 1 mile east of Pleasanton, this soil is on a slope, and hence is very much eroded. Much of the surface material has been washed away, exposing the underlying stratified silts and clays.

The crops and yields on this soil are similar to those on typical Holston silt loam.

Holston loam.—Holston loam differs from Holston silt loam in texture. The surface soil is grayish-brown loam, which becomes yellower with depth. The subsoil is yellowish-brown heavy loam. This soil is cultivated in connection with other soils. Crops and yields are similar to those on Holston silt loam.

Monongahela silt loam.—Monongahela silt loam has imperfect underdrainage. It is along streams in the region of sandstone and shale soils. The surface soil is grayish-brown silt loam, which becomes yellowish brown with depth. At 20 inches the soil shows gray and dull-gray mottlings. Below 28 inches and extending to a depth of 40 inches, the soil is mottled yellowish-brown and gray heavy silt loam or silty clay loam.

All the land has been cleared. Some of it is used for pasture, but most of it is in crops, of which corn, wheat, and mixed hay are the most important. Corn yields about 25 bushels an acre; wheat, 12 to 15 bushels; and mixed hay, 1¼ tons.

Monongahela silt loam, high-terrace phase.—The high-terrace phase of Monongahela silt loam is on terraces from 50 to 100 feet above streams. Like typical Monongahela silt loam, it has a grayish-brown silt loam surface soil and a yellowish-brown subsurface layer of silt loam underlain by a mottled gray, dull-gray, and yellowish-brown subsoil. The soil below 20 inches is more compact than the corresponding layer of the typical soil.

Land use and crop yields are about the same as those on the typical soil.

Tyler silt loam.—Tyler silt loam is along streams. It has poor surface drainage and underdrainage and requires artificial drainage to make it suitable for crops.

The surface soil to a depth of 7 inches is gray silt loam. Below this, to a depth of 24 inches, the soil is mottled gray and yellowish-brown silty clay. Below this is heavy clay which, for the most part, is gray with a slight yellowish-brown mottling.

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About 60 percent of the area is used for crops, timothy and mixed hay being the most important. Corn and wheat give good yields only in favorable seasons. Average acre yields are: Hay, 1 ton; corn, 25 bushels; and wheat, 12 bushels.

Tyler silt loam, high-terrace phase.—The high-terrace phase of Tyler silt loam is in valleys from 50 to 100 feet above streams. It is most highly developed in the vicinity of Albany.

The surface soil is gray silt loam. This is underlain by a mottled gray and yellowish-brown subsoil that becomes heavier with depth. The soil between 25 and 36 inches is mottled yellowish-brown and gray heavy silt loam that is very tight and compact. Locally this layer is called "hardpan."

This soil requires artificial drainage for satisfactory crops. The same crops are grown on this soil as on typical Tyler silt loam, and the yields are about the same.

Vincent silt loam.—Vincent silt loam is a well-drained, well oxidized soil underlain by stratified red slack-water clays. The surface soil is grayish-brown silt loam. This is underlain by a subsurface layer of yellowish-brown silt loam. The upper subsoil layer, to a depth of 24 inches, is yellowish-brown silty clay loam, with some grayish-yellow and red spots on the particle faces. Between 24 and 30 inches the material is variegated gray, yellow, and red silty clay. Below this the soil is solid red clay. At a depth of 40 inches are laminated red clays.

All this land has been cleared. Nearly 18 percent of the area is used for pasture; the rest is in crops, of which the leading ones are mixed hay, corn, and soybeans. Average acre yields are: Mixed hay, 1 ton; corn, 30 bushels; and soybean hay, 1½ tons.

Wyatt silt loam.—Wyatt silt loam is on the terraces along Federal Creek and the lower end of Hocking River. This soil is derived from material washed from the section containing interbedded limestone, sandstone, and shale. It has a fine-textured substratum which contains calcareous concretions.

The surface soil consists of a 6-inch layer of grayish-brown silt loam. This is underlain by silty clay that is yellowish brown on the cut surface and yellowish brown, olive drab, and in places, slightly pink on the broken surface. At a depth of 20 inches the soil is dull grayish-brown and gray highly plastic clay showing evidence of lamination, which increases with depth. Below 40 inches the soil is slack-water clay with, here and there, a layer of silt and fine sand. Pink, gray, and cream-colored calcareous concretions are numerous at a depth of 5 or 6 feet. In the more sloping areas, the subsoil between 6 and 20 inches is distinctly reddish brown.

Nearly 70 percent of the soil is in crops. Corn and mixed hay are the most important. Corn yields from 35 to 40 bushels an acre. Mixed hay yields average 1½ tons an acre.

A few poorly drained areas of this soil are on terraces along Federal Creek. Poor drainage is caused by lack of surface run-off and by seepage from hills surrounding the terraces.

Hocking silt loam.—Hocking silt loam occurs near Beaumont and Stewart.

The surface soil is grayish-brown silt loam. This is underlain by a subsurface layer of yellowish-brown silt loam. From 12 to 32 inches below the surface is bright yellowish-brown to almost buff-colored silt loam slightly heavier than the layer above and containing some very fine gravel. This layer is underlain, to a depth of 42 inches, by a dull-gray and yellow mixture of slightly cemented silt, sand, and gravel. Below 42 inches and extending to a depth of 60 inches is yellowish-brown cemented silt, sand, and gravel. Many of the surfaces, especially those of the gravel, are coated with black manganese deposits. From 5 to 8 feet below the surface, the dominant material is loose sand and gravel with only an occasional lump of cemented sand and gravel, and there is enough clay to make the soil sticky when moist. This layer is yellowish brown with a slightly red cast. At a depth ranging from 8 to 12 feet the material is reddish brown and is coherent when moist but not cemented. Below this the gravel is unweathered, although along old cracks or root channels reddish-brown weathered materials extend to a depth of 25 feet.

All the area has been cleared of trees. Some of the land is used for pasture, but the larger part is cultivated. Corn, wheat, and mixed hay are the principal crops. Average acre yields are: Corn, 30 bushels; wheat, about 16 bushels; and mixed hay, about 1 ton.

Included with Hocking silt loam are areas of gravelly soil on the escarpments of high level terraces along Hocking River. These areas are indicated on the soil map by gravel symbols. The surface soil is dark-brown gravelly loam. This is underlain by a bright yellowish-brown to almost buff-colored gravelly loam subsoil containing enough clay to make the soil slightly sticky when wet. The depth of the subsoil layer ranges from 4 to 20 feet, depending on the steepness of the slope.

The steepness of this soil prevents its use for anything except hay or pasture. Nearly three-fourths of the area is in pasture.

Hocking silt loam, poorly drained phase.—The poorly drained phase of Hocking silt loam occurs in the larger areas of Hocking silt loam. Its characteristics might have justified its recognition as a soil of a different series, but because of its small extent it is mapped as a poorly drained phase of Hocking silt loam.

The surface soil is gray silt loam. Small iron concretions are both on the surface and throughout the layer. From 8 to 20 inches below the surface, is mottled yellowish-brown and gray silty clay loam containing some fine gravel. This is underlain to a depth of 36 inches by a grayer soil of very similar texture. Below 36 inches and extending to a depth of 50 inches is mottled yellowish-brown and gray gravelly silty clay. This is underlain by interbedded gravelly silty clay and gravelly sandy clay, which is gray with some yellowish-brown mottling.

Most of the land is in pasture. Some corn and mixed hay are grown. Yields of corn are poor, averaging about 15 bushels an acre. Mixed hay yields 1 to 1¼ tons an acre.

Wheeling fine sandy loam.—Wheeling fine sandy loam is on terraces along Ohio River in the vicinity of Hockingport. The surface layer is dark grayish-brown fine sandy loam. Beneath this is yellowish-gray fine sandy loam that is moderately compact in place. Between depths of 15 and 28 inches is yellowish-brown to slightly reddish brown fine sandy loam. In place this layer is tight and hard, but it crumbles readily when disturbed. Below 30 inches is unweathered fine sand.

