SOIL SURVEY OF TRUMBULL COUNTY, OHIO.

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DESCRIPTION OF THE AREA.

Trumbull County, Ohio, is situated along the Pennsylvania line, in the northeastern part of the State, and is the second county south of Lake Erie. It is bounded on the north by Ashtabula County, Ohio, on the east by Crawford and Mercer Counties, Pennsylvania, on the south by Mahoning County, Ohio, and on the west by Portage and Geauga Counties. The county is in the form of a square and is divided into 25 townships of approximately 25 square miles each. The total area is 633 square miles, or 405,120 acres.

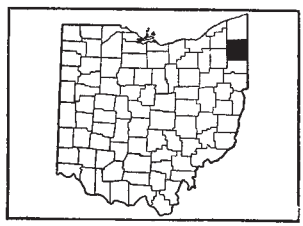

FIG. 33.—Sketch map showing location of the Trumbull County area, Ohio.

The surface of Trumbull County ranges from level to rolling and in some places to decidedly hilly and broken. However, the rougher sections are not extensive and most of the land is arable.

The eastern half, as well as a small section of the northwest corner, consists of a plateau that has been dissected to a considerable extent by stream action. Along the streams, particularly on the eastern side of the valleys, the slopes are rather steep and sometimes broken. This is especially true along Pymatuning, Yankee, Meander, and Mosquito Creeks. In most cases, however, the slopes to the streams are smooth and gentle.

Between the streams, particularly on the broad divide beginning near Girard and extending northward to the Ashtabula County line, the surface is very gently rolling, with some rather long stretches which are almost level.

As a whole the western half of the county is much less hilly than the eastern; in fact, most of it is level or gently undulating. The more level character of this section is due to the wearing away of the rock which constituted the plateau by large northward flowing preglacial streams and the formation of a broad valley extending from the escarpment along the east side of Meander and Mosquito Creeks to the one rising west of Mesopotamia and West Farmington. Remnants of the original plateau are found as rocky hills, rising 50

to more than 100 feet above the surrounding country. The more prominent of these occur north of De Forest, south of Lordstown, about halfway between Leavittsburg and Newton Falls, and west of Braceville.

Southington Township, especially the western part, is probably more rolling than any other township in this old valley, owing to a low moraine, known as the Cleveland moraine, which crosses it in a southeasterly direction. In Champion Township this moraine turns east and then northeast across Bazetta, Johnston, and Gustavus Townships. In its development in the western part of the county it forms a distinct ridge in many places 25 feet high and is quite noticeable from the south, but to the northeast it consists more of isolated knolls or low ridges.

The general elevation of the plateau is between 1,050 and 1,150 feet above sea level, although some of the higher points rise above 1,200 feet. In the broad valley covering most of the western half of the county, as well as in the larger valleys found in the plateau section, the elevation is usually between 850 and 950 feet. The highest point in the county, about 1,260 feet, is along the Pennsylvania State line about 2¼ miles north of Orangeville, while the lowest, a little less than 800 feet, occurs where the Grand River leaves the county. This gives an extreme range in altitude of about 465 feet.

Trumbull County is traversed by the divide between the Great Lakes and the Ohio River system. The northwestern one-fourth of the county drains into Lake Erie through the Grand River and its tributaries, while the drainage of the remaining three-fourths flows into the Ohio through the Mahoning and Shenango Rivers.

The largest streams in the county are the Mahoning and Grand Rivers. The Grand, after it enters the old valley, is shallow and sluggish, and during heavy rains may spread out over the level valley lands for a width of 2 or 3 miles. Pymatuning Creek flows across the northeastern part of the county in a preglacial valley which was originally occupied by a stream probably flowing in the opposite direction, and it is therefore also a sluggish stream.

Over much of the old valley in the western part of the county and upon the broad divides natural drainage has not yet become well established. This is due partly to the fact that the county is situated upon the divide between the Great Lakes and the Ohio River, partly to the comparatively short time which has elapsed since glaciation, and partly to the reversal of drainage which was brought about by the advance of the ice. There are very few, if any, areas in the county which can not be drained, although the small amount of fall in some of the streams presents considerable difficulty in some cases.

When Connecticut relinquished its claim to the Western Reserve to the Federal Government in 1800, Trumbull County was organized to

include all of that territory, with Warren as the county seat. Other counties were cut off from it from time to time.

After the organization of the county, settlement increased very rapidly. The early settlers were from New England, mainly from Connecticut. Persons of native parentage at present comprise more than three-fifths of the population, and native persons of foreign-born parentage include over one-fifth. European nationalities well represented are English, German, and Italian. Many of the Germans are farmers.

While the urban population has increased steadily from 1880 to the present time, there has been a decrease in the rural population. In 1880 the urban population was 8,307 and the rural 36,573. During the next 20 years the urban population increased to 18,627 and the rural decreased to 27,564. The census of 1910 showed an increase of rural population to 29,588. Most of the increase in population has been in townships adjacent to the larger cities and is probably due to the occupation of these localities for the purpose of growing fruit and vegetables for the city markets.

Warren, the chief city and the county seat, is situated southwest of the center of the county along the Mahoning River. In 1910 it had a population of 11,081. Five miles southeast is Niles, with a population of 8,361, and Girard, with a population of 3,736, is situated about 4 miles farther southeast, just north of the Mahoning County line. Hubbard, in the southeastern part of the county, has a population of about 1,700. Cortland, near the center, Newton Falls, in the southwestern part, and Mineral Ridge, in the southern, have between 600 and 1,000 inhabitants. Youngstown, in Mahoning County, a city of more than 80,000 people, almost touches the southern boundary, and Sharon, Pa., with a population of about 16,000, lies along the eastern boundary, and, in fact, part of the city is in Trumbull County.

Trumbull County has excellent railroad communication with a populous and highly industrial section of the United States. Two trunk lines, the Erie and the Baltimore & Ohio, pass through this county. The Erie comes up the Mahoning Valley from Youngstown and serves Girard, Niles, and Warren. Just west of Warren, at Leavittsburg, the Erie branches, one line going to Cleveland, the other to Chicago. To the east of Leavittsburg the main freight road of the Erie passes through Warren, Cortland, and Orangeville, and connects with the Youngstown line farther east in Pennsylvania. The main line of the Baltimore & Ohio passes through Girard and Newton Falls, and a branch line passes through Niles, Warren, and West Farmington to Painesville and Lake Erie. Another branch connects Warren and Newton Falls. The Cleveland, Youngstown & Pittsburgh branch of the Pennsylvania system passes through Girard, Niles, and Newton Falls, the trains running over the tracks of the

Baltimore & Ohio Railroad Co. under an operating arrangement. From Niles a branch of the Pennsylvania system extends northward through Warren to Ashtabula, while another extends southwestward to the main line at Alliance. Two lines of the Lake Shore & Michigan Southern, one exclusively for freight traffic, run north and south through the eastern part of the county. Another branch of the New York Central Lines extends from Phalanx Station, located on the Cleveland branch of the Erie, southward through Newton Falls to and beyond Alliance.

In addition to these steam railroads, the Mahoning Valley electric line runs from Youngstown through Girard, Niles, and Warren to Leavittsburg; another from Youngstown via Hubbard to Sharpsville, Pa., and one from Hubbard to New Castle, Pa. At present a line is being built from Leavittsburg to Newton Falls, where it will connect with another line to Ravenna.

CLIMATE.

The growth of plants depends not alone on soil but also on climatic factors, of which the principal ones influencing plant growth are rainfall, temperature, and amount of sunshine. In Trumbull County the mean annual temperature is between 48° and 49°, 48° being the record at Orangeville and 49.2° at Warren. The mean temperatures for December and January are but little higher than for February, and the mean for June and August only slightly less than for July. The extreme range for the county is 126°. At Warren the lowest reported was −25° and the highest 101°; at Orangeville the lowest was −28° and the highest 98°.

The average date of the first killing frost in the fall is September 30 at Orangeville and October 6 at Warren. The average date of the last killing frost in the spring is May 17 at Orangeville and May 14 at Warren. Both stations report a killing frost as early in the fall as September 14. The latest killing frost in the spring at Orangeville was June 9, and at Warren June 10, 1913. The late spring frosts retard the early growth of corn and potatoes, and the early fall frosts sometimes prevent full development of the plants. In 1914 immature corn and potatoes were injured by the early fall frosts. The average length of the growing season is 140 days.

The mean annual precipitation at Warren is 38.34 inches; at Orangeville 33.63 inches. The lowest annual precipitation at Warren was 32.66 inches in 1895, the highest was 47.07 inches in 1911. At Orangeville the lowest annual precipitation was 23.76 inches and the highest 46.35 inches. There is no regularity in the variation in precipitation from one month to another. Often a month with a low precipitation one year has a high precipitation another year. At Warren October had a precipitation of only 0.51 inch in 1895, but in

1911 the precipitation was 5.39 inches. In 1895 April had the lowest precipitation of the spring months, in 1911 the highest. Similar variations are shown at Orangeville.

The following table gives the normal monthly and annual temperature and precipitation and the maximum and minimum temperatures as recorded at Warren and Orangeville:

Mean normal and absolute monthly and annual temperature and mean precipitation at Warren and Orangeville.[1]

Month.	Temperature.						Precipitation.	
	Warren.			Orangeville.			Warren.	Orangeville.
	Mean.	Absolute.		Mean.	Absolute.		Mean.	Mean.
		Maximum.	Minimum.		Maximum.	Minimum.		
January	26.7	74	−25	25.1	75	−28	2.99	2.60
February	25.5	72	−20	23.7	65	−26	3.16	2.42
March	37.5	83	−10	36.2	81	−10	3.23	2.88
April	46.9	88	15	46.6	87	15	2.86	2.52
May	58.7	98	24	58.5	93	20	3.68	3.60
June	67.4	101	32	67.0	94	32	3.53	3.27
July	72.4	100	40	70.9	98	36	4.37	3.87
August	69.9	98	34	68.6	95	35	3.21	2.83
September	64.3	97	26	62.6	96	23	3.17	2.94
October	51.6	89	20	50.4	86	15	2.48	1.86
November	39.8	75	8	38.3	72	3	2.53	2.33
December	29.9	72	−10	29.1	69	−16	3.13	2.51
Year	49.2	101	−25	48.1	98	−28	38.34	33.63

[1] The Warren data cover the period from 1883 to 1913, inclusive, with the omission of 4 years, and the Orangeville data cover the continuous period from 1889 to 1908, inclusive.

AGRICULTURE.

After the organization of Trumbull County in 1800, its agricultural development took place rather rapidly, so that by the middle of the century a large part of the land was cleared and placed under cultivation. By 1870 62.9 per cent of the land in the county was improved. In 1910 the acreage of improved land was 253,073, or 62.4 per cent of the county. It is evident, therefore, that there has been practically no change in the percentage of improved farm land during the last 40 years, the slight decrease probably being due to the encroachment of the cities.

The same general crops are now grown and in about the same proportion as they were several decades ago. Probably the most noticeable change has been the increase in the acreage of potatoes and oats, and the discontinuance of the growing of flax, which was a

crop of considerable importance in the sixties, seventies, and eighties, the largest acreage being in 1869, when 4,237 acres were grown. In general, there has been a decrease in the number of live stock, particularly sheep, but a very marked increase in the production of milk. General farming and dairying are the main lines of farming at the present time, although fruit growing, market gardening, and stock raising are important. The principal crops are corn, oats, wheat, hay, and potatoes.

Although Trumbull County is outside the corn belt, this crop is one of the most important in the county. There was a slight decrease in the acreage of this crop in the sixties, but since that time there has been a steady though slight increase. The total area planted in corn in 1909 was 17,923 acres. The average yield is about 30 bushels per acre. Much of the corn is not grown for grain but is used for ensilage, particularly in the northern and northeastern parts of the county. About 5,000 acres are devoted to silage corn in addition to that given and the acreage is increasing.

The acreage in oats has doubled within the last 50 years and is now larger than that planted to corn. The total area in 1909 was 20,322 acres and the production 643,878 bushels, or a little more than 31 bushels per acre, which is about an average yield for the county, although much larger yields are obtained in the best seasons.

Trumbull is one of the low wheat-producing counties in Ohio. There were 9,392 acres reported in the 1910 census, with a production of 185,226 bushels. This gives an average of almost 20 bushels per acre for 1909, which is probably 4 or 5 bushels higher than the average for a number of years. The acreage in wheat tended to increase for several decades until about 1900, when there was a considerable dropping off; however, the last two years have shown considerable increase and the acreage may soon become as large as it was previously.

Rye and barley have never been important crops. The growing of buckwheat has increased somewhat in the last two decades, and in 1909 buckwheat was sowed on 3,388 acres, producing 63,102 bushels. Trumbull County is second in the State in the production of buckwheat.

