SOIL SURVEY OF ERIE COUNTY, PENNSYLVANIA.

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DESCRIPTION OF THE AREA.

Erie County forms the extreme northwestern portion of the State of Pennsylvania, and is the only section of the State that borders on Lake Erie. It is bounded on the north by Lake Erie, on the east by Chautauqua County, N. Y., and Warren County, Pa.; on the south by Crawford County, Pa.; and on the west by Ashtabula County, Ohio. The length of the county along the lake is about 45 miles and

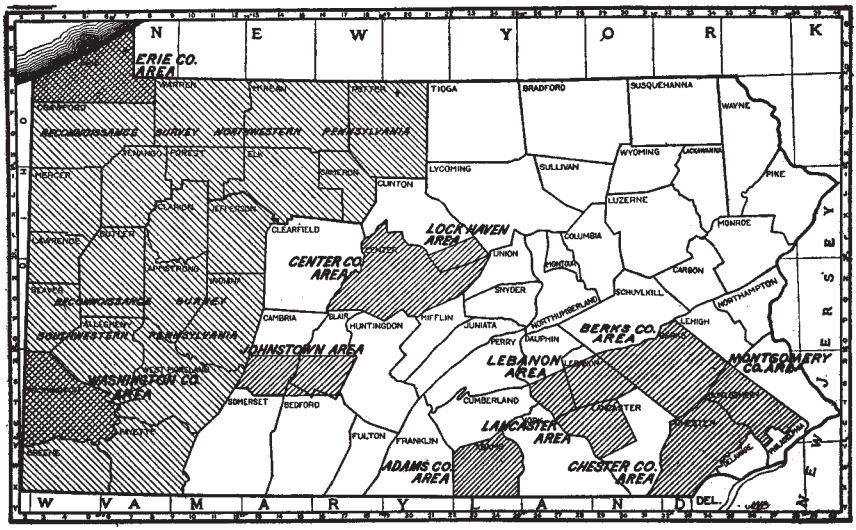

FIG. 3.—Sketch map showing location of the Erie County area, Pennsylvania.

along the Crawford line about the same. Its breadth along the Ohio State line is about 9 miles and along the Chautauqua and Warren County lines about 36 miles. Its area comprises 785 square miles, or 502,400 acres.

Trading posts were established in this region at an early date by both the French and English, and during the period from 1730 to 1760 the utmost efforts were made by both parties to win and hold the friendship of the Indians. In 1760 possession of this county passed into the hands of the English, by whom it was held until the

recognition of American Independence. The Indians gave more or less trouble until the difficulties were finally settled by treaty. From this time on the development of Erie County has been steady. White settlers came in from the adjoining country, those from New York and New England being mainly of English ancestry, while those from the southern counties of Pennsylvania were largely Scotch and Irish, and from Lancaster, Dauphin, and Cumberland Counties the new arrivals were of German extraction. Prior to 1788 all of the State of Pennsylvania lying west of the Allegheny Mountains was embraced in two counties, Washington and Westmoreland. During that year, by act of September 24, all of this section north of the Ohio River and west of the Allegheny River was set off as a new county, called after the latter river, with Pittsburg as the county seat. On the 4th of April, 1798, Erie Township was erected, with the identical limits of the present county.

By the act of March 12, 1800, the legislature set off a number of new counties, Erie being one of the number. Five of these, however, were at this time unable to support themselves as independent counties, and Erie, Crawford, Mercer, Venango, and Warren were for purposes of government joined as one county, with the general title of Crawford County, by act of April 9, 1801. The town of Meadville was selected as the county seat of the entire group, where one set of officers administered the affairs for all of them, and they were in like manner represented in the assembly by one member. This relation continued until 1803, when the first county officers were chosen for Erie County as it exists to-day.

The city of Erie, the county seat of Erie County, was incorporated as a borough in 1805 and was granted a city charter in 1841. In 1871 its limits were extended to include the borough of South Erie, which had been separated from the township and incorporated as a borough in 1866. The possession of a good harbor has given this city an important rank among the ports of the Great Lakes. The superior railroad facilities that connect it with the inland markets of the country have also aided in its development. Its present population is 66,525 and its importance as a manufacturing center, which is increasing daily, tends to bring about a steady growth.

Corry, in the southeastern part of the county, is the next city in size, having a population of 5,991. Corry is an important railroad point, being the junction of the Pennsylvania and Erie systems. It is a manufacturing center of considerable importance. In addition to these there are many smaller towns or boroughs, the principal ones being North East, Union City, Waterford, Elgin, Edinboro, Girard, and Albion.