The total acreage of this soil is small. Corn, wheat, and hay are the principal crops, although the soil is well suited for truck crops, such as tomatoes and watermelons. Average acre yields are: Corn, 30 bushels; wheat, 15 bushels; and hay, 1 ton.

Wheeling silt loam.—Wheeling silt loam occurs in the same locality as Wheeling fine sandy loam. The color is similar to that of Wheeling fine sandy loam, but the texture is different. The surface soil is silt loam. This is underlain by clay loam, which becomes sandier with depth. At a depth of about 2 feet the soil is sandy clay. Below 3 feet is unweathered fine sand. The crops grown and the yields are the same as on Wheeling fine sandy loam.

Chenango loam.—The surface soil of Chenango loam is a 7-inch layer of dark-brown loam. This is underlain by yellowish-brown clay loam or sandy clay loam not very hard or compact but, because of the clay, slightly sticky when moist. Between 16 and 28 inches below the surface is yellowish-brown sandy loam that contains a small amount of clay and gravel. The soil of this layer is hard and compact, as though slightly cemented, but it crumbles readily when removed. Below this layer, to a depth of 37 inches, is a reddish-brown mixture of slightly cemented sand and gravel. Below 37 inches are stratified sand and gravel.

Nearly all the area is in crops, chiefly corn and alfalfa. Yields of corn average 35 bushels an acre, and those of alfalfa hay, 2½ tons.

A gravelly phase of Chenango loam is shown on the map by gravel symbols. This soil differs from the typical soil in that it has considerable gravel both on the surface and throughout the soil.

Chenango silt loam.—The surface soil of Chenango silt loam is grayish-brown silt loam to a depth of 8 inches. This is underlain, to a depth of 22 inches, by brown or yellowish-brown silty clay loam. Below this is clay loam which, at a depth of 36 inches, grades into sandy clay loam that extends to a depth of about 44 inches. The particle faces are brown, but when the soil is powdered it is yellowish brown. A few dark-colored stains are on some particle faces. Below 44 inches is slightly weathered interbedded sand and sandy clay. Unconsolidated sand and fine gravel occur at a depth of 56 inches.

The areas of Chenango silt loam are usually cultivated in connection with the surrounding bottom or upland soils. The usual crops are corn, wheat, and hay. Acre yields are: Corn, 30 to 35 bushels; wheat, 12 to 15 bushels; and hay, 1 ton.

ALLUVIAL SOILS ON FLOOD PLAINS

The alluvial soils on the flood plains are developed from materials washed down from the uplands. In Athens County alluvial materials are of two distinct kinds: (1) That derived from sandstone and shale soils, which is generally acid in reaction; and (2) that derived from soils, the parent material of which contains some limestone; this is generally neutral or alkaline in reaction. The soils composed of shale-sandstone alluvium are classed in the Pope, Philo, and Atkins series; those with a marked content of limestone residue are classed in the Moshannon, Huntington, and Lindside series.

These soils are naturally productive, but because of frequent inundations in the spring they are best adapted to such crops as timothy and alsike clover, which are not ruined by flooding, or to such crops as corn and oats, which are planted after the spring floods are over.

Pope loam.—The surface soil of Pope loam is brown or dark-brown well-drained loam. The subsoil layer, below a depth ranging from 10 to 15 inches, is slightly lighter in color and a little more compact than the surface soil.

Pope loam occupies narrow strips along streams. As this soil is frequently inundated by spring floods, it is usually planted to corn or timothy. Corn, the most important crop, yields 35 to 40 bushels an acre, and hay yields 1¼ to 1½ tons.

Pope silt loam.—Pope silt loam differs from Pope loam in texture. The surface soil is loose friable brown silt loam. The subsoil is yellowish-brown slightly heavier silt loam. The soil is well drained. It is suitable for the same crops as Pope loam and produces similar yields.

Pope silt loam, alluvial-fan phase.—The alluvial-fan phase of Pope silt loam consists of poorly assorted mixed alluvial and colluvial material. It occurs where a small stream with a steep gradient joins a larger stream with a nearly level gradient. It consists of a mixture of slightly rounded gravel, fragments of sandstone, and silt and sand washed down from the sandstone-shale uplands. In most places it is brown.

Philo silt loam.—Philo silt loam has imperfect drainage. The surface soil is brown silt loam, similar to that of Pope silt loam. The upper subsoil layer is yellowish-brown silt loam. The lower subsoil layer at a depth of 15 to 20 inches has some gray and dull-gray mottling. Philo silt loam is used for essentially the same crops as Pope loam and produces similar yields.

Atkins silt loam.—Atkins silt loam is the poorly drained member of the flood-plain soils with acid reaction. At the surface, it is mottled gray, grayish-brown, and brown silt loam. The gray increases with depth. There is little or no change in texture throughout the soil.

Most of this soil is used for pasture, but a small amount of it has been seeded to timothy. Yields of hay average about 1 ton an acre.

Atkins silt loam, alluvial-fan phase.—Atkins silt loam, alluvial-fan phase, occupies a position similar to that of the alluvial-fan phase of Pope silt loam. It is a mixture of subangular fragments of sandstone and shale and of silt. As seepage water keeps it wet, it is mottled gray and yellowish brown throughout. It is generally used for pasture.

Atkins silty clay loam.—Atkins silty clay loam is similar to Atkins silt loam, except that it has a heavier texture. The surface soil, like that of Atkins silt loam, is mottled gray, grayish brown, and brown. The subsoil is mottled gray and grayish yellow. Drainage is poor, and, where cleared, the land is used chiefly for pasture.

This soil produces about 30 bushels of corn an acre in favorable seasons.

Atkins silty clay loam, high-bottom phase.—The high-bottom phase of Atkins silty clay loam is similar to the typical soil throughout. The areas above the streams are less subject to flooding and have a slightly higher land-use value. The drainage is poor, however, and crops are not successfully grown in normal years unless the land is ditched.

Moshannon silty clay loam.—Moshannon silty clay loam is on stream bottoms receiving considerable wash from red soils. The surface soil is reddish-brown silty clay loam. Below 10 inches the soil is slightly lighter in color. The texture changes little with depth.

Most of this soil is used for crops, chiefly corn and mixed hay. Corn yields 40 to 45 bushels an acre, and mixed hay, 1½ tons an acre.

Moshannon silt loam, alluvial-fan phase.—The alluvial-fan phase of Moshannon silt loam is a mixture of reddish-brown Moshannon silt loam and subangular rock fragments. It occurs at the junction of small streams from the hills and larger stream flood plains. It is a good soil for corn, the average yield being about 45 bushels an acre.

Huntington silty clay loam.—Huntington silty clay loam is along streams that receive materials from soils containing some limestone. It is dark-brown silty clay loam throughout and is usually slightly alkaline in reaction. It is very good soil for corn, the average yield being about 60 bushels an acre. Some alfalfa and wheat are grown, but spring floods damage these crops.

Huntington silty clay loam, high-bottom phase.—The high-bottom phase of Huntington silty clay loam is on benches which are a little above the level of the ordinary flood plains and are flooded only when the water is unusually high. The surface soil is dark-brown silty clay loam, and the subsoil is yellowish-brown or brown fairly compact silty clay loam.

Corn is an important crop. Yields are similar to those on the typical soil. Alfalfa and wheat are also grown to a considerable extent. Alfalfa yields average about 4 tons an acre, and wheat, 15 bushels.

Huntington silt loam.—Huntington silt loam is somewhat lighter in color than Huntington silty clay loam. The soil texture is silt loam throughout. Corn is the most important crop and yields an average of about 55 bushels an acre. Alfalfa is also grown on the higher areas of this soil.

Huntington loam.—Huntington loam is brown or dark-brown loam. The texture of the soil does not change with increased depth. Corn is the most important crop and yields average 50 bushels an acre.