Potatoes are of considerable importance in Trumbull County, especially on the sandy loam and loam types of soil. While the acreage has fluctuated from year to year, there has, in general, been a steady increase since 1860, and the acreage now devoted to this crop is considerably more than twice as large as that 50 years ago. In 1909 the total acreage was 5,252 acres, with an output of 450,891 bushels. This gives a yield of about 86 bushels per acre, which is probably a little less than the average for a period of years. While the acreage is not so great, the value of the potato crop nearly equals that of the corn crop and exceeds that of the wheat.

Hay is the first crop in acreage in Trumbull County, which ranks as the third county in Ohio in hay production. The area (61,762 acres) devoted to hay and forage is considerably greater than that (51,523 acres) used for the production of all the cereal crops combined. Of the total area in hay and forage crops 58,048 acres, with a production of 72,070 tons, is in tame or cultivated grasses. There is in timothy alone 25,449 acres, yielding 32,800 tons; in timothy and clover mixed 29,854 acres, yielding 36,407 tons; and only 518 acres, yielding 744 tons, in clover alone. As the fields sown to clover and timothy are usually left for several years, and as the clover nearly all disappears after the first year's harvest, the tonnage of clover is actually less than might be expected from the figures. The generally acid condition of the soils makes liming necessary in order to get a good stand of clover. The acreage devoted to hay has changed very little in the last 50 years. The acreage in 1858, according to statistics of the State Board of Agriculture, was 51,987 acres, which is almost as great as that given by the 1910 census (61,762 acres).

Considerable fruit, including apples, peaches, cherries, pears, grapes, and small fruits, is produced in Trumbull County.

There are a number of good apple orchards, some of them of very recent planting, in different parts of the county, especially in the more rolling sections. Almost every farmer has at least a few trees to furnish fruit for home use. There were in 1909, 134,181 apple trees in the county, which produced only 44,882 bushels of fruit. However, this was a very poor apple year, and the average annual production for the 10 years ending in 1909 was, according to statistics of the State Board of Agriculture, 220,196 bushels. The largest production since 1867, according to the same authority, was 863,686 bushels in 1896. With three exceptions the production of 1909 was the lowest for any year since 1867.

Of the other orchard fruits, peaches are the most important. Several very good orchards of peaches, some of which are just beginning to bear, were noticed during this survey.

Grapes are not grown very extensively, there being only one or two vineyards of any size in the county.

Small fruits, including strawberries, blackberries, dewberries, and raspberries, are grown to some extent, particularly in the vicinity of the towns.

While vegetables are grown on practically every farm, their production for market is principally in the southern and eastern parts of the county because of the nearness to Youngstown, Sharon, Warren, and Niles. A small area of Muck in Newton Township is used for the growing of onions and celery, and the drainage of other Muck areas, particularly the large one in the northeastern part of Bloom-

field Township, will probably result in an increased acreage of these crops. The total value of vegetables reported in 1910 was $333,764.

In 1910 the total value of domestic animals in Trumbull County was $2,476,268. This included 38,747 cattle, 11,875 horses, 154 mules, 13,634 hogs, 22,366 sheep, and 183,556 poultry. In general the number of domestic animals has been decreasing for several decades, and the decrease has been especially pronounced in the case of horses and sheep within the last 20 years. Cattle have largely changed from a beef to a dairy type. Of the total number of cattle, 22,413, or considerably more than half, are dairy cows.

Trumbull County is one of the most important dairy counties in the State, being second in gallons of milk produced. In 1909, 8,587,354 gallons of milk, 882,148 pounds of butter, and 1,920 pounds[1] of cheese were produced. A large quantity of milk is shipped to Pittsburgh, Youngstown, Cleveland, and other cities. The most important dairy section is in the northeast corner of the county, although the industry is fairly well distributed throughout all sections. The total value of dairy products, excluding home use of milk and cream, was $934,283. In general the dairy cattle are well bred, and there are some very high yielders in Trumbull County.

The majority of farmers in Trumbull County do not follow any systematic rotation of crops. Hay is considered the important crop and the land is usually left in mowings until it begins to "run out," when it is plowed and usually planted to corn to be followed by oats or wheat, with the idea of getting it back into grass again. As a larger acreage is devoted to grass than to all the cereal crops combined, it is evident that the fields in sod must be left for a number of years at a time. However, most of the farmers realize the value of crop rotation and are giving more and more attention to working out the most beneficial systems. Farmers living on the lighter soils, which are adapted to potatoes, include this crop in the rotation between corn and wheat or oats, followed by clover and timothy. Much clover is now being seeded in the oats. One of the greatest deficiencies is the lack of a larger proportion of leguminous crops in the rotation.

Commercial fertilizers are being used in increasing quantities. In 1880 the total expenditure was $19,250; in 1890, $44,915; in 1900, $52,760; and in 1910, $73,736. Much of the fertilizer used is a complete fertilizer, containing nitrogen, phosphoric acid, and potash, although many of the farmers are beginning to buy more of the unmixed goods and are using a larger amount of acid phosphate or

[1] This figure represents cheese made on the farm. The Ohio State Board of Agriculture reports 1,542,610 pounds of cheese manufactured in the county. There is no way to determine how much of the milk produced in the county is used in the manufacture of this cheese, or whether much milk is sent to the factories from farms outside the county.

bone meal, with very little or no nitrogen and potash, particularly on wheat. Some are also beginning to phosphate the manure.

Farm labor is high priced and hard to get because of the demands of the mills in Youngstown, Warren, Sharon, Girard, and Niles. Farm hands are paid $30 to $35 a month.

The average size of farms in Trumbull County is 82.1 acres, which is somewhat less than the average for the State, which is 88.6 acres. The larger number are between 50 and 99 acres; about one-fourth have between 100 and 174 acres, and about one-fifth are between 20 and 49 acres.

The percentage of farms operated by owners in 1910 was 81.8 per cent, and by tenants 17.2 per cent. The ratio of owners to tenants has not varied greatly since 1880, when 85.6 per cent of the farms were operated by owners. However, there was a decrease between 1880 and 1900 to 79.6 per cent. The increase since then is probably due to the movement of city people to the country in recent years.

The average value of farm land in 1910 is given by the census as $36.96. At the present time the values given for improved land by farmers range from $40 to over $100. There is some uncleared swampy land that can be purchased at as low as $20 an acre. A large part of the $40 land is flat and poorly drained and much of it is of the heavier types. The highest priced land is usually found near the larger cities and towns, and the value is due to location rather than farming value. There are, however, decided differences in land values due entirely to differences in soil. The Wooster and Chenango soils are generally considered among the highest priced lands in the county but their total acreage is small. Of the more extensive types, the Volusia loam and silt loam are valued most highly, particularly where, as in Kinsman Township, they grade toward the Wooster soils in character. The heavier, more poorly drained types are the lower priced.

The law in Ohio requires that land be assessed at its true money value. Figure 34 shows by townships the "average value per acre as fixed by the tax commission, exclusive of unincorporated villages, manufacturing plants and minerals," as given in its report for 1911.

With the exception of small areas occupied by the Wooster, Lordstown, Chenango, and Huntington soils, practically all the soils of Trumbull County are or have been in need of drainage. Although the rolling topography of the Volusia soils usually insures good surface drainage, the compact and rather peculiar subsoils make underdrainage necessary. All other soils, including the Trumbull, Braceville, Tyler, Papakating, Holly, and to some extent the Holston, have poor surface drainage as well as underdrainage. As the growing season in Trumbull County is rather short, the delay in planting

crops in the spring and the slow growth in the cold, wet soil result in much loss, even if only the damage from frost and not the lower yields are considered. Considerable tile has already been laid in Trumbull County. All the soils in the county are in need of lime, except those to which lime has been recently applied. One field which was limed at least 30 years ago still shows the effects by its much lighter growth

43.03 MESOPOTAMIA	33.99 BLOOMFIELD	36.85 GREENE	41.11 GUSTAVUS	50.75 KINSMAN
40.97 FARMINGTON	47.98 BRISTOL	38.60 MECCA	37.37 JOHNSTON	43.61 VERNON
36.33 SOUTHINGTON	40.37 CHAMPION	33.16 BAZETTA	42.51 FOWLER	44.69 HARTFORD
42.12 BRACEVILLE	90.64 WARREN	61.49 HOWLAND	45.76 VIENNA	104.49 BROOKFIELD
51.69 NEWTON	59.47 LORDSTOWN	96.52 WEATHERSFIELD	169.03 LIBERTY	68.65 HUBBARD

FIG. 34.—Sketch map showing assessed value of farm lands.

of sorrel and a better growth of grass. A number of farmers are already using lime, but the application is usually light. Ground limestone can be purchased for $2 or less per ton. Liming is often inadvisable on land where potatoes are the principal crop, as lime increases the danger of injury from scab.

The generally acid condition of the soils doubtless accounts for much of the difficulty in getting stands of clover and explains the consequently small quantity grown. Timothy is exhaustive of the nitrogen in the soil and the little clover with it does not add mate-

rially to the supply. Most of the farmers in Trumbull County give too little attention to the growing of clover, soy beans, or other legumes.

Excepting the small areas of the Papakating series and Muck and Peat, the soils of Trumbull County are low in organic matter and, as a result, are in poor physical and chemical condition for plant growth. This is particularly true of the Volusia and Trumbull clay loams and silty clay loams. The decay of organic matter in the soil tends to liberate plant food and to make other conditions more favorable to plant growth. Clover and other leguminous plants plowed under are efficient restorers of vegetable matter to the soil.

In the purchase of fertilizers the Trumbull County farmers do not give sufficient attention to the phosphorus content, since practically every experiment made in Ohio, as well as many in other near-by States, has shown a higher return on the investment in phosphorus than in either nitrogen or potash. Where timothy is grown most extensively the use of nitrogenous formulas may be profitable, but as a general proposition nitrogen can be placed in the soil more cheaply by growing leguminous crops than by incorporation in purchased preparations. Potash can probably be used to advantage with potatoes, but on most other farm crops its use is much less profitable than phosphorus. Where a large amount of manure, which is high in nitrogen and potash but low in phosphorus, is used it is more profitable for the farmer to invest in phosphorus than in a complete fertilizer. Reinforcing the manure with phosphorus is now practiced by a number of farmers.

SOILS.

Trumbull County lies entirely within the late Wisconsin glaciation and the soils are therefore almost entirely of glacial origin, although the character of the underlying rock has had a very important influence in determining the nature of the soil.

Geologically these rocks belong to the Waverly, Pottsville, and Allegheny formations of the Carboniferous, and the Ohio shale of the Devonian, the oldest rocks being found in the Grand River Valley and the youngest in the southern and eastern parts of the county.

The underlying rocks consist of sandstone, sandy shales, and shales, the sandstone largely predominating. Some thin layers of conglomerate also occur, but very little, if any, limestone is found. As sandstone and conglomerate are much more resistant to weathering than shale, they have tended to prevent the weathering down of the country where they occur, giving rise to hills or escarpments, and they are therefore more often exposed than shale.

While the sandstones and shales underlie the entire county, practically none of the soils have been derived directly from them, owing

to the fact that the great ice sheet, intermingling material from regions farther north with the soils of this region, and grinding up some of the underlying rocks, deposited a layer of till varying in depth from less than 3 feet to more than 200 feet.

It is believed by geologists that there were several different advances of the ice, separated by long intervals. As the preglacial drainage of this section of Ohio was northward into Lake Erie, the southward movement of the ice blocked the natural flow of the streams and caused the formation of temporary lakes. The old valley, covering most of the western half of the county, as well as valleys in other parts, was probably at one time such a lake. Into these lakes was carried material from the surrounding uplands. Later advances of the ice, pushing southward over these deposits, picked up part of the lacustrine material and, mixing it with other soil matter carried by the ice, formed an overlying deposit of drift. In many places in the western half of the county a layer of till overlies stratified sands, silts, or clays, but so complete has been the covering by till that only very small areas of the stratified material outcrop at the surface to form soil.

The depth to the underlying rock is greatest in the old preglacial valleys. Among these is the partially filled valley extending from Sharon to Youngstown, and a possible extension of the valley from near Niles somewhat along the line of Little Duck Creek toward Leavittsburg. Wells show that the bedrock is 200 feet or more below the surface. Another similar valley extends from near Leavittsburg southwest along Duck Creek to the Mahoning River, approximately 2 miles south of Newton Falls. Along the Grand River and Mosquito and Pymatuning Creeks the depth of the rock as shown by wells is 100 to 200 feet or over. These last valleys are also partially filled by till and partially by reworked glacial material. Some of these old valleys were undoubtedly formed by preglacial streams, while others are more probably of interglacial origin. Those which run in a more or less east-and-west direction, like the one between Sharon and Youngstown, are most probably of interglacial origin.

The areas where the drift is thin and the rocks within a few feet of the surface are mainly in the southern and eastern parts of the county on old preglacial ridges and along a few steep slopes near the streams. These thin deposits of till have usually given rise to the Lordstown stony loam or the Volusia loam, and their location can therefore be seen by reference to the soil map. In general the drift is deeper and heavier north of the Cleveland moraine, which includes most of the northwestern part of the county, than in other sections.