Erie County possesses a comprehensive system of roads aggregating about 1,800 miles. These are generally well kept and are con-

veniently laid out, affording very direct routes of communication between the various towns, as well as between the smaller settlements and farms. In many instances, traversing as they do an extremely hilly country, their directness results in very heavy grades. The wisdom of saving in distance at this cost is questionable. In some cases the grades are such as seriously to impair the efficiency of every team passing over the roads, because not more than half a load can ordinarily be drawn over them. The time and labor thus additionally spent increases the cost of marketing farm products out of all proportion. If each township each year would devote a portion of the road funds to the permanent improvement of grades on one or two of the steeper slopes, there would result in the course of a few years an improvement that would be of direct benefit to the farmers.

In the building of railrorads in this part of the country Erie County has received a good share. From the city of Erie the Pennsylvania, the New York Central, and the Nickel Plate systems lead to all parts of the country, and the Erie Railroad passes through Corry, in the eastern part of the county. Some of these roads touch at practically every town in the county, affording easy means of transportation of farm products. Besides the steam roads, trolley lines extend eastward from Erie City to Buffalo, N. Y., westward to Cleveland, Ohio, and southward to Meadville, in Crawford County, Pa. These various systems result in bringing all points in the county into close and convenient relationship to one another and to the city of Erie. The utilization of the trolley lines for the daily transportation of milk into the city of Erie has proved highly advantageous to many dairy farmers living at a distance in the county but who have a market for their products in that city.

The surface of Erie County is highly diversified; it may be in general divided into the lake plain, the high ridges and intervening valleys, the valleys of French Creek and its tributary streams, and the high lands south of French Creek. The lake plain parallels the south shore of Lake Erie, and occupies a belt the entire length of the county from east to west, extending inland from 2 to 4 miles, and rising more or less abruptly in a series of terraces from the shore line to the ridge that marks the highest level reached by Lake Erie in Glacial times. The general character of this lake plain is level to undulating, though the slope is quite variable. In the eastern part, near the New York line, it is high and sharp, while on the western extremity the slope is long and low.

Jutting out into Lake Erie from the mainland is a low sand bank known as the peninsula of Presque Isle. Extending in a crescent form, with an extreme length of about 7 miles and a breadth varying from a few rods to about 1½ miles, it almost completely surrounds the waters of Presque Isle Bay, which form the harbor for the city of Erie.

Lying immediately south of the lake plain there are four distinct ridges of different height, the elevation increasing as they recede from the lake shore. The first ridge that marks the limit of the immediate lake plain rises quite abruptly to a height of from 100 to 150 feet above the present lake level, the average height of the second being about 400 feet, while in the third and fourth the average altitudes range from 600 to 1,200 above the level of Lake Erie, which is 573 feet above sea level. The highest points in the county are the hill tops south of the city of Corry, which reach an altitude of 1,725 feet above tide. The separation of these ridges in the western and middle portions of the county is quite distinct, though east of Harbor Creek, Mill Creek, Summit, McKean, and Waterford Townships their individuality is lost to a great extent. As the third and fourth ridges extend westward they gradually recede from the lake shore and extend southward into Crawford County. The sides and summits of these ridges are much cut by ravines. Three distinct continuous valleys separate these ridges in the portions west of the townships referred to above and bear the names of Mill Creek, Walnut Creek, and Elk Creek Valleys, and through them flow the creeks named. These valleys are, however, somewhat broken in places by slight elevations. These streams rise in the hills of the third and fourth ridges, flow westward for some distance through their respective valleys, turn abruptly to the north, and break through the first and second ridges, flowing through deep cuts or "gulfs." These "gulfs" are a striking feature of this section, the solid walls of shale that form the sides being many feet high. The tortuous course of Elk Creek through the high lands of the second ridge, a few miles southeast of Girard, has produced a remarkable cut of this kind known as the Devils Backbone.

The drainage of Erie County is through Elk, Walnut, Conneautte, and numerous smaller creeks directly into Lake Erie, and thence by way of the Niagara River, Lake Ontario, and the St. Lawrence River into the Atlantic Ocean, or by the waters of French Creek and its tributary streams through the Allegheny, Ohio, and Mississippi Rivers to the Gulf of Mexico, the divide being about 8 miles from Lake Erie in the northeastern part of the county and about 16 miles south of it in Washington Township, where the ridge leaves the county, the general direction of the dividing ridge being northeast to southwest. Southward from the dividing ridge French Creek and its principal tributary, Leboeuf Creek, flow through broad, fertile valleys bordered by somewhat rounded slopes, separated by broad, flat table-lands.