Lindside silty clay loam.—Lindside silty clay loam has imperfect drainage. The surface layer to a depth of 15 inches is dark-brown silty clay loam. Below this depth the texture is similar to that of the surface layer, but the color is mottled gray, grayish brown, and brown. The soil is well adapted to corn; yields average about 55 bushels an acre. Some mixed hay is grown and yields an average of 1½ tons an acre.

Lindside silty clay loam, high-bottom phase.—The high-bottom phase of Lindside silty clay loam is on benches that are flooded only when the water is very high. The soil is silty clay loam throughout. The surface soil has the same color as the typical soil, but the subsoil is mottled gray and yellowish brown. Corn is the most important crop, and yields average about 50 bushels an acre.

Lindside silt loam.—Lindside silt loam has a dark-brown or brown silt loam surface soil overlying a mottled gray and yellowish-brown loam subsoil. Corn is the most important crop grown, and yields average about 45 bushels an acre. Some alfalfa and wheat are grown, but flooding seriously damages these crops. A small percentage of the area is used for pasture.

MISCELLANEOUS LAND TYPES

Rough broken land.—Rough broken land includes areas of rock cliffs and nearly perpendicular slopes on which is very little soil.

Mine pits and mine dumps.—The land type, mine pits and mine dumps, includes stone quarries, strip mines, and dumps of waste from coal mines. This land has no agricultural value, but the old strip mines may be able to support a fair growth of trees.

LAND USES AND AGRICULTURAL METHODS [6]

On the basis of their characteristics the soils of Athens County may be placed in five groups, each of which presents management problems peculiar to itself. These groups are as follows: (1) Soils of the rolling uplands developed from sandstone and shale; (2) soils of the rolling uplands developed from limestone, sandstone, and shale; (3) soils of the rolling uplands developed from red clay shale, sandstone, and shale; (4) soils developed from alluvial material on terraces; and (5) alluvial soils on flood plains.

The soils of the uplands occur on gently rolling or steep broken topography. Their use is related very closely to the slope of the land. Many steep areas unsuited to crops have been used for cultivated crops, with the result that erosion has caused very serious damage to the land. As a general rule, that portion of these soils with a slope of 20 percent or more (25 percent for the Westmoreland and Belmont soils) which is now in cultivation should be retired to permanent pasture. Areas with a slope of 30 percent (40 percent for the Westmoreland and Belmont soils) or more which are now in permanent pasture should be planted to forest. Regardless of slope, areas that are severely eroded generally cannot be made to yield a profitable crop. Where 50 percent or more of the surface soil is gone, therefore, the land should be thought of as future pasture rather than cropland, and where the soil is entirely removed to plow depth or below, as potential forest land. Badly gullied areas, regardless of location, should be planted to trees.

The present use of the lands in selected townships in which certain of the major soils predominate is given in table 7. These figures were obtained by averaging the data for the townships in each area as given in the Federal census for 1930. No data are available for the areas in which Muskingum loam predominates.

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[6] This section written by D. R. Dodd, extension specialist, Ohio State University, and G. W. Conrey, associate in agronomy, Ohio Agricultural Experiment Station.

TABLE 7.—*Use of the land in different sections of Athens County, Ohio*

Soil type	Township	Land in farms								
		Total	Cropland			Pasture			Woodland not pastured	All other land
			Harvested	Failure	Idle	Plowable	Woodland	All other		
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
All	Entire county	72.7	15.7	0.5	2.1	10.4	10.1	26.5	3.2	4.4
Muskingum silt loam Monongahela silt loam Tyler silt loam	Lee Alexander	100.0	27.1	.6	4.5	34.2	21.8	7.4	1.5	2.8
Muskingum silt loam, steep phase	Trimble York Dover Waterloo Athens	49.6	10.4	.7	2.1	6.5	9.1	13.2	4.7	2.6
Meigs silty clay loam Meigs silty clay loam, steep phase	Troy Carthage Lodi	79.5	18.0	.6	3.0	9.0	11.7	27.1	6.2	3.6
Westmoreland silty clay loam	Ames Bern	99.0	18.6	.3	.7	3.0	11.1	59.6	2.0	4.1
Belmont silty clay loam	Alexander Canaan Rome	84.0	14.2	.4	1.7	4.4	18.4	39.8	1.4	3.0

The profitable production of crops on these sloping lands is possible only where adequate measures are taken for the control of erosion. Included in these are: (1) The use of only the more gentle slopes for cultivated crops, (2) maintenance of a high productivity level, (3) rotations including a high proportion of sod crops to other crops, (4) strip cropping, and (5) crop rows and cultivation conforming to the contour.

SOILS OF THE ROLLING UPLANDS DEVELOPED FROM SANDSTONE AND SHALE

The soils of the rolling uplands developed from sandstone and shale, together with their pH determinations and suggested lime treatments to give a reaction favorable for alfalfa, are listed in table 8.

TABLE 8.—*pH determinations and suggested lime treatments for soils of the rolling uplands developed from sandstone and shale in Athens County, Ohio*

Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5	Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5
	pH	*Tons* [1]		*pH*	*Tons* [1]
Muskingum silt loan	5.3	2.5	Tilsit silt loam	5.3	2.5
Muskingum silt loam, steep phase	5.3	2.5	Rarden silt loam	5.4	2.0
Muskingum loam	5.2	2.5	Rarden silt loam, eroded phase	5.4	2.0
Muskingum loam, steep phase	5.2	2.5	Coolville silt loam	5.3	2.5
Wellston silt loam	5.3	2.5			

[1] Tons of agricultural ground limestone per acre.

These soils, for the most part, occupy rolling areas. Wellston silt loam, Tilsit silt loam, Coolville silt loam, and areas of Muskingum silt loam, Muskingum loam, and Rarden silt loam with a slope of less than 20 percent, where the soils are not already badly eroded, can be considered as general cropland.

The crops commonly grown on these soils include corn, small grain, and hay. Three 5-year rotations with suggestions for the use of fertilizer are given in table 9.

TABLE 9.—*Three recommended 5-year rotations including, or in preparation for, alfalfa on soils of the rolling uplands developed from sandstone and shale in Athens County, Ohio*

A. FOR LAND ADAPTED TO ALFALFA—pH 6.5 TO 7.0

Year	Crop	Manure	Fertilizer
First	Corn	6 tons on sod before plowing	125 pounds 0-14-6 in hill or 200 pounds 0-14-6 in row.
Second	Wheat or other grain	4 tons as top dressing on winter grains.	300 pounds 0-14-6.
Third	Alfalfa 12 pounds, timothy 3 pounds.		
Fourth	Alfalfa-timothy	6 tons manure reinforced with 200 pounds superphosphate or 250 pounds 0-14-6 during previous fall or winter.	
Fifth	do		

B. FOR LAND MODERATELY ADAPTED TO ALFALFA—pH 5.8 TO 6.4

Year	Crop	Manure	Fertilizer
First	Corn	6 tons on sod before corn	125 pounds 0-14-6 in hill or 200 pounds 0-14-6 in row.
Second	Wheat or other grain	4 tons as top dressing on winter grain.	300 pounds 0-14-6.
Third	Hay, 4 pounds alfalfa, 4 pounds red clover, 2 pounds alsike clover, 4 pounds timothy.		
Fourth	Hay	6 tons manure reinforced with 200 pounds superphosphate or 250 pounds 0-14-6 during previous fall or winter.	
Fifth	do		

C. FOR LAND NOT ADAPTED TO ALFALFA—pH 5.2 TO 5.7[1]

Year	Crop	Manure	Fertilizer
First	Corn	6 tons on sod before plowing	125 pounds 0-14-6 in hill or 200 pounds 0-14-6 in row.
Second	Wheat or other small grain	4 tons as top dressing on winter grain.	300 pounds 2-14-4.
Third	Hay, 4 pounds red clover, 3 pounds alsike clover, 5 pounds timothy, 2 pounds redtop.		
Fourth	Hay	6 tons manure reinforced with 200 pounds superphosphate or 300 pounds 0-14-6 before April 1.	
Fifth	do		

[1] Lime to raise reaction favorable for rotation A or B as soon as possible.