The drift material is composed principally of sandstone and shale material with a small admixture of granite, quartzite, and other crystalline rocks. The bowlders observed were usually angular to

subangular, indicating that they had been carried on or in the ice and consequently had not been subjected to pronounced grinding action, and therefore little of the crystalline rock material was ground fine enough to form soil. Although very few if any limestone fragments are found in the drift, most of the deeper subsoils, where the layer of till is several feet deep and not sandy, give a strong effervescence with hydrochloric acid, indicating the presence of quite a large percentage of lime.

During the final retreat of the ice some of the streams were apparently considerably swollen and deposits of sand and fine gravel were carried southward and deposited by the swollen waters. In some cases the streams have since lowered their channels, so that this material now occurs as gravel terraces along them, while in other cases the bed of the stream has been lowered only a few feet and good drainage has not yet been established. As the ice melted and the drainage began to take form, apparently some of the streams, particularly the Mahoning River, meandered over a large territory and the assorting action of the water caused the formation of small sandy areas. The drainage of the Grand River was apparently blocked by a moraine just a few miles south of Lake Erie, so that its upper course in this county formed part of a lake. A considerable area of material, which may be considered partly lacustrine and partly alluvial, was deposited in this section.

As most of the present streams have very narrow valleys, very little alluvial material is found along them.

Upon the retreat of the ice the agencies of weathering began acting upon the material and weathering, combined with the differences in the character of the underlying material, has given rise to a large number of different types of soil. Twenty-three separations are made. In most cases each separation represents largely one type of soil, but in some cases, especially in the narrow stream valleys, it is impossible to separate the different types in a series and only the predominant soil is shown. In some parts of the uplands, also, particularly in the section southwest and west of Warren, the soil conditions are very complex and the type mapped simply represents the preponderant soil.

Broadly speaking, with the exception of the organic soils, which constitute a group by themselves, soils may be divided into residual, or those formed by the breaking down of the rocks in place, and transported, or those formed from or composed of material which has been moved from the place where the rock was broken down and deposited elsewhere. In Trumbull County all of the soils except Muck and Peat are transported, although in case of the Lordstown stony loam, and possibly some of the other soils where the drift is

thin, the material has been derived in part from the underlying rocks and might therefore be considered as representing a transition between the two main groups.

The great group of transported soils may be subdivided into glacial soils, river-terrace soils, and alluvial soils.

The material in each of these groups was not uniform when laid down and further differences have been produced by the processes of soil formation which have been active since the deposition of the material. The more important changes have been brought about by differences in drainage, which, where very poor, has resulted in the accumulation of organic matter, causing a darkening of the surface soil, and, where moderately poor, has caused mottling or whitening of the soil and the accumulation of iron in concretions or in ocherous-yellow or brown stains.

Soils similar in all respects except texture are included in a series. A complete soil series would include all textures of soil from sand, through sandy loam and loam to clay, but usually only a few members of a series are found in one survey.

In Trumbull County the glacial shale and sandstone group of soils is divided into four series. Where drainage, both surface and internal, is good the surface soils are usually of a yellowish-brown color and the subsoils a brownish or reddish-yellow color. These soils are included in the Wooster series. Where drainage, particularly the underdrainage, is not so good, the surface soils are usually a little grayer in color, the subsurface a pale yellow to slightly mottled yellow, and the subsoils mottled gray and yellow. These soils are included in the Volusia series. Where the surface is practically level and drainage therefore poor, the soils have become a grayish brown to light gray, the subsurface light gray to almost white, often mottled with yellow, and the subsoil mottled gray and yellow. These soils are included in the Trumbull series. Where the drift is very shallow and the underlying rock usually less than 3 feet below the surface the soils are classed in the Lordstown series.

There is no sharp line of division between the Volusia and Wooster soils, on the one hand, and the Volusia and Trumbull soils on the other, but rather a gradual change from the Wooster through the Volusia to the Trumbull. There are many areas, therefore, which are intermediate in character between the Volusia and Trumbull. The most characteristic distinction between these series is the predominance of gray and the practical absence of yellow in the Trumbull. Where the gray in the subsurface predominates over the yellow, the soil has been classed with the Trumbull, but where yellow in the subsurface predominates over the gray the areas have been mapped with the Volusia.

The river-terrace soils and those that may be in part of lake origin may be divided into two groups, those having sandy or gravelly subsoils and those having subsoils of similar or heavier texture than the surface soils. The first group is divided into two series, the Chenango and the Braceville, the former including brown, well-drained soils and the latter gray and poorly drained soils. A similar division, based on drainage, can be made in the second group, the grayish-brown, better drained soils being included in the Holston series and the gray, more poorly drained soils in the Tyler.

The alluvial soils have been divided into three series, which, when typically developed, are strikingly different in color, owing primarily to differences in drainage. The well-drained Huntington series is rich yellowish brown, the more poorly drained Holly is gray to almost white, and the swampy Papakating is dark gray to black.

In addition to these soils composed very largely of disintegrated rock material, there are areas consisting almost entirely of organic deposits, which have been classed as Peat and Muck.

The following table gives the name and the actual and relative extent of each of the soils mapped in Trumbull County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Volusia clay loam	93,888	23.2	Chenango loam	3,200	0.8
Volusia silt loam	82,240	20.3	Muck and Peat	3,136	.8
Trumbull clay loam	56,576	13.9	Chenango sandy loam	1,664	.4
Trumbull silt loam	40,576	10.0	Volusia sandy loam	1,600	.4
Volusia loam	25,984	6.4	Wooster sandy loam	1,344	.3
Holly clay loam[1]	23,296	5.7	Trumbull silty clay loam	1,152	.3
Volusia silty clay loam	17,088	4.2	Holston silt loam	1,088	.3
Trumbull loam	14,528	3.6	Wooster silt loam	896	.2
Braceville loam	12,480	3.1	Wooster loam	768	.2
Tyler silty clay loam	9,664	2.4	Papakating clay loam[3]	640	.2
Huntington sandy loam	5,120	1.3			
Lordstown stony loam	4,672	1.1	Total	405,120	
Tyler silt loam	3,520	.9			

[1] Includes a large proportion of other members of the Holly series.
[2] Includes a large proportion of other members of the Huntington series.
[3] Includes a large proportion of other members of the Papakating series.

Wooster Series.

The soils of the Wooster series are yellowish brown to light brown in color. The subsoils are yellow to brownish yellow, showing often a faint reddish cast, and are friable and free from mottling, all members of the series being naturally well drained. They occupy upland areas through the glacial region, usually where glaciation has been heavy and the till is deep, and vary from smoothly rolling to

irregular morainic in topography. They are derived very largely from sandstone and shale material. In comparison with the Volusia soils, with which they are often associated, they are better drained and considered much the better agriculturally.

WOOSTER SANDY LOAM.

The Wooster sandy loam, to an average depth of about 8 inches, consists of a light-brown, slightly yellowish or reddish brown sandy loam, grading into a brownish-yellow to slightly reddish yellow sandy loam, which extends to a depth of 36 inches or more. There are some places, however, where the subsoil is rather light yellow, and other places, particularly near the borders of other soils, where gray mottlings appear within 3 feet, although such areas are not considered typical.

There is considerable variation in the percentage of the different grades of sand present. In some places it is largely medium, in others considerable coarse sand is present, and in still others the finer grades very largely predominate. However, very little difference in agricultural value is apparent and as the type occurs in only small areas it is impracticable to make any distinction between the different areas on the grade of sand. The percentage of finer material mixed with the sand also varies. In some of the larger areas the percentage is in places so small that the soil could more properly be considered the Wooster sand than the sandy loam. Not infrequently the subsoil becomes more sandy than the surface soil.

The most important area is found southeast of Newton Falls. Other areas are found in Mesopotamia, Braceville, Warren, Newton, Lordstown, Greene, Vernon, and Hubbard Townships.

In Warren and Hubbard Townships on several small morainic hills the soil and subsoil both contain 15 to 30 or 40 per cent of fine gravel, and at a depth of 3 or 4 feet stratified sand and gravel is found. This gravelly phase is indicated on the map by gravel symbols.

As the areas are all small the total acreage in the county is not large.

The surface of the type is usually rolling and this with the sandy texture gives good drainage, which, however, is not usually excessive, and crops do not often suffer from drought, except on the gravelly areas mentioned.

This type is one of the most easily cultivated soils in the county. Corn, the small grains, and potatoes are the principal crops. Its ease of cultivation, good drainage, quickness to warm up in the spring, and ready response to fertilization make this type well suited to market gardening where the areas are of sufficient size and not too distant from market.

WOOSTER LOAM.

The surface soil of the Wooster loam consists of a brown to yellowish-brown loam with a depth of 6 to 10 inches, usually about 7 or 8 inches. In some areas considerable medium to coarse sand is present, giving the soil a somewhat gritty feel, while in other areas the sand is rather fine and the texture grades toward that of the silt loam. The subsoil is also a loam but frequently contains more sand than the surface. The color is brownish or slightly reddish yellow, with no mottlings within 3 feet of the surface except near the border where it grades into other types. In places some gravel occurs both in the soil and subsoil and several small areas in different sections of the county have a sufficient quantity of gravel to form a gravelly loam. Both soil and subsoil of this variation are gravelly and the drainage is rather excessive. This variation is indicated on the map by gravel symbols.

Like other members of the Wooster series the area of this type is very restricted and confined to small morainic ridges scattered throughout the county. The largest areas are found in Hubbard, Liberty, Newton, and Bristol Townships.

The surface is rolling to hilly, but is usually not so uneven as to prohibit cultivation. The somewhat gravelly and porous nature of the deeper subsoil gives good though not excessive drainage, and artificial drainage is not necessary.

The Wooster loam is an excellent farming soil. Its good natural drainage, ease of cultivation, ready response to methods of improvement, and adaptability to a wide range of crops make it a very desirable soil where the surface is not too hilly. Good crops of corn, cereals, and potatoes are grown. It is also well adapted to small fruits and orchards.

WOOSTER SILT LOAM.

The Wooster silt loam consists of a light-brown to yellowish-brown silt loam, grading at an average depth of about 8 inches into a lighter brown or brownish-yellow silt loam. Usually both soil and subsoil have a smooth, friable, somewhat floury feel; but in some places considerable clay is found in the subsoil, making these areas somewhat plastic, and in others considerable gravel and sand, giving to these areas a somewhat gritty feel and insuring good drainage. There are places where some gravel occurs in the surface soil, but the amount is not sufficient to interfere with cultivation or justify its classification as a gravelly silt loam. The subsoil, where typically developed, is unmottled to a depth of 36 inches, but a considerable number of the areas mapped as this type in Trumbull County have gray mottlings in the lower subsoil. Such soil represents a gradation toward the Volusia silt loam and, in fact, some of these areas really

contain tracts of Volusia silt loam too small to indicate separately on the map.

Although this soil is not exactly like that on the experiment station farm at Wooster, the similarity is sufficiently close to justify their correlation as the same type. Part of the land mapped as Volusia silt loam, particularly the more rolling sections in Kinsman Township, is almost intermediate between the Wooster and the Volusia.

Only a few areas of this type were mapped in Trumbull County. These occur mostly in Liberty and Lordstown Townships. In the latter township the areas are more hilly than typical and the drainage is good.

The areas occupied by this soil have a rolling topography and fair underdrainage, although some of the lower occurrences could be improved by the use of tile.

The Wooster silt loam covers only 1.4 square miles, and as a large part of one of the areas is used by the Youngstown Country Club the type has very little importance in the agriculture of the county. It is a soil that can be brought to a high state of productiveness, as has been shown by the experiments on this type at Wooster. The small areas cultivated produce good crops of corn, oats, wheat, potatoes, and grass.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Wooster silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
271301	Soil	2.4	3.4	3.6	5.6	13.7	59.7	11.6
271302	Subsoil	.4	1.2	1.6	2.6	8.8	67.3	18.4

VOLUSIA SERIES.

The soils of the Volusia series are gray, light brown or yellowish brown, overlying mottled yellow and gray, plastic, clayey subsoils. They are derived from the glacial deposits of Ohio, New York, and Pennsylvania, where the country rock consists of shales and sandstones and the drift mantle is made up mainly of this material. The topography on which they occur varies from mountainous in eastern New York to smooth or rolling in Ohio.

VOLUSIA SANDY LOAM.

The surface 6 to 10 inches of the Volusia sandy loam is a light-brown to grayish-brown sandy loam, which varies in texture from a light to a heavy sandy loam. In fact, a considerable proportion of

the areas mapped as this type are almost a loam. Not only does the amount of fine material mixed with the sand vary, but also the size of the sand particles themselves. In some places the sand is medium to rather coarse and in others composed very largely of the finer grades. However, the areas are so small that it is impossible to make any satisfactory separation, and it is necessary in many cases to exaggerate these areas in order to indicate them on the map.