In this section are found three small lakes, on the banks of which are remnants of old beach lines and other evidences of a much greater size in former times. The largest of these, Lake Conneautte, about 1

mile long by three-fourths mile wide, lies partly in the borough of Edinboro. Conneautte Creek enters at its northern extremity and leaves it at the southern, continuing on to Crawford County, where it flows into French Creek. Lake Leboeuf, about three-fourths by one-half mile, is situated immediately southwest of Waterford; it is fed by Leboeuf Creek and Boyd and Trout Runs; its outlet falls into French Creek, in Leboeuf Township. With no inflowing stream, but apparently fed by springs from the bottom, Lake Pleasant is found in the southwest corner of Venango Township. It is about two-thirds mile long and half as broad; its outlet joins French Creek in Amity Township. The waters of these lakes are clear and usually cold, and of considerable depth.

No mineral deposits have been discovered in Erie County, except small ones of bog iron ore in Mill Creek and in Elk Creek Townships, which were slightly developed in the early days, but have not been touched for many years. Marl beds of unimportant size and character exist in Wayne, Waterford, and Leboeuf Townships, but have never been worked. Gas is found almost everywhere throughout the county, but so little oil has been obtained, and that of a quality only suitable for lubricating purposes, that it is not considered worth any extensive exploitation.

CLIMATE.

The tempering effect of Lake Erie on the climate of the adjacent shore is well recognized, and this effect extends a part of the way up the slope, making it possible to extend grape culture for some distance beyond the actual extent of the Dunkirk soils. Just how far back into the hills grapes can be grown with safety, however, is yet to be determined. The soils are well adapted for their production for a considerable distance and the limitations of the extension of vineyards into the uplands is controlled by climatic conditions alone, the chief factor being immunity from late frosts in spring and early ones in autumn. In this respect the weather conditions holding in the interior of the county are quite distinct from those of the lake plain. Unfortunately no data are available to afford definite comparisons, as there is no observing station in the upland section of the county. In the interior of the county, where the soils are well adapted to orcharding, much care will consequently be necessary in selecting orchard sites that are somewhat elevated, so as to secure good air drainage.

The following table, compiled from the records of the Weather Bureau, shows the conditions in the city of Erie and may be properly applied to all of the lake plain. Temperatures in the uplands are probably somewhat lower than those recorded, for frequently snow lies on the ground several weeks longer in this section than on the

lake front and killing frosts occur earlier in the fall and later in the spring.

Normal monthly and annual temperature and precipitation at Erie.

Months.	Temperature.	Precipitation.	Months.	Temperature.	Precipitation.
	° F.	Inches.		° F.	Inches.
January	26.2	3.03	August	69.6	3.26
February	26.2	2.85	September	63.9	3.49
March	33.5	2.66	October	52.9	3.80
April	44.4	2.40	November	41.1	3.61
May	56.6	3.43	December	31.9	3.06
June	66.5	3.75	Year	48.7	38.55
July	71.3	3.21			

Dates of first and last killing frosts at Erie.

Years.	Last in spring.	First in fall.	Years.	Last in spring.	First in fall.
1901	Apr. 10	Nov. 19	1906	Apr. 8	Nov. 1
1902	Apr. 8	Nov. 8	1907	Apr. 20	Oct. 19
1903	Apr. 5	Nov. 11	1908	Apr. 17	Nov. 13
1904	Apr. 21	Sept. 22	1909	Apr. 28	Nov. 24
1905	Apr. 22	Oct. 26	Average	Apr. 15	Nov. 2

AGRICULTURE.

The agriculture of Erie County may be properly treated under two heads, as the result of the soil and climatic conditions existing in the two very distinct sections of the county, the lake plain and the uplands.

The soils of the lake plain are for the most part well adapted to fruit, truck, and other highly specialized types of farming, while the ameliorating influence of Lake Erie on the temperature of this section adds to the value of the soils for this purpose. At present, however, much of this section is devoted to the production of general farm crops, and while the yields may be somewhat greater than those obtained on the upland soils they are not commensurate with the value of the land nor as profitable as the truck and fruit crops would be. The immunity from frost produced by proximity to the lake is very largely responsible for the development of the specialized industries that do exist, and further development along these lines must eventually be carried on until general farming has been entirely displayed in this section. Few localities possess an equally favorable outlook for this purpose, where both soils and climate are all that could be desired, and in addition there is in its midst a

rapidly growing city, which affords not only an excellent home market, but possesses unexcelled facilities for shipment to all points.