The grass crop included in the rotation will depend upon the reaction of the soil. Generally, for the soils of this group, the pH is below 5.5, and the lime required to give a reaction favorable for alfalfa (pH 6.5) is 2 or more tons an acre. In general farming with livestock, maximum use should be made of legume hays. With proper lime and fertilizer applications alfalfa-grass mixtures can be very generally grown on these soils.

The amount of manure indicated in the rotation is in excess of that which will generally be available. In such event, the application on the second-year meadow or just prior to corn may be omitted.

Strip cropping, in which cultivated crops are alternated with sod or small-grain crops in narrow strips following the contour of the land, offers a very effective means of minimizing the loss of soil by erosion. Such an arrangement allows insufficient length of slope to allow run-off of rainfall from the cultivated area to attain enough speed of flow to pick up much soil. Most of the soil carried off the cultivated area will be deposited on the sod strip below.

The width of the strips used will depend chiefly on the slope but may also be varied with the soil types and limit of productivity. Since soils of low productivity erode more readily than those of high productivity, the former should be handled in narrower strips. As a general rule, however, it has been suggested that slopes of 8 percent be laid out in 100-foot strips and that 5 feet be deducted or added for each 1-percent increase or decrease, respectively, in slope. On this basis, a 120-foot strip could be used on a 4-percent slope and an 80-foot strip on a 12-percent slope.[7]

As a large part of these soils, especially the steep phases of Muskingum silt loam and Muskingum loam, are in permanent pastures, their management and improvement are of considerable importance. A large proportion of the pastures on these soils are of poor quality and low carrying capacity.

In the improvement of pastures (*3*) the use of lime is a first essential. The amount needed should be determined by testing the soil. The application can be made directly to the surface soil at any convenient time, usually in the summer or fall. On steep land or where the vegetation is thin, grooving on the contour with a disk harrow will allow better incorporation. The application should be repeated when needed, as determined by the type of vegetation and further soil tests. Generally speaking, this will be every 6 or 8 years.

Fertilizer at the acre rate of 400 or 500 pounds of 20-percent superphosphate or 0–14–6 should be placed in the soil 1 or 2 inches deep by means of a disk drill running on the contour. The most satisfactory time of application is between October 1 and April 1. This application should be repeated every 4 or 5 years.

Manure is not extensively used on permanent pastures, but on thin sods it may be a very effective means of pasture improvement. Each ton should be supplemented with 40 pounds of 20-percent superphosphate or its equivalent. The usual rate is 6 or 8 tons an acre. This treatment may be repeated every 3 or 4 years.

Reseeding generally will not be necessary, as the desirable grasses and clover will increase rapidly following treatment. Where very rapid improvement is desired, however, or where less than 50 percent of the ground area is covered by vegetation, or where the content of desirable grass and clover is below 5 percent, reseeding with 5 to 10 pounds an acre of the following seed mixtures is desirable: 7 pounds of Kentucky bluegrass, 4 pounds of timothy or orchard grass, 3 pounds of redtop, 3 pounds of alsike clover, and 1 pound of white clover. On thin pastures, 3 pounds of Korean lespedeza and 3 pounds of common lespedeza, used in connection with this seed mixture or seeded separately, will be found very helpful in producing more pasture in midsummer and also in controlling erosion.

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[7] For further information on strip cropping and other means of controlling erosion see (2).

On badly eroded areas within a pasture, after treatment with lime and fertilizer and reseeding, it may be desirable to cover the land with brush to protect it from grazing until the sod has become established. In gullied areas it is necessary to provide, by the use of sod, wire, brush, or low stone dams, some temporary control of water until sod can be established in the gully. The gully banks are then graded back, limed as needed, liberally fertilized, and seeded. Orchard grass should always be included in the mixture for gully seedings. The temporary exclusion of livestock by the use of brush or by fencing is necessary to the development of a good sod on gullied areas.

Regardless of how well permanent pastures are limed and fertilized, satisfactory sods will not develop, nor can a good sod be maintained, unless careful attention is given to care and management. The ideal seems to be so to graze that the vegetation may be kept at a height between 1½ and 5 inches at all times but not continuously so short as 1½ inches. If the vegetation can be maintained at the heights indicated, a white clover-bluegrass sod will develop rapidly. Particular care should be taken not to overgraze in the early spring or in July and August.

Very steep rough broken areas or badly eroded areas should be planted to trees. This will serve as a protection against further serious erosion and will eventually produce a valuable crop of timber. Species best adapted to these soils include red, Scotch, and white pines. For the successful development of forest, it is essential that livestock be kept out at all times. The results obtained in reforesting these lands are well shown at the Waterloo State Forest in the southwestern part of the county.

SOILS OF THE ROLLING UPLANDS DEVELOPED FROM LIMESTONE, SANDSTONE, AND SHALE

Soils of the rolling uplands developed from limestone, sandstone, and shale are chiefly in the north-central and central parts, where they occupy a rolling to very rolling topography. The soil types included, together with their pH determinations and suggested lime treatments to give a reaction favorable for alfalfa, are listed in table 10.

TABLE 10.—*pH determinations and suggested lime treatments for soils of the rolling uplands developed from limestone, sandstone, and shale in Athens County, Ohio*

Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5	Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5
	pH	*Tons* [1]		*pH*	*Tons* [1]
Brooke silty clay loam	7.0	0	Belmont silty clay loam	6.5	[2] 0
Westmoreland silty clay loam	6.5	[2] 0	Belmont silty clay loam, steep phase	6.5	[2] 0
Westmoreland silty clay loam, steep phase	6.5	[2] 0			

[1] Tons of agricultural ground limestone per acre.
[2] Included areas of Muskingum silt loam that are acid, with a lime requirement of 2½ tons an acre.

These soils are used chiefly for general farming and livestock raising. A large proportion of the area is in permanent pasture. The excellent bluegrass pasture makes possible extensive livestock raising, which includes the production of beef cattle, dairy cattle, and sheep.

Brooke silty clay loam and the smoother areas of Westmoreland silty clay loam and Belmont silty clay loam are used for cultivated crops. If proper measures to control erosion are followed, it is possible to cultivate areas with slopes up to 25 percent. The excellent bluegrass sod which these soils produce is an important factor in making the soils less erosive than the Muskingum soils on comparable slopes.

The chief crops produced are corn, small grain, and hay. Alfalfa can be grown without liming on Brooke silty clay loam and on a considerable part of the Westmoreland and Belmont soils. The latter soils are a mixture in which some of the acid Muskingum soils are included with the limestone soils, hence it is desirable to test various parts of fields to determine the areas that require liming for the production of alfalfa.

A recommended rotation for these soils is given in table 11.

TABLE 11.—*A recommended rotation for the soils of the rolling uplands developed from limestone, sandstone, and shale in Athens County, Ohio*

Year	Crop	Manure	Fertilizer
First	Corn	6 tons on sod previous fall	125 pounds 0-14-6 in hill or 200 pounds 0-14-6 in row.
Second	Wheat or other grain	4 tons as top dressing on winter grains.	400 pounds 0-14-6.
Third	Alfalfa 12 pounds; timothy 3 pounds, or orchard grass 7 pounds.		
Fourth	Alfalfa-grass (hay and pasture)	250 pounds 0-14-6 or 6 tons manure reinforced with 200 pounds superphosphate in fall.	
Fifth	do		
Sixth	do	6 tons manure in fall as indicated for corn.	