The subsoil is a yellow or pale-yellow sandy loam to sticky sandy loam, overlying a mottled yellow and gray sandy loam or clay loam. Apparently this sandy material has been deposited over the heavier till. In some cases this clay loam or clay subsoil may be within 18 inches of the surface and in others 2 or 3 feet or even more below. The clay loam subsoil usually grades into a clay, and the sandy loam, where it extends deeper than 21 inches, usually changes to a sticky sand which includes lenses of blue clay. This change most often comes at about 28 inches in depth.

As the areas of this type are quite small and not very numerous, the total acreage in the county is not large, and the soil is therefore on the whole not of very great importance. Nearly all the areas of this type are found in the southwest quarter of the county. They are located on low ridges, generally in sections where the rock is near the surface.

As this type often occurs in very small detached areas, surrounded and usually underlain by much heavier material, its exact origin is in doubt. The sand probably came from the sandstone found in this section, but the occurrence of sandy material over heavy clays shows that, in these cases at least, it could not have come from the underlying rocks, which are often many feet below the surface. It seems most probable that these areas of sandy material were formed at the time of or just after the melting of the ice and represent the assorting of material by water action. Probably this sand was deposited by the Mahoning River in its wide meanderings over the county before it took a definite channel.

In general this type occupies slightly higher lying land than the surrounding soils and therefore possesses fairly good drainage. The porous surface soil allows practically all the rainfall to enter and as this moves downward it encounters the heavier subsoil, which retards its movement, causing it to flow somewhat along the surface of the heavier material. Because of this condition this type is not so well drained as one would expect from its sandy nature, and its drainage can in many cases be improved by tile.

Potatoes are the most important crop. Corn, oats, wheat, and garden vegetables are also grown. The ease with which this soil is cultivated makes it well adapted to the growing of potatoes and to gardening.

VOLUSIA LOAM.

The Volusia loam consists of a grayish-brown to yellowish-brown loam underlain by a pale-yellow loam, which at a depth of 15 to 18 inches becomes mottled with gray.

In texture the surface soil varies from a loam containing sufficient sand to make it distinctly gritty to a loam in which the sand is fine. Usually, however, sand is present in sufficient quantities to be very evident to the feel, and is also quite noticeable in roads on this soil. In color the surface varies from a very light gray in dry plowed fields to distinctly grayish brown, with which there is mixed a small quantity of yellow, when the soil is moist. In general the more level areas are grayer while the more rolling have more yellow.

The texture of the subsoil varies from a loam, rather sandy, to a clay loam; however, the texture of the subsoil is not usually uniform in the same boring, but rather shows a tendency toward the formation of sandy loam or clay loam pockets mixed with loam. In general the subsoil is heavier near areas of the clay loam and more silty near areas of the silt loam. The color in the upper portion of the subsoil is a pale yellow, but becomes mottled with gray before a depth of 3 feet is reached, and usually at about 14 to 20 inches. In some of the more level areas mottlings may occur in the immediate subsoil, but such areas are not considered typical but as a gradation toward the Trumbull loam. The mottlings are usually gray, but brown, rusty-iron or ocherous-yellow spots are not infrequent. At an average depth of about 2 feet the brown iron stains become quite numerous and there is a tendency toward the formation of an iron hardpan; in fact, the farmers often speak of this slightly cemented layer as hardpan. It has probably been formed by the leaching out of the iron in the upper portion of the subsoil through the action of organic matter and its concentration at the depth at which the water table most often stands for a number of days after a period of wet weather. There are a few places where mottlings do not appear in the subsoil until a depth of 30 inches is reached. This is especially true east of Pymatuning Creek and north and east of Kinsman.

Along the escarpments west of the Grand River Valley in Mesopotamia Township, and east of Pymatuning Creek near the Ashtabula County line, and in a few other places, stones ranging from pebbles to bowlders but mostly between 2 and 10 inches in diameter are plentiful on the surface and through the soil, in places making it impossible to penetrate deeper than 15 or 18 inches. This phase is indicated on the map by stone symbols.

The Volusia loam is usually found in those areas where the underlying sandstones are within a few feet of the surface, and the overlying drift therefore contains a larger percentage of sand. However, in some cases where this type is associated with the Volusia sandy

loam, as is the area southwest of Newton Falls, the sand in the surface soil has apparently not come from the underlying rock but has been mixed with the soil in the same way as the sandy surface of the Volusia sandy loam. Such areas usually have a typical loam surface soil but a subsoil somewhat heavier than in those areas where the underlying rocks are nearer the surface. In most areas of this type the rock is not over 10 or 15 feet in depth and in many cases it is considerably nearer the surface.

Although occupying a smaller area than the silt loam or clay loam of either the Volusia or Trumbull series, the Volusia loam is an important type in Trumbull County. There are three sections of the county in which this type is most extensively developed, around Newton Falls, in the vicinity of Warren and eastward, and between Johnstonville and Kinsman and along the escarpment northward from Kinsman to the Ashtabula line and southeastward to Orangeville. Many other areas of smaller size occur throughout the southeastern part of the county and a few in the northwestern part.

The surface of the type is gently rolling to hilly. Some of the larger areas occur along the escarpment and therefore have a rather steep slope. The more rolling and hilly areas usually have very good drainage, although there is some tendency to seepage on the slopes. On the more level areas, where the tendency is toward the Trumbull soils, tiling is necessary in order to get the best results.

This type produces good yields of corn, oats, wheat, hay, and potatoes. Not much clover is grown although this legume does well where lime is applied. Where other conditions are suitable this type is well adapted to fruit and is one of the best apple soils in the county. The steeper slopes are in pasture, and as the soil covering here is not very deep erosion would soon remove it if under cultivation.

VOLUSIA SILT LOAM.[1]

The surface soil of the Volusia silt loam, to an average depth of 7 inches, is a grayish-brown to yellowish-brown or yellowish-gray silt loam to silty loam. When dry the plowed fields appear light gray or slightly yellowish gray; in a moist condition the color is a grayish brown usually with just a slight suggestion of yellow. The extreme variation in depth of surface soil is from 6 to 10 inches, but the usual depth is between 6 and 8 inches. While silt is the principal constituent of this soil and gives to it its smooth, soft, velvety feel, there is usually present an appreciable quantity of fine and very fine sand, and in most areas considerable clay, but where the soil is typically developed the amount of clay is not sufficient to give plasticity or cause much baking.

[1] The Volusia silt loam in this county differs somewhat from the type mapped under the same name in New York, as the latter contains a much larger percentage of shale and sandy shale fragments, and can therefore be more properly considered as the Volusia shale silt loam. (See Rec. Soil Survey of Ohio, p. 72.)

The subsoil, to an average depth of 18 inches, is a pale-yellow silty loam to heavy silt loam, frequently containing considerable fine sand. The lighter or slightly sandy subsoils are usually to be found in the neighborhood of areas of Volusia loam. In some places, particularly where this type grades into the clay loam, the texture of the subsoil becomes a heavy silt loam or clay loam containing a large percentage of silt. Below 18 inches a yellow and gray mottled layer is found. The texture of this layer varies from a silt loam, frequently containing considerable sand and sometimes small rock fragments, to a clay loam or silty clay loam. Near areas of the Trumbull soils mottling usually begins within 12 inches of the surface, and in fact there are many areas where some gray mottlings may occur just beneath the surface soil, but on the higher, better drained places there is no mottling until a depth of 20 inches or even more is reached. The yellow in the mottled layer is frequently replaced by a brown or drab, these colors being more prominent in the heavier subsoils. Sometimes there is a combination of all three colors. Ocherous-yellow or brown iron spots are occasionally quite prominent.

In most sections the subsoil does not contain a sufficient amount of lime within 3 feet of the surface to effervesce with acid, but in areas where the deeper subsoils are somewhat heavier than the average of the type effervescence may be obtained at a depth of 30 to 40 inches.

While the type as a whole presents the same general characteristics, many variations occur in it. In most places the gradation from the silt loam to the clay loam is not sharp. This is particularly true in Warren, Lordstown, and Weathersfield Townships. In these townships a considerable part of the areas mapped as Volusia silt loam is not so distinctly mealy and silty, and the subsoil is also heavier. In the southeast corner of Lordstown Township and the southwest corner of Weathersfield Township the Volusia silt loam, which borders on the Volusia silty clay loam, has a subsoil which is but slightly lighter than that of the silty clay loam type, and some parts of these areas could have been mapped with the silty clay loam with almost as much propriety as with the silt loam. In this section also there are low ridges of silt loam separated by narrow, low places where the soil is gray and the texture a clay loam or silty clay loam. These areas of Trumbull soils are too small to be shown on the map, so they were included with the Volusia silt loam.

In all parts of the county the Volusia silt loam areas as shown on the map include small areas of the gray Trumbull soils, usually the Trumbull silt loam. Likewise many small areas of the Volusia silt loam are found scattered through the land mapped as the Trumbull silt loam. The division between the Volusia silt loam and the Trumbull silt

loam is frequently difficult to draw, as the one grades gradually into the other.

The Volusia silt loam has been formed by the shallow glaciation of sandstones and shales, and the soil material consists mainly of these rocks with a slight proportion of crystalline origin. The underlying rock is usually a fine-grained sandstone or sandy shale, and in most places is probably not more than 20 or 30 feet below the surface.

The surface of the type is gently undulating to rolling, and, except in a few places, not too steep for cultivation. On the more gently undulating surfaces the fall is not sufficient for good drainage and on many of the slopes, even where the surface drainage is good, the compact subsoil holds too much moisture, making the soil wet and cold. Tiling has given good results on these areas, as well as upon those which are more nearly level.

The Volusia silt loam is found almost entirely in the eastern and southern parts of the county. Its most extensive development is in the southeastern, where it occupies nearly all of Hubbard, Liberty, Brookfield, and Vienna Townships. It also constitutes quite a large proportion of the soils in the two eastern tiers of townships north to the Ashtabula County line. In addition it occupies quite a large proportion of the southern parts of Weathersfield, Lordstown, and Newton Townships.

Very peculiar, long, narrow ridges, resembling wide railroad embankments, occur in the country between Lordstown and Warren. These have been included with this type, although they are almost as nearly a clay loam as a silt loam. These ridges vary from 3 or 4 to possibly 10 or 15 feet in height and from 50 to probably 300 feet in width. They extend almost continuously for 2 or 3 miles, with branches running off in different directions. No satisfactory explanation of their origin can be suggested.

This is one of the most important soil types in the county, both in extent and agriculturally. It produces good crops of corn, oats, wheat, potatoes, and hay. Though not much grown, clover does well where the land is limed. Its texture is such as to make this soil rather easy to cultivate, for, although clods may form, especially when the soil is plowed when rather wet, these can be easily crushed and a good seed bed obtained. Small fruits, grapes, and apples do well upon this type, and there are several orchards of apples, of peaches, and of pears. This type and the Volusia loam are probably the best orchard soils in Trumbull County.

VOLUSIA CLAY LOAM.

The Volusia clay loam consists of a grayish-brown heavy silty loam to clay loam, underlain at about 8 inches by pale-yellow heavy clay loam, which becomes mottled with gray, particularly below a depth

of 11 to 15 inches, and at 16 to 24 inches it grades into a grayish or drabbish-brown heavy clay loam to clay, often containing little or no mottling.

Although the texture of the surface soil varies from a heavy loam to a clay loam, the greater extent of the type contains a larger proportion of clay than either the loam or silt loam, which makes this type heavier, more inclined to clod or bake, and more difficult to cultivate than the lighter types. It does not have the gritty feel of the loam or the smooth, floury feel of the silt loam or silty clay loam.

More pronounced differences in texture occur between the subsoils of these types than in the surface soils. The subsoil of the clay loam is decidedly heavier than that of the loam or silt loam, but more friable and not smooth and greasy like the subsoil of the silty clay loam. The change in texture downward is usually rather gradual. Beginning as a friable clay loam, it becomes heavier with depth, and at about 18 to 24 inches becomes more distinctly a heavy clay loam to clay. Some grit and small fragments of rock usually occur. In some cases this grit is sand, but in others it is small iron concretions, which on continued rubbing with the fingers break down, so that the gritty feel disappears. Brown iron stains and a tendency to form bog iron ore or hardpan is sometimes noticed at a depth ranging from 18 to 24 inches. Lime concretions usually occur in the deeper subsoils, and effervescence with hydrochloric acid usually takes place at a depth of 36 to 42 inches.