At present the highest specialization is in the vicinity of North East in grape culture, where the growing and handling of this fruit has reached a high state of perfection. The Concord, Niagara, and Worden are the principal varieties produced, the acreage of the first, however, exceeding many times that of the last two. The heavier soil types of the Dunkirk series predominate in this section, and they seem to be eminently adapted to the production of this fruit. This is especially the case with the Dunkirk gravelly loam. The soil characteristics have, in the opinion of growers, much to do with the flavor and shipping qualities of this fruit, that produced on the heavier loams being considered superior in these respects. The extension of the vineyards is being carried on successfully back from the lake shore on the Volusia soils well into the first ridge of hills, the Volusia gravelly loam and silt loam being well adapted to the purpose, as shown by the quality of the fruit produced. Just how far back from the lake grape culture can be successfully carried on is yet to be shown. Whether the immunity from frosts afforded by proximity to the lake can be offset by any means at the command of the grower is yet to be determined.

The heavier types of soil found in the western portion of the lake plain are in every way as adaptable to grape culture as are those on the eastern end. But little development, however, in this line has taken place in this section, notwithstanding that there is in the vicinity of Girard a vineyard of 40 acres that will compare favorably with any in the county. The recent purchase by several nursery firms of some extensive tracts of land in this section will undoubtedly stimulate interest in this direction.

The condition of this industry was noted in a reconnoissance survey of northwestern Pennsylvania made in 1908, in which the following statements occur:

> Of the varieties of grapes grown in the North East belt the Concord is the only one that can be depended upon to sell readily in full carload lots in every market. As a result the Concord is the commercial variety of the whole lake belt, and corresponds in market position to the Baldwin apple in the East and to the Ben Davis in the Middle West.
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> A full car of Delaware, Niagara, Catawba, Worden, Brighton, Agawam, or other variety of grapes is difficult to dispose of anywhere, but mixed cars sell readily, and so a relatively small acreage is still planted with these varieties. Of these secondary varieties the Delaware and the Niagara are by far the most important, with plantings of the latter rapidly decreasing, as they no longer sell at a higher price than the Concord, and hence there is no object in planting them.
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> It is roughly estimated that the Concord occupies at least 80 per cent of all bearing vineyards, while more than 90 per cent of present plantings are of that variety.

During the general planting of the older extensive vineyards little attention was given to the selection of soils. Inasmuch as grapes would grow anywhere in the lake belt and were practically immune from frosts, the fact of the differences in profits which the different kinds of soil would bring was not heeded; in fact, as such adaptations had not then been demonstrated, they could not even be considered.

Accumulated experience, however, has eventually shown that some soils within this favored belt are worth much more than others for grape growing. And the fact is very noticeable to-day that the percentage of vineyards that are being allowed to "run out" is very much greater on the soils distinctly sandy than on some of the heavier types.

The ease of cultivation of the sandy soils, which led to the planting of many vineyards upon them in the early days of grape growing, is offset many times by the disadvantages attending the industry on these light soils. It costs more to fertilize; the ravages of the "rose-bug" or rose-chafer are very much more serious, because the mellow character of the soil favors their development, and besides grape-juice factories and wineries will pay more for grapes grown on a heavier soil.

This is simply because grapes grown on the heavy soils will yield more expressed juice per ton and of a higher sugar content than fruit grown on the sandy types of soil. This point has already become a matter of the highest importance, for it means nothing less than that the grape-juice men and the wine men will purchase from preference Concord grapes from vineyards on the heavy soils, either as a whole or those remaining after the selects have been used for basket trade, before they will take those from the light soils. Some years this makes no difference, as all the surplus grapes are needed, but in years of a glut in the market it means that the grapes from the heavy soils are sold first, even if they do not bring a higher price, and it is believed that eventually a higher price will be obtained because of their great value for the purposes to which they are to be put.

The highest quality of Concord grape is grown on the clayey soils, and the fruit will ship much better because it is more firm, but the greatest yield per acre is obtained from the loam types. Hence the soil problem of the grape grower is how to select the soil that will produce the highest quality of grape consistent with a satisfactory tonnage. As far as the Concord grape is concerned, the sands should be eliminated on the one side for reasons already stated, while soil as heavy as the Dunkirk clay is not relatively profitable because the high quality of the fruit produced does not make up for the low yield.