Since the land is well adapted to grass and legumes, longer rotations, which can be used to supply winter feed of high protein content and midsummer pasture, are particularly desirable. The meadow area may be cut for hay in early June and the second growth grazed off during July and August. The area must have protection from grazing after September 10. If the stand is to be maintained, under these conditions, in alfalfa and grass for 4 years, care must be taken not to graze too severely. If the pasture is continuously grazed, a height of 6 to 10 inches must be maintained at all times. If the pasture is grazed in rotation, a height of 8 to 12 inches should be allowed between grazing. On lands that are too steep for cultivated crops, corn may be omitted from the rotation previously outlined.

Strip cropping, in which cultivated crops are alternated with sod or small-grain crops following the contour of the land, is highly desirable on these soils. The width of strip recommended for the Muskingum soils can be used with the Westmoreland and Belmont soils. It is possible to use somewhat wider strips with the limestone soils, because of the lower erosibility.

These are primarily pasture soils. Included in the Westmoreland and Belmont soils are areas of Muskingum soils, which support a relatively poor pasture vegetation. The lime and fertilizer treatments recommended for the Muskingum soils would serve to improve the quality of the grass on such areas. Careful attention to grazing management is essential to maintaining the pasture areas at their greatest carrying capacity. The recommendations for the Muskingum soils hold, except that on thin soils lime is rarely required. Liberal applications (300 to 500 pounds an acre) of superphosphate may be expected to increase the yield of the average pasture on these soil types by 50 to 100 percent.

Pasture supplies the cheapest form of digestible nutrients for livestock and with proper treatment and management has been found to produce meat and milk at one-half, or less, the cost of production with barn feeding. An important factor in the high yield of these pastures is the nitrogen content, which can be most economically supplied by keeping up the percentage of white clover in the pasture. The ideal pasture on these soil types is capable of yielding annually as much nitrogen in the form of protein as could be added in 1,000 to 1,200 pounds of sulphate of ammonia. Since the cost of such application is out of the question for most farmers, the necessity of a fertilization and management program which will maintain the white clover is quite evident.

In a system of livestock farming in which alfalfa-grass mixtures are used for midsummer grazing, certain precautions should be observed to prevent bloat. These include never turning the animals on the alfalfa when they are hungry, but rather giving them a good fill of other feed first. Once the livestock have been turned into the alfalfa-grass mixture they should remain there, milk cows being removed only for milking and then immediately returned. Both salt and water should be liberally supplied. The presence of grass with the alfalfa reduces the possibility of bloat but will not always prevent it. The use of alfalfa for the grazing of livestock is rarely discontinued by farmers who have adopted the practice. Bloat does not continue to be a serious problem when these general precautions are observed.

SOILS OF THE ROLLING UPLANDS DEVELOPED FROM RED CLAY SHALE, SANDSTONE, AND SHALE

Soils of the rolling uplands developed from red clay shale, sandstone, and shale are in the southern and southeastern parts, where the topography of much of the area is very rolling and rough and broken. Extensive areas are very seriously eroded. The soil types included, together with their pH determinations and suggested lime treatments to give a reaction favorable for alfalfa, are listed in table 12.

TABLE 12.—*pH determinations and suggested lime treatments for soils of the rolling uplands developed from red clay shale, sandstone, and shale in Athens County, Ohio*

Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5	Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5
	pH	*Tons*[1]		*pH*	*Tons*[1]
Upshur clay	5.5 to 7.0	[2] 0 to 3	Meigs silty clay loam, steep phase	5.5 to 6.5	[2] 0 to 3
Meigs silty clay loam	5.5 to 6.5	[2] 0 to 3			

[1] Tons of agricultural ground limestone per acre.
[2] The reaction of these soils is variable, and can only be determined by test; a large proportion of the area of these soils in Athens County is acid.

The better areas of these soils can be handled in much the same way recommended for the Muskingum and other soils of group 1. Because of very severe erosion on large areas of these types, it is advisable to allow such lands to revert to woods, rather than to attempt to improve them.

SOILS DEVELOPED FROM ALLUVIAL MATERIAL ON TERRACES

Soils developed from alluvial material on terraces occupy level areas where the topography is favorable for the production of cultivated crops. Many farms include terrace lands and bottom lands with sloping uplands. Where this condition exists, it is possible to produce a large portion of the cultivated crops on the terrace lands and bottom lands, and to reserve the uplands for pasture. Other farms may be confined almost entirely to the terrace lands and bottom lands. In either case it is desirable to follow good soil management practices in order to obtain economical crop production. The soils included in this group, together with their pH determinations and suggested lime treatments to give a reaction favorable for alfalfa, are listed in table 13.

TABLE 13.—*pH determinations and suggested lime treatments for soils developed from alluvial material on terraces*

Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5	Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5
WELL-DRAINED SOILS OF THE TERRACES					
	pH	*Tons*		*pH*	*Tons*
Holston silt loam	5.2	3.0	Wheeling silt loam	5.8	1.5
Holston silt loam, high-terrace phase	5.2	3.0	Chenango loam	5.4	2.0
Holston loam	5.2	2.5	Chenango silt loam	5.5	2.5
Vincent silt loam	5.2	3.0	Hocking silt loam	5.0	3.0
Wheeling fine sandy loam	5.5	1.0			
IMPERFECTLY DRAINED SOILS OF THE TERRACES					
Monongahela silt loam	5.1	3.0	Hocking silt loam, poorly drained phase	5.0	3.0
Monongahela silt loam, high-terrace phase	5.1	3.0	Wyatt silt loam	5.8	2.0
POORLY DRAINED SOILS OF THE TERRACES					
Tyler silt loam	5.0	3.5	Tyler silt loam, high-terrace phase	5.0	3.5

Corn, small grain, and hay are produced on these soils. Corn occupies a much larger percentage of the area than on the upland soils. Truck crops are grown near Athens for the local market and for other towns of the county. Rotations suggested in table 9 are well adapted to these soils, but the rotations should be shortened to 3 or 4 years. Where the soil conditions are unfavorable for alfalfa, it is advisable to reduce the seeding of this legume to 4 to 6 pounds and to add 2 pounds of alsike clover and 4 pounds of red clover. Lime is essential on most of the terrace soils for the production of good-quality hay. It is the beginning point in the improvement of these soils.

Artificial drainage is desirable with the Monongahela, Wyatt, and Tyler soils. The spacing of the tile will vary with the subsoil conditions, 4 rods being adequate except where heavy clay is near the surface, under which condition the lines should be spaced 2 to 3 rods apart.

ALLUVIAL SOILS ON FLOOD PLAINS

The alluvial soils on flood plains, the important ones of which are listed in table 14, include the most productive soils of the county. Because of the hazard of flood damage these soils are best adapted to corn and to hay or pasture. Very poorly drained areas are adapted to pasture only. Some truck crops are grown on the well-drained soils. Small grains tend to lodge badly.

A common rotation consists of corn, 2 or 3 years in succession, followed by alfalfa or alfalfa-grass mixtures for 2 or 3 years. The new seedings are established with oats or as a straight seeding without a companion crop.

TABLE 14.—*pH determinations and suggested lime treatment for important alluvial soils on flood plains*

Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5	Soil type	Unlimed reaction	Suggested lime to raise reaction to pH 6.5
WELL-DRAINED ALLUVIAL SOILS					
	pH	*Tons*		*pH*	*Tons*
Pope loam	5.4	2.0	Huntington silty clay loam, high-bottom phase	7.0	0.0
Pope silt loam	5.3	2.5	Huntington loam	7.0	.0
Mosbannon silty clay loam	6.5	.0			
ALLUVIAL SOILS WITH FAIR DRAINAGE					
Philo silt loam	5.6	2.25	Lindside silty clay loam, high-bottom phase	7.0	0.0
Lindside silt loam	7.0	.0			
Lindside silty clay loam	7.0	.0			
ALLUVIAL SOILS WITH POOR DRAINAGE					
Atkins silt loam	5.2	3.0	Atkins silty clay loam, high-bottom phase	5.2	3.5
Atkins silty clay loam	5.2	3.5			

These soils range from neutral to strongly acid in reaction. Excellent stands of alfalfa can be obtained without liming on many of them. They have a low fertilizer requirement and are less responsive to manure than the upland soils. Fertilizer applications should be cut to about one-half to two-thirds the amounts recommended for the various crops in table 9.