In general the color of the surface soil can best be described as grayish brown, although there is considerable variation, depending largely upon the drainage and the amount of moisture actually in the soil. In general the more level the surface the grayer the color, and the more rolling the surface the more yellow is mixed in the brown. In dry, plowed fields the surface becomes a very light gray, but when moist this changes to a light brown. There is usually a distinct and sharp change in the color between the surface soil and subsoil, particularly where the land is under cultivation. In forested areas, where the land has never been plowed, this change is more gradual and the soil is usually shallower. The predominating color of the subsurface is a pale yellow, but this is often mottled to some extent with gray, and these gray mottlings always appear at a greater depth than 11 to 15 inches. From these depths down to 18 or 24 inches the subsoil is nearly always mottled. Here the gray changes to more of a bluish gray, the yellow to a yellowish brown or drab. In general the change in color is accompanied by a change to a heavier, more compact subsoil, although the color change may precede the change in texture. The material having a bluish-gray color is more of a greasy or silty clay, while the portions which are brown or yellow are more friable and contain some grit.

There is seldom any sharp line of division between this type and other members of the Volusia or the Trumbull series. Instead, the types grade into each other. Near the Volusia loam areas the surface soil is often rather loamy, and this texture may extend to a depth of 16 or 18 inches. Near silt loam areas the silt becomes quite prominent in the soil and upper layers of the subsoil. Frequently the areas near the silty clay loam are distinctly more silty than the average of the type in both soil and subsoil; but the latter is rather friable and has not the soapy or greasy feel which is characteristic of the subsoil of the silty clay loam, within 3 feet of the surface, although the deeper subsoil in these areas is much like that of the silty clay loam.

Small fragments of sandstone and sandy shale, as well as granitic bowlders, are quite common, but the percentage is not sufficient to interfere with cultivation. Considerable stony material was observed west of Mosquito Creek in Bazetta Township, and east of Grand River in Bloomfield and Bristol Townships.

The Volusia clay loam is derived from the deeper, heavier till, which is found principally along the north of the Cleveland moraine. Outcrops of the underlying rock are very seldom seen, and the drift is in most cases more than 25 feet in thickness and in some cases probably as much as 100 feet or more. In the section east and south of Niles the rocks are apparently nearer the surface on an average than anywhere else in this type, but the soil here is not entirely typical and represents a gradation toward the loam or silt loam. It is probable that a larger proportion of the drift where this type occurs was brought from farther north, where the underlying rocks are composed more largely of shale, which would account for its heavier texture, although it is possible, in some cases at least, particularly in areas associated with the silty clay loam, that part of the material consists of lacustrine clays which were picked up by the ice and mixed with the drift.

The Volusia clay loam is one of the most extensive soil types in Trumbull County. A broad development extends almost uninterruptedly north and south through the center of the county, being especially well developed from Cortland northward, and east and south of Niles. From Cortland this area extends southward and westward along the line of the Cleveland moraine to State Road, where it is interrupted by an area of the silty clay loam. At Southington it begins again and extends northward in a broad strip through the western part of Farmington and Mesopotamia Townships to the Ashtabula County line. Another important area extends north and south through Bloomfield and Bristol Townships, where it occupies the eastern slope of the Grand River Valley. Smaller detached areas are found in parts of the county, but practically none occur in the southwestern or eastern sections.

The surface of this type varies from gently rolling to rather hilly. Very little is too hilly for cultivation, and most of it has just about sufficient slope to give good surface drainage. However, the heavy character of the subsoil prevents good underdrainage and tile could be used to good advantage over the larger part of this type. As a result of the heavy nature and retentiveness of moisture of the subsoil this type is a rather cold soil, warming up slowly in the spring and causing considerable delay in planting. Good underdrainage would undoubtedly tend to alleviate this condition.

The greater part of this type is cleared, but there are considerable areas still in woodland. Dairying and general farming are the important pursuits. Corn, oats, wheat, buckwheat, grass, and a small quantity of clover are grown, and good yields, particularly of hay, are obtained. Potatoes are also grown, but the soil is rather heavy for this staple. Although lime is present in the deeper subsoil the surface soil is in need of lime in order to get best results with clover. As this soil usually has a large quantity of lime in the deeper subsoil, it is probable that alfalfa would do well on the better drained areas if a heavy application of lime were applied.

VOLUSIA SILTY CLAY LOAM.

To an average depth of 7 inches the Volusia silty clay loam consists of a pale yellowish gray to grayish-brown heavy silt loam to silty clay loam, underlain by a pale-yellow, or pale-yellow slightly mottled with gray, silty clay loam or silty clay, which becomes heavier with depth and grades at 15 to 18 inches into a smooth, greasy, plastic, heavy clay, varying in color from brownish yellow to olive drab, with usually some bluish-gray spots. These bluish-gray spots are generally more plastic than the yellow or brown, and on wetting have more of a soapy feel. The lower subsoil is practically always very calcareous. Very little reddening of litmus takes place at a depth greater than 20 inches, but the subsoil seldom effervesces before a depth of 30 to 40 inches is reached. Below the latter depth white lime spots in the subsoil are quite common and in road cuts lime concretions are usually found.

There are variations in color, texture, and the depth at which the heavy subsoil appears. In some places, where the slope is gradual, mottling appears immediately below the surface soil, but is more pronounced below 10 or 12 inches. Below 20 inches very little if any mottling occurs. Near the Volusia silt loam areas the surface soil is more silty, the subsurface a light, rather friable silty clay loam, and the lower subsoil somewhat less plastic and greasy than the average of the type. Near some areas of Volusia clay loam a small quantity of sand may be present. In some places along the steeper slopes the heavy clay subsoil lies within 8 or 10 inches of the surface, while

in others it may be as much as 2 feet below. Practically all of the roads have cut down to this heavy clay subsoil and are therefore very sticky and almost impassable during wet weather.

This type is of glacial origin and is believed to represent areas where the drift is composed very largely of lacustrine material which has largely been reworked by the ice. It is possible that its origin may be due to the drift here being composed more largely of material derived from heavy clay shales, but the rock, in areas where this soil is found, is usually far below the surface and in some places is undoubtedly as much as 100 or 200 feet. This fact, together with the appearance of the material itself, makes it more probable that it represents areas where the drift consists largely of reworked lacustrine material.

The main body of the type is found in Southington Township, but with an extension eastward into Champion and northward along the boundary between Farmington and Bristol Townships. A small area is found in the southwestern part of Farmington Township, extending southward into Southington. Much of the clay loam in Farmington and Southington Townships has the heavy, unctuous clay characteristic of this type, occurring at a depth of 3 to 6 feet below the surface.

While the surface of this type is gently undulating to rolling and in some places somewhat hilly, usually there is sufficient slope to give surface drainage except in depressions or swales. These areas, however, are usually not typical of the Volusia silty clay loam but are more like the Trumbull silty clay loam, although the areas covered by them is so small that it is not practicable to show them on the map. While this type is a cold, wet soil, and therefore in need of artificial drainage, the heavy, rather impervious nature of the subsoil makes this difficult.

On the whole the Volusia silty clay loam is generally considered by the farmers as one of the poorer types of the county. Its heavy, rather intractable nature makes cultivation difficult. If plowed when too wet, hard clods are formed which are not easily broken down, and if allowed to become too dry it bakes and much power is required to turn it. Some of this type is still in woodland, but a large part is in cultivation. Corn, small grains, and hay are grown, but the yields are not large. Most of the corn on this type in the season of 1914 was very poor, partly due to lack of moisture. Early in the summer it was observed that corn on this type was suffering from drought when crops on other soils were not affected. Very fair yields of hay are obtained and it is better adapted to the growth of grass and for pasture than to corn. Although the surface soil is in need of lime, the subsoil is very calcareous and it is probable that with the use of lime sweet clover or alfalfa could be grown successfully.

Trumbull Series.

The soils of the Trumbull series are gray to light brown in color to a depth of about 7 inches, with an inch or two of darker material at the surface. The surface soil is underlain, where the series is typically developed, by a very light gray to nearly white subsurface layer. Where the series is imperfectly developed, on account of better drainage than the normal, this layer becomes mottled with brown iron stains. At about 20 inches from the surface there is a change to a gray or bluish-gray, yellow, and brown mottled subsoil, heavier in texture, as a rule, than either the soil or subsurface. The gray portion of this layer seems to be practically unweathered glacial till, and less leached, therefore, than the gray of the higher layers, though the lime content is insufficient to cause noticeable effervescence. The topography is flat and the derivation is from glacial till of sandstone and shale origin.

Trumbull loam.

The Trumbull loam consists of a gray loam about 7 or 8 inches deep, underlain by a gray, or gray mottled with yellow, loam, which at 18 to 20 inches becomes a mottled gray and yellow heavy loam or clay loam in which the percentage of yellow is considerably greater than in the subsurface soil.

When dry the surface soil is very light gray or almost white, but when moist it becomes darker, changing to brownish gray or grayish brown. In some of the most poorly drained areas the amount of organic matter is greater than in the average of the type, and, in fact, is sufficient to make the soil, when moist, rather dark gray. The texture varies from a rather coarse loam, particularly near areas of the Volusia sandy loam or Braceville loam, to a fine, rather silty loam where it grades into Trumbull silt loam or Volusia silt loam. Sometimes there are small areas distinctly sandy which, had they been more extensive, would have been mapped as Trumbull sandy loam. The depth of the surface soil varies from 4 to 10 inches, but is usually, particularly in cultivated fields, about 7 or 8 inches.

The subsurface material shows considerable variation, particularly in color. In the level and more poorly drained areas the color is usually very light gray or almost white, with very little mottling except brown or ocherous-yellow iron stains. As drainage conditions become better, yellow mottlings appear and the yellow increases in prominence until it predominates over the gray and this type grades into the Volusia loam. In some places bog iron ore is found in this subsurface layer or near its contact with the lower subsoil. The texture is usually about the same as that of the surface soil, though it frequently contains more clay and occasionally sufficient sand for the

sandy loam; however, the texture often varies considerably in the same boring, pockets of sandy or clayey material being intermixed with the loam.

The subsoil is a mottled gray, yellow, and brown heavy loam to clay loam, which usually begins at a depth of about 18 or 20 inches. This subsoil practically always contains more yellow than the subsurface and very seldom consists of the light gray so characteristic of the upper part of the subsoil. Sometimes there is a rather distinct change between the subsurface and the subsoil, but in some cases, particularly where the subsurface is mottled, the distinction between the two is not so marked. The mottled subsoil, especially when it is a clay loam, sometimes begins within 14 or 15 inches of the surface. The texture of the subsoil is not always uniform, but may consist of lumps of clay mixed with sandy material.

The type is usually found in areas where the underlying sandstones are not very far below the surface, and owes its origin to the larger percentage of sand in the drift as a result of the nearness of the rocks to the surface. Some areas probably represent material which has been partly reworked by water action.

The surface of the type is level and artificial drainage is practically always necessary, at least enough to carry off the surface water after continued rains.

This type is found principally in the southwestern quarter of the county, the only important exceptions being the two areas in the western part of Greene Township. The largest area is found in the vicinity of Warren.

Because of its naturally poor drainage much of the Trumbull loam is still forested, although a considerable area is under cultivation. Corn, small grains, and grasses are the principal crops grown. It is a rather easy soil to cultivate and, if proper drainage is provided, gives very good yields.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type are given in the following table:

Mechanical analyses of Trumbull loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
271327	Soil	0.5	2.4	6.0	13.0	12.2	47.8	18.2
271328	Subsoil	.5	2.6	5.6	12.4	13.4	46.2	19.2
271329	Lower subsoil	.6	3.2	3.2	15.2	14.9	40.4	22.3

TRUMBULL SILT LOAM.

The Trumbull silt loam consists of a gray silt loam about 7 inches deep, underlain by a light-gray, sometimes mottled with yellow, heavy silt loam changing at about 18 inches to a mottled gray and yellow silty clay loam.

The color of the surface soil varies from very light gray or almost white when dry to grayish brown or brownish gray when moist. In the most poorly drained areas the quantity of organic matter may be sufficient to give a rather dark gray color. The color of the subsurface is, in the most typical areas, very light gray, with usually some rusty-brown, iron-stained spots. While this light-gray color of the subsurface is considered most typical, quite a large proportion of the type has some yellow mottlings. In the flat areas there is usually very little yellow coloring, but it increases as the drainage becomes better, and as the surface becomes rolling the type gradually changes into the Volusia silt loam. While the subsurface is typically gray, rather than mottled, the subsoil is in nearly all cases mottled gray and yellow. Frequently ocherous-yellow or brown iron spots and in some cases bog iron ore occur, usually below 30 inches, although they sometimes appear nearer the surface. In general the color follows rather closely the topography, the level areas being decidedly gray while those which are gently undulating have some yellow mixed with the gray, particularly in the subsoil. Sometimes on slopes where there is some seepage from higher lying areas the soil is grayer than would be expected from the topography.