Under present conditions, therefore, the [Dunkirk] gravelly loam seems to be the most valuable soil for growing the commercial Concord. The [Dunkirk] clay loam is next in order, and under certain lines of treatment may equal the gravelly loam. If stable manure and green crops, especially hairy vetch, are used in sufficient amounts to keep the clay loam very mellow and friable and yet not enough to cause an excessive growth of vine, an ideal soil results because the quality of the fruit is excellent, and in this way the yield may be maintained at a satisfactory point. This is working toward high quality of product without impairing the yield, though a profitable limit is soon reached on account of the extra cost of working and the greater injury from the heaving of the vines in winter on soils that are too heavy. There is some tendency to utilize heavier soils for Concord vineyards than formerly, and it is probable that this tendency will increase—a fine sandy loam, either gravelly or not, being the lightest of the desirable soils for that variety.

The Delaware vine, being weak in habit of growth, is much more liable to serious injury from heaving at times of alternate thawing and freezing in late winter than any of the other commercial varieties, and so is not safe on soils as heavy as the average of the best Concord soils.

The Delaware should not be planted on soil heavier than a loam, and it does exceptionally well on a fine sandy loam. The Niagara is similar to the Delaware in soil preferment, but also succeeds on soils a little too heavy for the latter variety.

Thus while soil adaptations have been solved commercially only on broad lines, and that as a process of elimination on the part of the best growers, the fact remains that when segregated from the other factors which have to be considered in locating vineyards the soil factor is one of great commercial importance, while for any who wish to work up a special trade in select table grapes it is of the utmost concern.

The cultural methods followed in vineyards by competent growers are intensive. The vines are planted in a deep double furrow to facilitate working, which practice is also said to lessen injury from the grape rootworm. In cultivation the soil is drawn away from the vine until late in June or very early in July, after which it is thrown toward the row. A three-gang plow is used first, and then a special form of cultivator, which is often supplied with one disk next the row to control the amount of dirt thrown and to assist in cutting out weeds between the vines. With a slow-walking team it is possible to do most of the hand hoeing with this cultivator, at least to such extent that one man can hoe out the remaining weeds by hand at a rate of several acres in a day. Many workings are profitable, say not less than eight, and even a greater number is desirable. There is almost no limit to the amount of care which it is profitable to bestow on a vineyard, while the neglected vineyard is never profitable for very long.

There is great latitude in the fertilization of the vineyard soils, and while it is commonly asserted that the grape will grow without fertilization or with very little, the best growers are fertilizing more and more each year. An application of 400 pounds per acre of a fertilizer analyzing 2 per cent nitrogen, 8 per cent phosphoric acid, and 10 per cent potash used in conjunction with a cover crop of crimson clover is an average representative treatment. Some use from 600 to 800 pounds of the same formula, while a few of the most careful growers use from 500 pounds to as much as 2,000 pounds per acre according to conditions, and in some cases stable manure is used. The Delaware grape requires high fertilization.

Grape roots are brought largely from Fredonia, N. Y., though local men sometimes grow a patch of one-fourth to one-half acre. The cost of these roots is about $20 a thousand. The roots are commonly planted 7 feet apart in rows that are 8 or 9 feet apart, though some growers plant 8½ by 6½ feet, this giving about 600 vines per acre. Still others plant the Concord 8 by 9 feet. The Delaware grape, having a much less vigorous growth of vine, is planted closer.

During the first year another crop is almost always grown between the rows of the vineyard, and some persist in inter-row cropping for a longer period, but the best growers never go beyond the first year, and some are now discontinuing even this practice and substituting clean tillage and cover crops.

At the end of the first year the vines are well sprawled over the ground, and the following spring, before the vine starts to grow, it is tied to a two-wire trellis with twine and is henceforth trained to this two-arm system. The first wire is placed about 24 inches from the ground and the second 26 to 28 inches above the bottom one. Four canes should be put up for each vine, but some

growers tie up too many canes on young vines. The Delaware vine requires high fertilization to make sufficient wood to bear a heavy crop and is more difficult to prune satisfactorily than the Concord. So it is trained to the umbrella shape by extending an arm over the second or top wire and then tying it to the bottom wire. By this system the danger of the string breaking, as sometimes happens with the first method, is obviated. The Delaware buds are so much thicker than the Concords that there is great danger lest too many buds be left for the vine to carry and thus overtax the vine. Spraying is now effectively carried on by all the best growers, a spray motor outfit being largely used.