On farms which include some bottom land with hill land, the maximum proportion of cultivated crops should be produced on the flood plain soils. In this way it is possible to cut down on the area of sloping lands in cultivated crops and to aid very materially in controlling erosion.

PRODUCTIVITY RATINGS OF SOILS

Table 15 gives productivity ratings for the soil types and phases mapped in Athens County.[8]

TABLE 15.—*Productivity ratings of soils of Athens County, Ohio*

Soil types	Productivity rating [1]	Crop productivity index [2] for—						
		Corn	Wheat	Oats	Mixed hay	Red clover	Alfalfa	Pasture
Upland:								
Muskingum silt loam	4.5	4(6)	5(8)	4(6)	4(7)	3(8)	0(7)	2(7)
Muskingum silt loam, steep phase	9	------	------	------	------	------	------	2(4)
Muskingum loam	5.5	3(5)	4(7)	4(6)	3(7)	3(7)	0(6)	2(5)
Muskingum loam, steep phase	9.5	------	------	------	------	------	------	2(4)
Wellston silt loam	4	4(7)	5(8)	4(6)	4(8)	3(7)	0(7)	3(7)
Tilsit silt loam	5	3(6)	4(7)	3(5)	4(7)	3(6)	0(6)	3(6)
Rarden silt loam	4.5	4(6)	4(7)	4(6)	4(7)	3(7)	0(6)	2(7)
Rarden silt loam, eroded phase	10	------	------	------	------	------	------	1(4)
Coolville silt loam	4	4(6)	4(7)	4(6)	4(7)	3(7)	0(6)	3(7)
Upshur clay	6	3(5)	4(7)	3(5)	6(7)	4(8)	5(7)	5(7)
Meigs silty clay loam	6	3(5)	5(7)	3(5)	4(7)	3(8)	3(7)	3(6)
Meigs silty clay loam, steep phase	8	------	------	------	------	------	------	3(5)
Brooke silty clay loam	3	8(9)	6(8)	5(6)	8(9)	9(10)	8(9)	10(10)
Westmoreland silty clay loam	4	5(7)	6(8)	4(6)	7(8)	6(9)	6(9)	8(9)
Westmoreland silty clay loam, steep phase	6	------	------		------	------	5(8)	5(7)
Belmont silty clay loam	4	5(7)	5(7)	4(6)	7(8)	6(9)	7(9)	8(9)
Belmont silty clay loam, steep phase	6	------	------	------	------	------	5(8)	5(7)
Terrace:								
Holston silt loam	4	4(6)	4(8)	4(6)	5(7)	3(7)	0(6)	5(7)
Holston silt loam, high-terrace phase	4	4(6)	4(8)	4(6)	5(7)	3(7)	0(6)	5(7)
Holston loam	5	4(6)	4(8)	4(6)	5(7)	3(7)	0(5)	5(7)
Monongahela silt loam	5	3(6)	3(7)	3(6)	4(7)	3(6)	0(5)	5(7)
Monongahela silt loam, high-terrace phase	5	3(6)	3(7)	3(6)	4(7)	3(6)	0(5)	5(7)
Tyler silt loam	7	1(4)	1(4)	1(4)	3(5)	0(4)	0(3)	3(5)
Tyler silt loam, high-terrace phase	7	1(4)	1(4)	1(4)	3(5)	0(4)	0(3)	3(5)
Vincent silt loam	4	4(6)	4(8)	4(6)	5(7)	3(7)	0(6)	5(7)
Wyatt silt loam	5.5	3(5)	3(6)	3(6)	5(7)	3(7)	0(4)	5(7)
Hocking silt loam	4	4(6)	4(8)	4(6)	5(7)	3(7)	0(6)	5(7)
Hocking silt loam, poorly drained phase	5	3(6)	3(7)	3(6)	4(7)	3(6)	0(5)	5(7)
Wheeling fine sandy loam	5.5	4(6)	5(7)	4(5)	5(7)	5(7)	4(7)	3(5)
Wheeling silt loam	3	5(7)	6(9)	5(6)	6(8)	7(9)	5(8)	6(9)
Chenango loam	4	4(6)	4(8)	4(6)	4(6)	4(8)	0(7)	4(6)
Chenango silt loam	3	5(7)	5(9)	5(7)	5(7)	5(9)	1(8)	5(7)
Alluvial:								
Pope loam	5	6(7)	5(7)	5(6)	5(6)	4(6)	3(6)	5(7)
Pope silt loam	4	7(8)	6(7)	6(7)	7(8)	6(8)	4(7)	7(9)
Pope silt loam, alluvial-fan phase	4.5	6(8)	5(7)	5(6)	5(6)	4(6)	4(7)	5(7)
Philo silt loam	5	4(7)	4(5)	3(5)	6(8)	5(8)	3(7)	5(7)
Atkins silt loam	7	1(4)	--------	1(4)	1(6)	2(4)	0(3)	2(5)
Atkins silt loam, alluvial-fan phase	7	1(4)	--------	1(4)	1(6)	2(4)	0(3)	2(5)
Atkins silty clay loam	7.5	1(4)	--------	1(4)	1(6)	1(4)	0(3)	2(5)
Atkins silty clay loam, high-bottom phase	7.5	1(4)	--------	1(4)	1(6)	1(4)	0(3)	2(5)
Moshannon silty clay loam	3.5	8(9)	4(5)	6(7)	8(9)	8(9)	7(8)	8(9)
Moshannon silt loam, alluvial-fan phase	3	8(9)	5(6)	6(7)	9(9)	8(9)	8(9)	8(9)
Huntington silty clay loam	2	9(10)	4(5)	6(8)	9(9)	8(9)	8(9)	9(10)
Huntington silty clay loam, high-bottom phase	2	9(10)	4(5)	6(8)	9(9)	8(9)	8(9)	9(10)
Huntington silt loam	2	9(10)	5(6)	7(8)	9(9)	9(10)	9(10)	9(10)
Huntington loam	4	8(9)	4(6)	6(7)	8(9)	8(9)	8(9)	8(9)
Lindside silty clay loam	3	5(9)	4(5)	4(6)	5(8)	5(8)	5(7)	6(8)
Lindside silty clay loam, high-bottom phase	2.5	6(9)	4(5)	4(7)	5(9)	5(9)	5(8)	7(9)
Lindside silt loam	3	5(9)	4(5)	4(6)	5(8)	5(9)	5(7)	6(8)

[1] 1 is the highest productivity rating.
[2] 10 is the highest productivity index.

[8] This table of productivity ratings of soil types was furnished by G. W. Conrey, in charge of the Ohio soil survey.

Special circular 44 of the Ohio Agricultural Experiment Station (*1*) gives further information concerning the classification and productivity of soils of the State and explains the figures in the table as follows:

Two different ratings are used in the tables; first, a state-wide productivity rating, and second, a crop production rating or crop productivity index. In the State-wide productivity rating the most productive soil (with good soil management) is rated as "1" and the least as "10." In the crop production rating or crop productivity index, the most productive soil for any given crop is rated as "10", and all other values are lower. A soil with an index of "5" will yield only one-half as much as one with an index of "10." Two values are given for each crop—the first, for the soil without artificial drainage, fertilizer treatment, manure, or lime, and the second, with adequate drainage and a good system of soil management (including the use of manure and fertilizer and of lime where the soil is acid).

For example, the productivity rating for Belmont silty clay loam is 4 as compared with 1 for the most productive soil in the State. For this same soil type the crop-productivity index corn, 5(7), is 5 without special treatment, and (7) with adequate drainage and good soil management, as compared with 10 for the best soil for corn in the State.