While the texture of the surface soil on the whole is distinctly silty, quite a little variation occurs in different parts of the county. In the large areas in the eastern and northeastern townships the material usually has a distinctly smooth, velvety, silty feel, with no grit and very little, if any, plasticity. Near the border of areas of Trumbull loam, Volusia loam or Volusia sandy loam the Trumbull silt loam contains considerable sand in both soil and subsoil, and there are some small areas in these sections which, had they been larger, would have been mapped with one of these types. Near areas of Trumbull clay loam and Volusia clay loam more clay is present, particularly in the subsoil, and some small areas in these sections are really more nearly like the clay than like the silt loam, but it was not possible to separate these on the map. In the southwestern part of the county the soils are especially complex, varying in texture from a silt loam or loam on the one hand to a clay loam on the other. Where the prevailing texture is that of a silt loam these areas have been included with the Trumbull silt loam.

The Trumbull silt loam is derived from the same character of till as the Volusia silt loam, the difference being due to changes which have

been brought about as a result of poor drainage conditions. In general, the drift in these areas is not very deep, in most cases probably being between 10 and 25 feet, although there are some areas where it is less, and others where it is undoubtedly deeper, particularly in the sections in which this soil is associated with the clay loam.

The surface of the type is very flat to slightly undulating. In most cases the surface slope is not sufficient to carry off surface water after rains. A rise in elevation of only 2 or 3 feet will usually witness a change from this type to the Volusia silt loam. Because of the level surface and the slowness with which water passes through the subsoil, this type has naturally very poor drainage and all areas require artificial underdrainage for best results.

In area this type is one of the first in the county, the largest development being in the section between Kinsman and Vienna. Several areas of considerable extent are also found in eastern Kinsman, Vernon, and Hartford Townships, and more or less throughout the southeastern and southwestern parts of the county. Very little of it is found in the northwestern part of the county.

Partly because of its poor natural drainage, a considerable proportion of this type is still forested, although by far the larger part is under cultivation. Corn, oats, wheat, and hay, chiefly timothy, are the principal crops and, where the land is drained, good yields are the rule. Some clover is grown, but the land must be tilled and limed in order to insure good results with this legume. Although there is some tendency to bake, the soil on the whole is rather easily cultivated and, if drained and properly handled, is a good soil for general farming.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Trumbull silt loam:

Mechanical analyses of Trumbull silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
271324, 271348...	Soil.....	1.1	2.7	2.2	7.9	12.7	55.4	18.1
271325, 271349...	Subsoil.....	.6	2.4	2.4	8.2	12.1	53.2	20.8
271326.....	Lower subsoil.	.9	2.2	2.6	6.9	11.6	52.2	23.6

TRUMBULL CLAY LOAM.

The Trumbull clay loam consists of a gray, rather silty clay loam about 8 inches deep, underlain by a light-gray, sometimes mottled with yellow, heavy clay loam, which at an average depth of about 20 inches changes into a mottled gray and yellow clay.

When dry the surface soil is very light gray to almost white, but when moist it becomes brownish gray or grayish brown. In poorly drained areas the quantity of organic matter is occasionally sufficient to give it a somewhat dark gray appearance, and such areas are sometimes referred to by the farmers as "black." At an average depth of about 8 inches, but ranging between 4 and 10 inches, a distinct change in color takes place. Below this depth the subsurface is very light gray, or gray mottled with brown and yellow iron stains. Although much of the area mapped as this type has some yellow in the subsurface, the gray is the predominating color. Below an average depth of about 20 inches, but varying somewhat in different sections, the subsoil is practically always mottled gray and yellow, with ocherous-yellow or brown iron stains quite commonly present. Sometimes the gray has a slight bluish tinge and is spoken of by the farmers as "blue clay."

Although most areas of the Trumbull clay loam contain a large quantity of silt, it is distinctly heavier in character than the silt loam, particularly in the subsoil. However, there is considerable variation in texture, the range extending from a heavy loam or heavy silt loam to clay loam, or almost a silty clay loam. In general, however, the texture is that of a clay loam in which the percentage of silt is rather high. The areas in the Mahoning River Valley, northwest of Warren, have a greater range of texture and often contain more sand than the large area farther northward. The texture of the subsurface is a heavy clay loam, usually rather high in silt, which becomes a clay. In some cases this heavy subsoil may begin within 14 inches of the surface and again may be as much as 30 inches below and in a few cases it does not occur within 36 inches. Both subsurface and subsoil are more or less plastic, particularly the latter. There is usually a close relation between the plastic property of the subsoil and the color, the gray or bluish-gray part being quite plastic and often smooth and unctuous, while the yellow and brown portion is generally friable and sometimes has a gritty feel, due, in some places, to small particles of bog iron ore rather than the presence of sand. Occasional fragments of sandstone, shale, or other rocks are found in both soil and subsoil.

Like the Volusia clay loam, the Trumbull clay loam is derived from the deeper and heavier drift. It is closely associated with the Volusia type. The difference between the two is due to macerating processes which have gone on under poor drainage conditions. The two types, therefore, grade into each other and there are small areas of the one included in the areas mapped as the other.

As poor drainage is an essential condition for the formation of this type, the areas occupied by it have a level to very gently undulating surface, in most cases hardly sufficient to drain off the water after

rains. This level surface and the heavy character of the subsoil make drainage a somewhat difficult problem on this type. Most of the drainage at present is surface drainage, but tiling of all areas will be necessary before the land can be brought to the highest state of productiveness.

The occurrence of this type is confined almost exclusively to the north-central part of the county. By far the largest area begins just north of the moraine in Champion and Bazetta Townships and extends northward into Ashtabula County, taking in the greater part of the western half of Mecca and Greene Townships and the eastern half of Bloomfield and Bristol Townships. A smaller area begins near the infirmary north of Warren and extends westward, with one interruption, to the Portage County line. Most of the area included by the bend of the Mahoning River northwest of Warren is occupied by this type. Another important area occurs on the divide south of Cortland and smaller areas are found along this same divide northward to the Ashtabula County line.

The heavy character and poor drainage make this soil cold and wet, causing it to warm up slowly in the spring and retarding the planting of crops, particularly if the spring is a wet one. Its heavy character makes it somewhat difficult to till and it must be worked within a rather narrow range of moisture conditions. If slightly wet, hard clods form, which are somewhat difficult to break down, while, on the other hand, if the ground becomes too dry it gets hard and plowing is difficult. This type is well adapted to hay and is used quite extensively for this purpose, timothy being the principal grass. Some good corn is produced on the lighter, better drained fields, but on the heavier land the yields are not large, although when well drained and cultivated this soil produces good crops of corn as well as of wheat and oats. It is too heavy to give best results with potatoes. Considerable areas, particularly where drainage is most difficult, are still forested, although the larger percentage is under cultivation.

TRUMBULL SILTY CLAY LOAM.

The Trumbull silty clay loam has many characteristics in common with the clay loam, but it usually has less grit and more silt and clay and the subsoil is distinctly heavier and more greasy and plastic. The surface soil consists of a heavy silt loam to silty clay loam with an average depth of about 6 or 8 inches, where it changes to a gray, or gray and yellow mottled, silty clay loam to silty clay. At a depth of about 15 or 18 inches this grades into a heavy, greasy clay of a bluish-gray color intermingled with yellow, brown or drab. Typically both soil and subsoil are free from grit and pebbles, but there may be some admixture of these, particularly near areas of Trumbull clay loam or Volusia clay loam.

The Trumbull silty clay loam is of glacial origin, but as in the case of the Volusia silty clay loam, the drift here is believed to be composed very largely of lacustrine material mixed to some extent with other material carried by the ice. Like other members of the Trumbull series the difference between this type and the corresponding member of the Volusia series is due to the poor drainage of the Trumbull.

This type occupies several small areas in Warren, Lordstown, and Weathersfield Townships, the largest area being near Leavittsburg. Small strips or areas are found throughout the Volusia silty clay loam, although these were usually too small to be shown on the map.

The level character of the surface and the heavy, impervious nature of the subsoil make natural drainage very poor and render artificial drainage difficult. Most of the area occupied by this type is under cultivation, but the heavy character of the soil makes it difficult to handle, and it is not considered a desirable soil for farming. However, it is well adapted to grass and fair yields of hay are obtained, particularly of timothy. Some oats, wheat, and corn are grown and give moderate yields.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Trumbull silty clay loam:

Mechanical analyses of Trumbull silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
271360	Soil	0.2	1.4	1.2	8.6	10.4	43.7	34.5
271361	Subsoil	.2	.5	.9	4.4	8.5	42.7	42.6

LORDSTOWN SERIES.

The soils of the Lordstown series are brownish gray to light brown, and the subsoils, which are of about the same texture as the soils, are yellowish brown or brownish yellow, resting upon sandstone and shale bedrock at a depth of 12 to 30 inches. The soil material is partly residual from the underlying formations and partly glacial from the same and near-by formations. These soils occur on slopes, ridges, knolls, and more nearly level stretches associated with the Volusia, Trumbull, and other series of glacial soils of sandstone and shale origin, being confined to such areas as have only a thin veneer of soil material over the bedrock. They are naturally well drained, and on account of the shallow depth of the soil, rather droughty. Only the stony loam type is represented in this county.

LORDSTOWN STONY LOAM.

The most distinctive feature of the Lordstown stony loam is the presence of stone, usually as bowlders or shaly fragments on the surface, but if not on the surface, then only a few feet below. In some

places the quantity of stone on the surface is very small, while in others it is so large that cultivation is impracticable. The individual fragment ranges from small pebbles to large sandstone or granitic bowlders and slabs of shaly sandstone.

The interstitial material consists of a brown or yellowish-brown, or when dry a yellowish-gray, loam to silty loam, grading at 6 to 9 inches into a yellow loam or silty loam.

The total area of this type is not large. It is found mainly in Brookfield, Hubbard, Lordstown, and Braceville Townships, but there are small areas in other parts of the county, some of them of so little extent that they were not indicated on the map.

Some good orchards are located on the Lordstown stony loam, and this is probably one of the best uses to which this type can be put. Some potatoes, small grain, and corn are also grown, and, in areas where the rock is not too near the surface good crops are obtained if the season is not too dry. However, the shallowness of the soil gives very little room for storage of moisture and crops suffer during periods of dry weather.

Chenango Series.

The Chenango series includes types having yellowish to light-brown surface soils and brown to yellow subsoils. A characteristic of the series is the uniform occurrence at the depth of 3 feet or more of stratified gravel or sand.

The series includes terrace soils, occurring along streams in those sections of the glaciated region where the upland soils result from the glacial grinding of shales and sandstones, with only a moderate admixture of other material. The material forming the series was deposited by swiftly flowing streams of water. With deeper erosion by the streams this material was left as terraces and is not now subject to overflow.

CHENANGO SANDY LOAM.

The Chenango sandy loam consists of a light-brown or yellowish-brown sandy loam to a depth of 7 or 8 inches, where it changes to a slightly reddish or brownish yellow sandy loam, which becomes sandier with depth until it grades into a bed of gravel and sand. The depth at which this sand or gravel occurs is sometimes within 2 feet of the surface, but frequently it is more than 3 feet. The sand in both soil and subsoil varies from fine to coarse, but the predominating texture is that of a medium sandy loam. Typically no mottlings are present either in the subsurface or subsoil, but in some low areas and near other types the deeper subsoil shows some mottlings.

This type has been formed from reworked glacial material under conditions of good drainage, which has caused a high oxidation and

the consequently yellow or slightly reddish yellow color, which may become very pronounced where the gravel is near the surface and the stream channels have been lowered, so that the underground water is many feet deep.

The gently rolling surface and the sandy or gravelly nature of the subsoil insure good drainage.

This type occurs only in small areas scattered along the main stream valleys of the county. Because of its small extent it is of very little agricultural importance. It is considered an excellent soil for trucking and is used to a considerable extent for growing truck crops and small fruit. However, much of it is devoted to grain and grasses. The type gives fairly good yields.

CHENANGO LOAM.

The soil of the Chenango loam to an average depth of 8 inches is a light-brown to yellowish-brown loam, varying in texture from a rather sandy loam to a silty loam. The subsoil is a brownish-yellow or slightly reddish yellow loam with about the same variation in texture as the surface soil. Typical areas have no mottling within 3 feet of the surface, but on some low areas and near the border of other types some gray mottlings appear at depths ranging from 2 to 3 feet. At an average depth of about 3 feet, sometimes more and occasionally less, a layer of sand or gravel occurs. The change to the sandy or gravelly subsoil is not always abrupt, but frequently a small quantity of gravel occurs in the surface and the quantity increases downward until the subsoil consists very largely of gravel.

A number of small areas of the Chenango gravelly loam are included with the loam and shown on the soil map by gravel symbols.

This type has been formed from reworked glacial shale and sandstone material. The sandy or gravelly nature of the subsoil has caused good drainage, which has resulted in the higher oxidation and more pronounced yellow or reddish color of the soil and subsoil. There are, however, some low, poorly drained spots included. The surface is level to gently undulating.