A great deal of extra labor is employed at picking time, girls and women being preferred for this work. The harvest is the only time during the year when a large force is necessary, as one man with a team can take care of from 20 to 40 acres, depending upon the intensity of cultivation. The pruning is done during the winter season, and so can be done by the force required to drive the teams during the summer.

Grapes bear about one 8-pound basket per vine the third year from planting, provided good care has been given. After that 400 baskets per acre is an average yield, but a well-cared-for vineyard should give 600 baskets the fourth year and hold to that yield for many years. The best growers not infrequently get a yield of 1,000 baskets an acre. This represents a very high profit and is the reward of the skillful grower, who does not hesitate to give an extra amount of care every year and to fertilize heavily, thus maintaining his vineyard at a high point of efficiency.

The price of grapes varies, but the price almost never gets so low that the good grower can not make more than the expenses of producing the crop. The skillful grower obtains a sufficient yield to make the business profitable even at low price. The price frequently goes below the point of profit, however, for the ordinary or careless grower, but that is not the fault of the business; it is the fault of the man.

One great advantage that the grape industry has over the growing of tree fruits is the fact that the vineyard bears annually, and another advantage is that it comes into bearing at about one-fourth the age of an apple orchard, and yet produces well for a long term of years.

The opportunity for the extension of grape growing on the Dunkirk soils and also on the low adjoining hills of the Volusia loam to the south is excellent for the man with skill above the average. This opportunity includes not only the growing of good yields for grape-juice factories and the ordinary wholesale trade, but also for growing and packing fancy table grapes.

Good grape land within reasonable distance of the railway station at North East is worth $150 an acre. Land ranges in price from $100 to $250 an acre, owing to location with reference to town or the lake front. It costs about $100 an acre additional to bring a vineyard to bearing age. The selling price of vineyards ranges from $200 to $500 an acre. Even at the latter price a good vineyard pays excellent profits, and while many think it more attractive to buy a good vineyard already in bearing than to plant a new one, there is good opportunity for one to grow his own vineyard from the start and thus procure an even stand of well-pruned and productive vines in the space of only four years.

Another highly specialized industry of a part of the lake plain section is asparagus culture. At present this industry is chiefly confined to the eastern portion of this section, although all conditions favorable for its growth can be found at many points.

While asparagus will grow on many soils in this area, the lighter sandy types of the Dunkirk series are to be preferred to heavy stiff soils for its production. These lighter soils warm up sooner in the spring and produce an early crop, which in the case of this product is quite desirable. Moreover, they are more easily cultivated and entail less expense in their original preparation. Good drainage, both surface and subsoil, are necessary, and in the location of beds places upon which water stands after rains should be avoided. The presence of gravel in soil and subsoil is not of itself objectionable, especially if the soil material is rather heavy, as it will usually be found that soils of this character possess good underdrainage conditions.

The ideal soil for asparagus is a good, well-drained light sandy loam with preferably a somewhat clayey subsoil, and there are many localities in the lake plain section of Erie County where these conditions can be found and where the climatic conditions are such that early crops could be obtained. In the preparation of new beds it is very desirable to select a site that is free from weeds, such as a piece of land that has previously been in cabbage, potatoes, or other worked or hoed crop. Freedom from weeds is more desirable than great fertility, as heavy manuring is necessary for success with this crop. Roots, or crowns, 1 year old, purchased from nurserymen who make a business of growing them, will be found more satisfactory than using seed for the establishment of new beds. After deep plowing and thorough preparation of the field, rows should be marked off about 5 feet apart and a furrow opened up on each one. The depth of the furrow will, in a measure, depend upon the character of the soil, for experience has shown that the crowns should be set deeper in light soils than in heavier ones, varying from about 10 inches in the former to about 6 inches in the latter. Crowns should be set about 15 inches apart in the furrow, care being taken in filling in to see that they remain right side up. When first set the crowns should be covered with 2 or 3 inches of soil only, leaving them in a depression. Subsequent cultivation to keep down weeds between the rows will soon fill them entirely. Formerly it was the practice to throw up a furrow over the rows, covering them deeper for the winter, this protection being thought necessary to prevent damage by frost. At present, however, after the trash has been cut off and burned in the fall many growers scrape off the surface of the rows, leaving not more than 2 inches of soil above the crowns and in the early spring throw the dirt over the rows in a ridge to blanch the young sprouts. This is sometimes supplemented by a mulch of straw or other suitable material. This ridging, or mulching, or both, causes the young shoots to blanch, producing "white" asparagus. Where no such covering is used the product is the "green" aspara-

gus. In harvesting the former, it is cut off close to the crown considerably below the surface, the latter type is cut only an inch or so below the ground.