MORPHOLOGY AND GENESIS OF SOILS

The soils of Athens County have been developed in a forested region under the influence of a humid climate. The mature soils of the area are podzolic and are included in the great soil group known as the Gray-Brown Podzolic soils (*7*).

Physiographically the area is a part of the Kanawha section of the Appalachian Plateaus and has the features of that region. Because of the steep slopes, natural run-off is rapid and is accompanied by sheet erosion over most of the county. This has prevented the development of mature soils except on a few gently rounded ridge tops and on terraces.

A good example of a well-developed Gray-Brown Podzolic soil is a profile of Wellston silt loam observed in the northwest quarter of section 34 of Trimble Township. This soil was under a grass cover in a fence row and had not been disturbed for many years. The leaf litter and the mold layers, which are features of a strictly virgin profile of the soil, were missing. A description of the profile follows:

1. 0 to 3 inches, very dark grayish-brown silt loam containing considerable organic matter. It is slightly acid.
2. 3 to 9 inches, light grayish-yellow silt loam. The color gradually changes with depth. The structure is platy, with lens- or plate-shaped particles. It is strongly acid.
3. 9 to 18 inches, bright yellowish-brown silt loam, slightly heavier in texture than the horizon above. Some of the particle faces are pale yellowish brown. It breaks into lumps then into subangular particles one-eighth inch or less in diameter. Numerous roots penetrate the particles. The whole layer is friable and free from stones. It is very strongly acid.
4. 18 to 28 inches, bright yellowish-brown layer, slightly more red than the layer above. The texture is about the same, but this layer is more compact. It breaks into lumps ranging from 1 to 2 inches in diameter, then into particles one-fourth inch in diameter. Some breakage faces show segregation of finer material. Roots encircle the particles. It is free from stones and is strongly acid.

5. 28 to 36 inches, yellowish-brown silt loam containing a few sandstone fragments. It breaks into large lumps and then into small particles about one-fourth inch in diameter. It has a slight gray mottling, and many particle faces have black stains, probably of manganese dioxide. It is strongly acid.
6. 36 inches+, a mixture of partly disintegrated sandstone and shale.

This soil occurs on gently rounded ridge tops where little soil has been removed and soil development has not been impeded. Where the slopes are steeper, the surface soil is continually being removed, exposing new material to the process of weathering. This does not allow development of mature soil but produces a soil more closely related to the parent material. The profile of Muskingum silt loam described as follows was obtained in a woods 1½ miles west of Beaumont, where the slope is about 18 percent:[9]

1. 0 to one-half inch, very dark grayish-brown silt loam and forest litter. It is strongly acid.
2. One-half to 1½ inches, grayish-yellow silt loam. Dark material from above is mixed with it. This is caused by insects and fine plant roots. It is very strongly acid.
3. 1½ to 8 inches, brownish-yellow slightly gray silt loam containing numerous small stones. Particles are lens-shaped and arranged in layers. It is very strongly acid.
4. 8 to 14 inches, bright yellowish-brown silt loam containing numerous rock fragments and a few black concretions. It breaks into irregular particles one-fourth inch in diameter. No segregation of material occurs along cracks. It is very strongly acid.
5. 14 to 24 inches, yellowish-brown moderately heavy silt loam containing numerous stones ranging from one-fourth inch to 4 inches in diameter. It breaks into particles one-fourth to one-half inch in diameter. Particle faces are reddish brown, but when powdered the soil is yellowish brown. It is very strongly acid.
6. 24 to 36 inches +, a mixture of reddish-brown soil and of sandstone and shale which vary in color. It is very strongly acid.

The parent rocks of the Wellston and Muskingum soils are largely sandstone with a little shale. Elsewhere the parent rocks are shale with a little interbedded sandstone. Because of different chemical composition and physical make-up, shale produces a different soil. Rarden silt loam is typical of these shale soils. It is comparable to Muskingum silt loam in that it has similar relief and the same characteristics to a depth of 14 inches. Layers 1, 2, 3, and 4 are the same as the corresponding layers of Muskingum silt loam. Below this depth, the profile is as follows:

5. 14 to 18 inches, yellow and pale yellowish-gray silty clay loam which breaks into irregular fragments. It is very strongly acid.
6. 18 to 24 inches, mottled gray and yellow heavy silty clay loam with a little red. Some breakage faces are bright yellow and shiny; others are gray and dull. The material is very strongly acid.
7. 24 to 36 inches, mottled red and yellow clay. Some of the particles are red throughout. The material breaks in large lumps, but the individual particles are small. Very strongly acid.
8. 36 inches+, mottled red, yellow, and gray partly disintegrated shale. The red in this layer is produced in the process of weathering of shale.

Another soil derived largely from shale is Coolville silt loam. As it occupies slopes less than 10 percent, it has characteristics typical of a mature soil. To a depth of 30 inches this soil has the characteristics of Wellston silt loam. Below this depth and extending to

[9] Detailed information on Muskingum silt loam is given in U. S. Dept. Agr. Tech. Bull. 430 (8).

parent rock, at 4 feet, the layers are very similar to those below 14 inches in Rarden silt loam, but the red is more pronounced in Coolville silt loam.

These four soils have some characteristics in common, especially in the upper layers, where the influence of climate is greatest. The lower layers have differences that are directly due to differences in parent materials. The depth at which the parent material dominates the soil-forming processes depends on the degree of the slope. The two mature soils have slopes less than 7 percent, and the two immature soils have slopes greater than 15 percent.

Imperfect underdrainage is another important factor in soil formation. The effect of this factor is shown in Tilsit silt loam. This soil is derived from sandstone and shale parent material and developed on level ridge tops. Surplus water has prevented good aeration in the soil and lessened oxidation, as is indicated by the light color. Also, the fluctuating water table has held the downward displacement of fine material within a definite zone, thus creating a layer of heavy texture.

Following is a description of a profile of Tilsit silt loam observed in section 18 of Troy Township:

1. 0 to 6 inches, grayish-yellow silt loam with lens-shaped particles arranged in a platelike structure. It is strongly acid.
2. 6 to 16 inches, yellowish-brown silt loam with some black iron concretions. It breaks into particles about one-fourth inch in diameter. Burrows made by worms and insects are lined with heavier textured material of about the same color. It is strongly acid.
3. 16 to 22 inches, mottled gray, dull-gray, and grayish-yellow silt loam containing many small iron concretions. In place this layer is fairly tight, but when removed it crumbles readily into particles one-eighth inch in diameter. It is strongly acid.
4. 22 to 36 inches, mottled gray, dull-gray, and yellowish-brown silty clay loam containing many dark iron concretions. It is more compact and tight than the layer above and crumbles less readily into lumps, one-fourth inch in diameter or larger. When powdered, it is grayish yellow. It is very strongly acid.
5. 36 to 48 inches, gray, olive-gray, and grayish-yellow loam containing many dark iron concretions. Some particles are coated with gray. The material is compact and tight. The pH is 4.6.

From clay shales, which are mostly in the southeastern part of the county, a soil is formed that is slightly differentiated into horizons and hence has only a slight relation to the typical regional soil. This soil, Upshur clay, is clay throughout, with a definitely red base color, derived from the parent red shale. The surface layer is somewhat darkened by organic matter.

From the beds of limestone and their closely associated beds of shale still another distinct type of soil is formed, Brooke silty clay loam. This soil occupies small areas on ridge tops and hillsides. It is not a mature soil. The profile described as follows was observed in the southeast quarter of section 10 of Ames Township:

1. 0 to 6 inches, very dark gray or very dark grayish-brown clay containing numerous limestone fragments. It is very granular. The granules are about one-eighth inch in diameter, and the outsides are darker than the interior. The material is neutral in reaction.
2. 6 to 12 inches, very granular clay containing small limestone fragments. It is somewhat lighter gray and browner than the surface. The granules are irregular in shape and range from one-eighth to three-eighths inch in diameter. The interior of the particles is olive drab. This layer is alkaline.