Small areas of Chenango loam are found along all the larger streams except the Grand River. It is also found in the old valley extending southwestward from near Leavittsburg along the line of Duck Creek. There are many small areas of Chenango soil associated with the Braceville loam which could not be shown separately.

Although an excellent soil, its small extent makes it of little importance. It is easily cultivated and the good drainage causes it to warm up early in the spring, so that it is a desirable soil not only for general farm crops, but also for truck and small fruits. With a liberal application of lime, alfalfa could doubtless be grown successfully on this type.

Braceville Series.

The surface soils of the Braceville series are gray to brownish gray or gray splotched with rusty iron ore. The subsoils to a depth of 18 to 36 inches vary in color from brownish gray to gray mottled with yellowish brown and rusty brown and in texture from that of the soil to somewhat heavier, giving way below to beds of sand and gravel. They are derived from waterlaid deposits of sandstone and shale origin, occurring as terraces, filled-in valleys, and outwash plains. They are flat in topography and poorly drained. On account of the poor drainage conditions only a small percentage of the Braceville soils have been brought under cultivation. They are easily drained, where sufficient fall can be obtained, and converted into good land, though less valuable than the Chenango soils, to which they are closely related. Only the loam type is mapped in this county.

BRACEVILLE LOAM.

The Braceville loam consists of a grayish-brown or brownish-gray, rather light loam, grading at 7 to 10 inches into a gritty loam or sandy loam, which varies in color from gray, or gray mottled with yellow, to yellow mottled with gray. At a depth averaging about 18 or 20 inches, but varying from about 15 inches to almost 3 feet, the subsoil changes to a sand or sticky sand, containing a varying amount of gravel. The color of this lower subsoil varies from pale yellow, mottled with gray and ocherous yellow, to mottled gray and yellow.

There is considerable variation in the color of the surface soils in areas mapped as this type. Over the larger proportion the surface soil when dry is light gray, but when moist becomes brownish gray or grayish brown. In some places where drainage is especially poor, a considerable quantity of organic matter has accumulated in the surface soil, giving rise to small areas which have a very dark gray color. Such areas may be seen along the southern township-line road in the southwestern part of Warren Township. Where the drainage is somewhat better than the average, the percentage of gray decreases and that of yellow increases, until the soil grades into the Chenango loam or sandy loam. Quite a large proportion of the area mapped as the Braceville loam really consists of what can best be considered as not typical of the Braceville but rather as representing a gradation toward the Chenango loam. In fact, there are throughout the area mapped as this type many small patches which are much more like the Chenango loam or sandy loam than like the Braceville loam, although their small extent made it impossible to indicate them separately. Wherever there is a slight elevation above the surrounding country either the Chenango loam or a gradation toward that type is developed.

On the whole, the texture of the Braceville loam is lighter or more sandy than that of other loam types in the county. Most of it should be classed as a light loam, but there are small areas which are quite sandy and others that are quite silty or clayey. The sandier spots are found along Mosquito and Eagle Creeks, and some parts of Duck Creek, while the more silty portion is found near the junction of Eagle Creek with the Mahoning River. The latter area has a large quantity of silt and fine sand in the surface, and, although the subsoil becomes much sandier, it is mainly fine and very fine sand, and contains no gravel. Along Mosquito Creek and in the old valley southwest of Leavittsburg there are places where a large quantity of gravel occurs in the lower subsoil, but there are others which are free from gravel. Some of the valleys in which the Braceville loam is found seem to have been filled partly by till and partly by water-deposited material. Therefore, it was not always possible to separate all the till deposits, so that small areas are included in which the subsoil contains considerable clay, and which might probably be more properly considered as Trumbull rather than Braceville soil. There are other places where the sandy subsoil rests upon clay or clay loam at depths ranging from 30 to 36 inches. Such areas apparently represent thin deposits of reworked glacial material over the till.

The Braceville loam has been formed from reworked glacial, shale, and sandstone drift material under poor conditions of drainage.

The surface of the type is level to very slightly undulating. Although the subsoils consist of sand or sand and gravel, the type is poorly drained. The lowering of the water in the main stream channels would in many cases provide sufficient drainage, as the sandy and gravelly subsoil would permit the ground water to move rather freely and it ought not to be necessary in any case to lay tile very close together.

This type occurs in several rather extensive areas. Its principal development is along Mosquito, Eagle, and Tinker Creeks, and extending southwestward from near Leavittsburg along the line of Duck Creek and the old valley to the Mahoning River.

Part of the area is still in woodland, but most of it has been cleared and is either cultivated or in pasture. Corn, oats, wheat, and hay are the principal crops, and very fair yields are obtained. The Braceville loam is not so good a soil, however, as the Chenango loam.

In the following table the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type are given:

Mechanical analyses of Braceville loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
271335	Soil	2.0	12.2	11.4	29.8	6.2	25.9	12.3
271336	Subsoil	1.0	9.4	9.6	29.6	6.2	28.1	15.8
271337	Lower subsoil	1.0	7.3	11.4	59.0	6.5	7.8	6.6

HOLSTON SERIES.

The Holston series includes types with yellowish-brown to brown surface soils and yellow subsoils. It is developed on old alluvial terraces, and the soils are formed principally of material washed from sandstone and shale soils. The silt loam type is mapped in Trumbull County.

HOLSTON SILT LOAM.

The Holston silt loam consists of a pale yellowish gray or grayish-brown silt loam, underlain at about 7 or 8 inches by a yellow silt loam, which gradually becomes slightly heavier with depth and at about 16 inches is mottled with gray and brown. Some slight gray mottlings may occur immediately below the surface soil, although the uniform yellow sometimes extends to a depth of 2 feet or more. Over most of the type the texture is quite uniformly a smooth, friable silt loam. In some cases the subsoil becomes slightly heavier with depth, but in most places there is present a considerable proportion of very fine sand. Part of the large area in Braceville Township has considerably more clay in the subsoil. The subsoil also contains more gray and the mottlings appear in the upper portion; in fact, much of this area is about as nearly the Tyler silty clay loam as the Holston silt loam, and some areas of the former type are included with the latter on the map. The small area along Meander Creek is a little more sandy than the typical soil.

The Holston silt loam is formed from material laid down apparently in the dammed waters of northward flowing streams, principally the Mahoning River.

The surface varies from almost level to slightly undulating, the slope being just sufficient to carry off surface drainage. The absence of, or great depth to, a sandy layer below causes rather poor underdrainage.

Only a few small areas of this type occur in Trumbull County and these are almost all situated along the Mahoning River. Part of it is still forested, but where cultivated it produces good crops of corn, oats, wheat, and particularly of grasses.

Tyler Series.

The surface soils of the Tyler series are gray to grayish brown. The subsoils are yellowish to mottled yellow and gray and of rather compact and slightly plastic structure. The series is usually developed on stream terraces and the material is of sandstone and shale derivation. The drainage is not good, and structural conditions are rather unfavorable. In Trumbull County the silt loam and silty clay loam types occur.

TYLER SILT LOAM.

The Tyler silt loam consists of a gray to light-brown silt loam, grading at 8 to 11 inches into a gray, usually mottled with yellow, silty clay loam. This extends in most places to a depth of 36 inches, but becomes more of an ocherous yellow and gray at about 16 to 23 inches.

There is nearly always present in both surface soil and subsoil a considerable percentage of fine to very fine sand, and, in most cases, the texture of this soil is about as nearly that of a fine loam as of a silt loam. In some places, especially in narrow strips along the banks of the old channels, the quantity of fine sand is almost enough to justify these areas being classed as a fine or very fine sandy loam. On the whole, both soil and subsoil have a mealy, friable, rather incoherent structure. In general, the texture is lightest near the old or present stream channels and heaviest, particularly in the subsoil, where this type borders the silty clay loam. In fact, there is a rather gradual change from the silt loam to the silty clay loam and in some cases the surface soil is a silt loam while the subsoil is heavier and more like a silty clay loam. Although the texture of the surface soil and subsoil are usually rather uniform, there are places, particularly in the old channels, which have a variety of material, ranging from sand to clay. This material is partially stratified in places, but generally more or less mixed. Sand and gravel are usually found at a depth of 8 or 10 feet below the surface.

While the color of the typical surface soil is gray, it usually shows considerable variation. On some ridges or knolls slightly higher than the surrounding areas the color is usually yellowish brown while the more level portions are gray. The subsoils in these slightly elevated areas also contain more yellow than the level areas, and the ocherous-yellow and brown iron stains are not so numerous. The difference between these soils is readily comparable with that between the Volusia and Trumbull series, but the areas of the more yellow soils are so small and so intimately mixed with the gray that it is impracticable to separate them on the map.

The Tyler silt loam has been formed from delta or alluvial-fan deposits which have been carried into the Grand River Valley by

streams issuing from the higher lands to the west, particularly by Swine Creek.

The surface is level to gently undulating, with a slight slope toward the Grand River. The fall is usually not sufficient to give good surface drainage. Old stream channels, 1 foot to 2 feet in depth, and very low ridges give the only variation from the generally level surface.

Although low and flat, the greater part of the Tyler silt loam is in cultivation, and produces good crops of corn, small grains, and hay. Some of the best corn seen in the county during the survey was upon the better drained areas of this type. Most of it, however, is in need of drainage, and the yields of all crops could doubtless be much improved by the use of tile.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Tyler silt loam:

Mechanical analyses of Tyler silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
271317	Soil	0.0	1.2	3.0	8.2	13.4	51.9	22.3
271318	Subsoil	.0	.9	1.0	4.2	12.6	58.2	23.1

TYLER SILTY CLAY LOAM.

The Tyler silty clay loam consists of a gray or brownish-gray silty clay loam, changing at 7 or 8 inches to a slightly heavier silty clay loam having a light-gray color slightly mottled with yellow or yellow and brown. The yellow usually increases with depth and the texture becomes heavier, until at a depth of about 16 or 20 inches the subsoil is a mottled gray and yellow silty clay or clay. Brown or ocherous-yellow iron stains are very common in the subsoil, and sometimes iron concretions are also found.

Considerable variation occurs in the type, both in color and texture. The color of the dry plowed fields is almost white, but when moist it becomes a brownish gray. Below the first inch or two the uncultivated surface soil, even when moist, is rather light gray, somewhat resembling the subsurface material. Brown iron stains are often present in these areas, but where cultivated this brown material has become mixed with the remainder of the soil and caused it to be browner than the uncultivated areas. In the better drained places there may be a slight tinge of yellow, but the level, more poorly drained areas have none. In general the poorer the drainage the grayer the color of both surface soil and subsoil, and in some of the slight depressions the subsoil becomes a blue clay. There are places

where the surface soil is a heavy silt loam, owing to the deposition of a shallow layer of the more silty material over the clay. Such areas are usually found near the border with the silt loam or near the banks of old stream channels. There are places where the soil is quite heavy, the surface becoming a silty clay and the subsoil a blue, heavy, plastic clay.

The Tyler silty clay loam is formed from a deposit of heavy alluvial material and mixed alluvial and lacustrine material. The northward flowing Grand River was blocked by a moraine about 15 miles south of Lake Erie and forced to turn westward. It is very probable that this portion of the Grand River Valley at that time was a lake, in the quiet waters of which the heavy material forming this type was laid down. Poor drainage and lack of lime carbonate have caused this material to turn gray or become mottled.

The surface is very level, with barely enough slope northward to cause the removal of surface water. The channel of the Grand River in this section is not deep enough to give good drainage, and because of this fact and the level lay of the land this stream after heavy rains sometimes spreads out over a large proportion of this type, turning the country into a temporary lake. All portions are in need of drainage, but in most cases this can not be established until better provision is made for the carrying away of the water in Grand River.

A large portion of the type occurs in one area in the northwestern part of the county. This begins about a mile northeast of Farmington and extends northward in the Grand River Valley to the Ashtabula County line. Small areas occur along the Mahoning River between Newton Falls and Braceville.

Only a small part of the area is in cultivation, due largely to its level surface and poor drainage. A large part of the land is wet and is useless except for forestry or pasturage until flooding is prevented by the straightening of the channel of the Grand River. Even then tiling will be necessary, for the heavy texture prevents adequate natural drainage. Some corn and hay are grown on the higher lying areas, and if this type were properly drained it should produce good yields of grains and grasses.

The results of mechanical analyses of samples of the soil and subsoil of the Tyler silty clay loam are given in the following table:

Mechanical analyses of Tyler silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
271319	Soil	0.2	1.2	1.2	3.2	8.0	55.4	30.7
271320	Subsoil	.2	1.4	1.0	2.0	5.8	58.6	31.1

Huntington Series.

The Huntington soils are light brown to brown and the subsoils are yellow, yellowish brown or light brown. Frequently there is little change in color, texture or structure within the 3-foot section. They are alluvial in origin and of recent deposition, the material being of mixed derivation, usually containing some calcareous material. The drainage is good and the topography smooth.

HUNTINGTON SANDY LOAM.