Immediately after the cutting season the use of a harrow over the entire field is sometimes advisable for the purpose of destroying the numerous small weeds that spring up between the plants. This destroys some shoots, but if not set deep enough to reach the crowns, it will in no wise injure the plants. At this time, too, the fields are given a heavy dressing of stable manure, liquid manure, or commercial fertilizer.

The former practice of manuring heavily in the autumn is no longer regarded with favor. Early spring and at the close of the cutting season are now, as the result of experience, regarded as the proper times, with perhaps an intermediate application during the season when the sprouts are being cut, as it is recognized that it is during the growth of the bush after the cutting season is over that the buds from which next year's spears are formed appear on the crowns. It is desirable, therefore, to induce as heavy a growth as possible during the period following the cutting season.

In the use of fertilizing materials for this crop nearly every individual grower has his own plan. All agree, however, that it is better to apply stable manure between or alongside of the rows than to put it where the sprouts come into actual contact with it when applied in the spring. Many hold, however, to the benefit to be derived from applications directly over the crowns after the brush has been removed in autumn, claiming that by spring all of the soluble matter will have been carried into the soil and be available for the use of the plants. The main point is to avoid contact between the young spears or shoots and fresh or only partly decayed manure as a preventive of discoloration of the young shoots, production of rust, etc.

The brush should be cut as soon as the berries are fully colored, hauled off the field and burned, the ridges leveled, and all weeds destroyed.

The extension of this industry deserves attention, not alone on the lake plain, but in other parts of the county as well, many suitable areas being found along the valleys of French and Leboeuf Creeks, which, while lacking the influence of the lake for producing very early crops, are in every way suited to asparagus production.

In other localities, where asparagus culture is largely carried on, a yield of 1,800 to 2,000 "bunches" is considered a conservative estimate for beds from 5 to 15 years after planting. Up to 5 years, of course, the yield would be less, and at the end of 15 or 20 years the field would fall off in yield. The income, however, of from 1 to 5 acres would be greater than from the same land devoted to general crops for the same time.

Lying along almost the entire length of the lake plain, parallel to and but a short distance from the lake shore, are a series of depressed areas of a more or less mucky character. On some of these there is already established a profitable onion-growing industry. The utilization of these soils for this purpose could be readily extended to include all of this type in the area, besides which the Dunkirk fine sandy loam will be found well adapted to onion culture.

The chief advantage to be gotten from the use of muck soils is the amount of organic matter they contain, for unless they are unusually deep the operations of cultivation mingle a portion of the subsoil with the muck of the surface, and the resulting soil in this area is really a sandy loam very rich in organic matter, chiefly distinguishable from the Dunkirk soils by its darker color. A large amount of organic matter is desirable in soils used for onion production, but this can generally be supplied for small areas by the use of stable manure or by turning under a green manuring crop that thrives best under intensive cultivation; consequently the best results follow when moderate acreages are planted.

Where muck soils are to be used, they should be thoroughly drained, and should be plowed in the fall and exposed to the action of the frost. In some cases it may be advisable to plant to some other crop in order to get the land free of weeds and in condition for onions the following year, for if once the weeds get started the crop will be extremely difficult to save. Applications of commercial fertilizers alone will be sufficient on muck soils, but when the sandy loams are used for onion culture heavy applications of stable manure and the frequent plowing under of green crops will be necessary in addition. Manure used for onion culture should be well rotted, and whatever fertilizer is used should have not less than 8 to 10 per cent potash in it, with nearly as much phosphoric acid. From 2 to 3½ per cent of nitrogen will usually be sufficient, a larger amount tending to produce an overgrowth of tops at the expense of the bulbs. While the yield from the muck soils is generally somewhat greater, the onions grown on sandy and fine sandy loams have proved to be solid, heavy, and of superior keeping qualities.

Seed should be sown as early in spring as it is possible to get the ground in satisfactory condition. Nothing is gained by early planting on poorly prepared land, however. Where hand cultivation is practiced the rows can be as close as 14 inches, but if it is intended to cultivate with horse power about 3 feet apart is the proper distance. Seed is usually sown by specially designed drills that admit of such regulation that but little thinning is required. Hand weeding of the rows is, however, necessary. The use of hand wheel hoes

and other implements of the kind is general and saves much time and expense over the regular hand hoe formerly used.