3. 12 to 21 inches, mostly olive-gray shale and limestone fragments. The texture varies. The material is alkaline.
4. 21 inches+, limestone rock.

In soils developed from water-laid material on terraces, the high-terrace phase shows maturer development than does the typical soil. In the Holston-Monongahela-Tyler group the Monongahela soils are the most important. Comparison of the profiles of Monongahela silt loam and its high-terrace phase shows the greater development of the high-terrace soils.

The profile of typical Monongahela silt loam described as follows was observed in section 1 of York Township:

1. 0 to 7 inches, grayish-brown silt loam.
2. 7 to 14 inches, yellowish-brown silt loam containing some small concretions. It has an indefinite platy structure.
3. 14 to 20 inches, yellowish-brown silty clay loam containing few concretions. It breaks into lumps one-fourth inch in diameter. There is some slight gray color along the particle faces.
4. 20 to 28 inches, dull yellowish-brown silty clay loam mottled with gray and containing some concretions. It breaks into lumps three-fourths inch in diameter.
5. 28 to 36 inches, mottled gray and yellowish-brown silty clay loam containing numerous dark concretions of variable size. The particles are one-half to three-fourths inch in diameter and break into fragments one-fourth inch in diameter.
6. 36 inches+, stratified clay, silt, and fine sand. The material is strongly acid throughout.

Following is the description of a profile of Monongahela silt loam, high-terrace phase, as observed three-fourths of a mile north of Albany:

1. 0 to 6 inches, grayish-brown silt loam of medium acidity.
2. 6 to 12 inches, grayish-brown or yellowish-brown silt loam with a platy structure. It is strongly acid.
3. 12 to 20 inches, yellowish-brown slightly compact silt loam with some light-gray mottling. It breaks into irregular particles ranging from one-fourth to one-half inch in diameter. It is very strongly acid.
4. 20 to 27 inches, mottled gray, dull-gray, and yellowish-brown silty clay loam containing a few dark concretions. The layer is slightly compact and appears to be weakly cemented. It breaks into lumps ranging from one-half to three-fourths inch in diameter. It is very strongly acid.
5. 27 to 40 inches, mottled yellowish-brown and gray heavy silt loam or silty clay loam containing some dark concretions. For the most part it breaks into 2-inch lumps. It is slightly cemented and is very strongly acid.
6. 40 inches+, sand, silt, and clay.

In the high-terrace phase, downward leaching of material has been sufficient to produce a slight compaction and cementation.

A number of alluvial soils on flood plains have been separated into series. These show little differentiation into horizons, and hence little soil development, and may be considered youthful soils.

The various types of soils are separated on the basis of differences in texture, drainage, and reaction. The soils of this county can be summarized as follows: (1) Soils with the characteristics of the regional mature soil. This group comprises Wellston silt loam, Coolville silt loam, Tilsit silt loam, Hocking silt loam, the Chenango soils, the Wheeling soils, Wyatt silt loam, Vincent silt loam, the Holston soils, and Monongahela silt loam. (2) Soils in which the parent material dominates the process of soil formation. In this group are the Muskingum soils, Rarden silt loam, Brooke silty clay loam, Upshur clay, Westmoreland silty clay loam, and Belmont silty clay loam. (3) Soils the development of which has been prevented by imperfect drainage. These are Tyler silt loam and Hocking silt loam, poorly drained phase. (4) Youthful or alluvial soils on flood plains. This group includes the Pope soils, Philo silt loam, Atkins silt loam, Moshannon silty clay loam, the Huntington soils, and the Lindside soils.

SUMMARY

The area included in Athens County is a highly dissected plateau with narrow ridge tops and steep hillsides. Natural drainage ranges from good to excessively rapid. In this section annual rainfall is well distributed and high. The temperature is moderate, with warm summers and cold winters. The climate is favorable for a diversified agriculture.

The county lies within the belt of Gray-Brown Podzolic soils. The original vegetation was a forest of oaks, yellow poplar, chestnut, shagbark hickory, ash, beech, and maple.

The upland soils are residual in origin, being derived from sandstone, shale, clay shale, and limestone, and they are markedly influenced by these parent materials. As many of the rock formations are thin and interbedded, in some areas the soils derived from the different kinds of rocks are too intimately mixed to be shown separately on a small-scale map.

The soils derived from sandstone and shale, which are in the west-
The soils derived from sandstone and shale, which are in the west-
ern part of the county, have grayish-brown surface soils, yellowish-ous stages of disintegration. They have been placed in the Wellston, Coolville, Tilsit, Muskingum, and Rarden series. A large proportion of the area occupied by these soils is so steep that cultivation is almost impossible.

The soils derived from limestone are between the sandstone and shale soils in the western part and the clay shale soils in the southeastern part. The purely limestone soil, Brooke silty clay loam, is in the northeastern and central parts. It has a dark-brown surface soil and an olive-drab subsoil, and where it is intimately mixed with soils developed from sandstone and shale, and clay shale, it has been grouped in two series, Westmoreland and Belmont. These soils produce excellent bluegrass and make fine pasture land.

Upshur clay, the soil derived from clay shale, is in the southeastern part. It is red and has very little organic matter. Where it is intimately mixed with Muskingum silt loam, it is recognized as Meigs silty clay loam. Only small percentages of these soils are on slopes smooth enough for cultivation.

Soils developed from alluvial material on the terraces are along streams and old valley courses. Where underlain by gravel, these soils are in the Hocking series. The soils derived from fine-textured material have been mapped as Vincent silt loam or as types or phases of the Holston, Monongahela, and Tyler series. Where underlain by gravel, the soils on the terraces along the active streams are in the Chenango series. The soils of the terraces underlain by calcareous slack-water clays are members of the Wyatt series.

The alluvial soils with acid reaction on flood plains are placed in the Pope, Philo, and Atkins series. The neutral to alkaline flood-plain soils are classified in the Moshannon, Huntington, and Lindside series.

Corn is the most important crop. The dominance of corn is not a natural response to the character of the soil but is due to the necessity of providing winter feed for livestock. Stream flood plains and soils with gently rolling relief are used mainly for corn. An unusually large percentage of Wellston silt loam is used for this crop. This may be due to its topographic position, as there is little other soil suitable for a cultivated crop in the section where it occurs. Wheat is grown on most soils, but only a little is grown on the heavy-textured soils, such as the silty clay loams and clays.

Mixed hay is grown on most soils, especially those with medium subsoil drainage. Red clover is grown on soils derived from parent material containing some limestone and on sandstone and shale soils which have been heavily fertilized. Timothy is produced on most soils. It is grown in considerable quantities on Upshur clay and Muskingum loam, largely because it is the only crop that gives good yields on these soils. Alfalfa is grown almost exclusively on the limestone soils, especially on Belmont silty clay loam.

Pasture is dominant on all soils derived from parent material containing some limestone. Pastures on these soil types have good stands of bluegrass. Even the steep phases of these soils support good pastures without danger of excessive soil erosion unless they are overgrazed. Pastures on all other soil types have very poor stands of bluegrass, and weeds and poverty grass are much in evidence.

The abundance of good pasture has favored the development of livestock farming. Dairying is the most important, followed by beef cattle feeding and by sheep raising. Hay growing and cattle feeding have fallen off greatly in the last few years.

Fruit growing is carried on in the southeastern part of the county. This industry is not so much the result of soil conditions as of favorable economic conditions.

The steep slopes of the Muskingum and Meigs soils are favorable for forestry. Not much land is being planted to trees, but the abandonment of land is increasing the acreage of woodland.

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U. S. GOVERNMENT PRINTING OFFICE: 1938

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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; crosshatching indicates areas covered by both detailed and reconnaissance surveys.

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