The Huntington sandy loam consists of a brown sandy loam usually of medium texture, and 10 or 15 inches in depth, underlain by a brown, usually fine sandy loam. The different grades of sand are quite intimately associated and it is impossible to separate them on the map. The texture depends, of course, upon the velocity of the current at the place where the soil was deposited. Usually the coarser sandy texture occurs along the immediate banks of the streams which are usually composed of sandy loam or fine sandy loam, while the areas slightly farther away consist of a fine loam or silty loam, which in some cases is almost heavy enough to class as a silty clay loam. In some places the texture is uniform to a depth of more than 3 feet, while in others the subsoils may have more sand than the surface soils, or vice versa.

The Huntington sandy loam is of recent-alluvial origin. It consists very largely of reworked shale and sandstone material washed from the uplands and deposited along the streams, which has not been subjected to poor drainage conditions.

The Huntington sandy loam with the heavier Huntington types included is found more or less along nearly all the streams in the county, although the areas along most of the smaller streams are not large enough to be indicated on the map. The principal development is along the Mahoning River and along Swine and Meander Creeks. A considerable part of these areas, however, really consists of Holly soils, and in some other cases, particularly along the Mahoning River west of Niles, the soils are somewhat intermediate in character between the true Huntington soils and the Holston.

In general, the surface of the Huntington sandy loam and included types is almost level, but some relief is afforded by low ridges or old stream channels. Most of the larger streams have rather deep channels, so that these soils do not overflow except during periods of unusually high water. They occupy the higher and better drained portions of the bottom lands and are the best drained alluvial soils in the county.

The Huntington sandy loam and included Huntington types of heavier texture are among the best and most productive soils in

Trumbull County, and were it not for the danger from overflow they would be esteemed much more highly. They are especially well suited to corn, as this crop is probably the one least easily damaged by the floods. When well cultivated and not flooded, corn gives large yields. Some areas are planted to small grains and grass, and others are used for pasturage. A considerable proportion is still forested. The greatest hindrance to their proper development is the danger from overflow. Along Swine Creek floods have almost been eliminated by straightening and deepening the channel, but elsewhere very little has been done and in many places the area of bottom land is so narrow that the cost is practically prohibitive.

Holly Series.

The Holly series is characterized by the gray color of the surface soils and the mottled gray and yellow or brown color of the subsoils. These soils are developed in the first bottoms and are subject to frequent overflows. The drainage is poor and in their present condition they are best suited to grasses. The component material is wholly alluvial and is derived from soils of sandstone and shale formations. The soils are not so well drained as the Huntington and are less productive.

HOLLY CLAY LOAM.

In its typical development the Holly clay loam consists of 6 to 10 inches of a brownish-gray silty clay loam, underlain by a gray and yellowish-brown mottled clay loam to silty clay. The extreme variation in the texture of the soil is from a loam to silty clay, although these occur in such small areas and so intricately associated with the typical clay loam areas that they can not be shown separately on the map. Whether of the lighter or heavier phases, the subsoils are usually heavier than the surface soils, the loam type having a clay loam subsoil, the silt loam type a silty clay loam subsoil, and the clay loam or silty clay loam types a silty clay or clay subsoil. Sometimes, however, the same texture extends to a depth of more than 3 feet, and there are also places where the subsoils are lighter and contain more sand than the surface soils. In a few places the subsoils are decidedly sandy and contain some gravel.

The Holly clay loam, with other included Holly types, is of recent alluvial origin and represent material washed from the upland, deposited by streams and subjected to rather poor drainage conditions, which have caused the soils to become light colored.

The larger areas of Holly clay loam are found along Pymatuning and Mosquito Creeks and the Grand River. Less extensive areas are found along the Mahoning River and the smaller creeks.

While the areas shown on the map as Holly clay loam consist largely of this and other Holly types, they also include many small

areas of Huntington and Papakating soils. In many places the bottom lands are so wet and the undergrowth so dense that it is impossible to get into them and map out all of the dark Papakating soils.

All of these areas of the Holly soils are low and wet and subject to overflow. A small acreage is cultivated, but the greater part is in forest or used only for pasture. The fall along many of the streams is so slight that these areas are difficult to drain. A large proportion of the areas along Pymatuning and Mosquito Creeks is very poorly drained because the water in these streams is held back by dams, causing the bottom lands to remain in an almost constantly flooded condition. The drainage in most of the streams can be very much improved by straightening the channels. If the area occupied by these soils could be drained and protected from injury against floods, they would prove quite valuable lands, although not so productive as the Huntington soils.

Papakating Series.

The Papakating series includes dark-gray, dark-brown, or black surface soils, with gray or bluish-gray subsoils. The dark color of the surface soils is due to the accumulation of organic matter under very poor drainage conditions. These soils are developed along streams in the glaciated province and the sediments are derived from wash from upland soils of glacial origin. These soils are found in low, marshy places or depressions in the upland and in the bottoms, the essential condition for their formation being a practically constantly saturated condition. The wet condition of the soil favored the rank growth of marsh grasses and the accumulation of organic matter in the surface soil. The Papakating soils are quite frequently assodiated with Muck.

PAPAKATING CLAY LOAM.

In the areas mapped as Papakating clay loam the texture of the black soil varies from a loam or silty loam to a clay loam or silty clay loam, and in some cases to a clay. The areas of different texture are entirely too small to indicate separately and it is necessary to exaggerate some of them in order to show them on the map. In most areas, however, the clay loam is the predominant type. The subsoil is mainly a clay, but there are places where it is a loam or clay loam, grading into a clay or silty clay. In a few cases there is a layer of sandy material between the dark surface and the heavy subsoil.

The Papakating clay loam and other included types of the series are of alluvial or lacustrine origin. The areas along streams are strictly alluvial, but those in slight depressions in the uplands, which were probably formerly occupied by lakes, have been formed by the

washing in of material from the surrounding higher land, and may therefore be considered as more properly lacustrine. Their most distinctive characteristic, their dark color, is due to the relatively large content of organic matter.

With the exception of Muck and Peat, the Papakating soils occupy the most poorly drained areas in the county. Unless they are drained water stands on the surface the greater part of the year. As they are found in the lowest places in the bottoms of uplands, artificial drainage is sometimes rather difficult, and most of this land is still uncultivated. Wild grass makes a rank growth and produces fairly good hay or pasturage.

Only a few small areas of these soils are under cultivation, but where they have been well drained they are very fertile, being particularly well suited to corn and hay. The large content of organic matter in the surface soils causes them to granulate, and it is easy to get them into a good tilth. Their low position causes them to be more subject to frost than higher lying land.

Organic Soils.

MUCK AND PEAT.

Muck and Peat differ markedly from other soils in being composed almost entirely of organic plant remains instead of the disintegrated and more or less decomposed product of rock material. Where the vegetable remains are still in a fibrous or only partially decomposed condition, so that they still retain their original structure and the material has a brown color, it is classed as Peat; but where decomposition has gone on to such an extent that the fibrous nature is largely destroyed, resulting in a black spongy mass, the material is classed as Muck. In Trumbull County the larger proportion of the areas classed as Peat and Muck have reached this advanced stage of decomposition. Peat and Muck are usually very closely associated and, in fact, both may sometimes be found in the same boring, so that it is not practicable to differentiate them on the map. Peat is more often found in those sections where the deposit of organic material is several feet deep.

The depth of the deposits of Muck or Peat varies from a few inches to several feet. Where the material is less than 6 inches in depth the soil is classified with the Papakating series. Over most areas the Peat or Muck has a depth of 2 to 3 feet, or even more, and much of it is several feet in depth, but there may be important differences even within short distances.

There is considerable variation in the character of the material underlying the deposits of Muck and Peat. The areas southwest of Newton Falls are generally underlain at a depth of 3 or 4 feet by a sticky sand, while the area along the Pennsylvania Railroad in the

southern part of Bloomfield Township is somewhat shallower and much of it is underlain at less than 3 feet by loam and sandy loam, changing to a clay loam, which grades into a bluish-gray plastic clay in some places and into a gritty clay in others. The large area east of Lockwood, known as the Bloomfield Swamp, is in most places 3 feet or more in depth. The subsoil underlying the organic material is usually a bluish-gray or light-gray clay, which is quite plastic and contains little sand. In some places this becomes a very heavy clay loam. However, the heavy subsoil is commonly found even within the small areas where the surrounding soils are rather light in texture. While the subsoil in other areas usually shows somewhat similar variations, it is most often a bluish-gray or drab silty clay loam or clay.

Muck and Peat have been formed by an accumulation of plant remains under a constantly saturated condition. The tracts now occupied by these soils were originally small lakes or ponds, which have gradually been filled by the accumulation of organic remains.

The surface of the areas of Muck and Peat is very flat and the drainage very poor. Artificial drainage is always necessary before these areas can be utilized for agricultural purposes.

Only a small part of the total area of Muck and Peat is now in cultivation. The larger part, which is still undrained, is covered with a growth of marsh grass and flags. Some tamarack is found in the Bloomfield Swamp, but the greater part of this, as well as of other areas, is treeless. When drained and placed under cultivation, Muck is a very valuable soil, particularly for special crops like celery and onions. However, these crops are at present little grown. The Bloomfield tract is now being drained, but at present only a small part is cultivated. While Muck is more valuable for special crops, it can also be used for general farming and produces well in corn, buckwheat, potatoes, and some other general farm crops.

SUMMARY.

Trumbull County, situated in the northeastern part of Ohio, has a total area of 633 square miles, or 405,120 acres.

The surface is level to rolling, with some small areas of steep and hilly land. The eastern half and extreme northwestern part consist of a plateau with a broad valley, covering most of the western half, connecting them. The divide between Lake Erie and the Ohio system passes through Trumbull County.

The county, as organized in 1800, included all the Western Reserve. Its settlement was rapid. The early settlers were from New England. Later a considerable foreign element was introduced, especially in the towns. While the urban population has increased rapidly, the rural population is considerably less now than in 1880.

A number of steam and electric railways furnish good transportation facilities.

The mean annual precipitation is 38.34 inches at Warren and 33.63 inches at Orangeville; the mean annual temperature is 48° and 49.2°, respectively. The average length of the crop-growing season is 140 days.

About two-thirds of the land in the county is improved, the percentage being practically the same now as it was 40 years ago. General farming and dairying are the principal lines of farming, although there is considerable fruit grown and market gardening and stock raising are carried on.

Corn, oats, wheat, potatoes, and hay are the principal crops, hay, principally timothy, being by far the most important. Trumbull is one of the principal dairy counties in the State, ranking second in the number of gallons of milk produced.

Most farmers realize the value of crop rotation but do not carry it out systematically. Meadows, which occupy a larger acreage than all cereal crops combined, are left until they "run out."

Labor is high priced and scarce.

The average size of farms is 82.1 acres, and the percentage of farms managed by owners is 81.8 per cent.

The value of improved farm land ranges from $40 to over $100 an acre, but some unimproved land can be bought for as low as $20.

The soils of Trumbull County are chiefly of glacial origin. The underlying rocks are sandstones and shales and the soil material is therefore composed almost entirely of disintegrated products of these and similar rocks to the northward, which have been brought southward by the ice.

The soils may be divided into glacial soils, river-terrace soils, alluvial soils, and organic soils.

The glacial group is divided into four series.

Where both surface drainage and underdrainage are good the surface soils are a yellowish brown and the subsoils a brownish or slightly reddish yellow. These soils have been included in the Wooster series, in which 3 types of small extent are mapped.

Where drainage, particularly underdrainage, is not so good, the surface soils are a little grayer, the subsurface a pale or slightly mottled yellow, and the subsoils mottled gray and yellow. These soils have been included in the Volusia series, in which there are 5 types separated. Of these the silt loam and clay loam are the most important, the loam and silty clay loam less important, and the sandy loam of least extent.

Where the surface is level and drainage poor the soils have become gray, the subsurface light gray to almost white, and the subsoils mottled gray and yellow. These have been included in the Trum-

bull series, which has 4 members, a loam, silt loam, clay loam, and silty clay loam. Of these the silt loam and clay loam are the most extensively developed.

Where the underlying rock is usually within 3 feet of the surface the soils have been classed as the Lordstown stony loam.

The river-terrace soils are divided into those having sandy or gravelly subsoils and those having subsoils of similar or heavier material than the surface soils. The former group is divided into two series, the brown, well-drained Chenango sandy loam and loam and the gray, poorly drained Braceville loam. The latter group includes the grayish-brown Holston silt loam and the gray, poorly drained Tyler silt loam and silty clay loam. These series occupy only small areas and are, therefore, of little importance.

The alluvial soils are divided into three series. The well-drained Huntington series is rich yellowish brown; the more poorly drained Holly light gray; and the swampy Papakating dark gray to black.

The organic soils comprise Muck and Peat. Small areas are found. Most of these are undrained, although the largest tract is being drained at the present time.

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