The crop ripens and is harvested during the early part of autumn or late summer, the bulbs being allowed to get as ripe as possible before pulling them. At this time the tops should be ripened down and shriveled and the outer skin of the onions should be quite dry. After pulling they are allowed to lie in windrows for a while, when they are gathered into crates, the tops being entirely removed at this time.

Yields vary from 300 to 400 bushels per acre, although on small tracts where extraordinary care and attention are possible the latter figure is frequently exceeded. The price paid to the grower will average about 45 cents a bushel, and the actual cost of production is in the neighborhood of $50 an acre.

On many of the soil types of this section now devoted to general farm crops the production of tomatoes, cantaloupes, cucumbers, beets, and other truck crops could be carried on, not alone for the market afforded by the city of Erie, but also for export to the other and larger cities with which Erie is so well connected by transportation facilities. But little attention appears to have been given to celery growing in this section. This industry could be profitably taken up on the sandy loam soils of the lake plain with every prospect of success. Any fertile, well-drained soil will grow celery, it is true, but a sandy loam well supplied with organic matter is the preferable type for the purpose. Many of the so-called muck soils of this section can be made ideal celery soils. This is especially true of those where the layer of surface soil is shallow and overlays a sandy or sandy loam subsoil. The operations of tillage will mix the organic matter of the surface layer with the sandy material of the subsoil, resulting in ideal conditions for the growth of this crop. A soil of this character is preferable to a deep, true muck for celery growing, the product being of better flavor and quality, though perhaps not so large. Especial care must be taken to keep up the humus content of the soil, by green manuring after every two or three crops, and by heavy applications of well-rotted stable manure plowed under early every spring before planting. Celery culture entails considerable hand labor, and it may justly be said to be a costly crop to produce, but on the soils suitable for celery growing in this section a fair yield would be from 1,000 to 1,200 dozen per acre, which at 25 cents a dozen ought to give a net return of over $100 an acre.

At present considerable interest is being shown in fruit culture, particular attention being given to the prune plum. Mature trees of this fruit show that its cultivation is profitable, and the environment afforded along the lake shore is suitable for its growth. It is grown on all types of the Dunkirk soils, though good drainage is

important. The presence of gravel in the soil is considered to be an advantage.

Peaches do well in this section and many varieties can be found suited to the locality that are excellent for canning or for dessert fruit. The experience of growers puts Elberta at the head of the list of varieties where the fruit is destined for a distant market, but there are many others quite as suitable for a local supply. The gravelly loamy soils are the best adapted for peach culture.

Many varieties of cherries are grown in a small way and give good yields of excellent fruit. With this fruit drainage is more important than soil texture, and there is no reason why first-class fruit should not be produced on any well-drained piece of land in this section of the county.

Apparently but few apple trees have been planted in this section in recent years, though the remnants of many old orchards testify to the former popularity of this fruit. These all, however, show evidence of neglect in the matter of spraying, pruning, etc. The soils of this section as a whole are not particularly well suited for apple production; that is, they are not adapted to many varieties. Judging, however, from the products of the orchards that are in existence, Baldwin, Fameuse, and Northern Spy appear to be those best suited to the soils of this section. Where these varieties are to be seen they take on a good color, and with a little care first-class fruit could be produced.

Small fruits do well throughout this section and have proved a profitable crop. The acreage devoted to their production is constantly increasing, especially that devoted to raspberries and strawberries. The raising of winter vegetables under glass is a growing industry in the vicinity of Erie, several well-equipped plants being located west of the city. Tomatoes and cucumbers are the main crops raised, the forcing of these, however, being accompanied by the raising of out-door truck crops during the summer months. The wonderful industry that has been developed in Ashtabula, Ohio, in raising winter vegetables under glass leads to the conclusion that with the unexcelled shipping facilities at the hand of the grower of this section this industry could be very greatly extended.

Southward from the lake plain the most extensive soil type found is the Volusia silt loam, which, together with the loam, clay loam, and gravelly loam types of the same series, occupies all of the county except small areas in the creek valleys.

The Volusia soils are as a rule deficient in lime and in organic matter. They also frequently need a certain amount of underdrainage. In most cases they will, however, respond to treatment, and the increased yields following any reasonable expenditure on them

will be found amply to justify the expense incurred, as the following instance will illustrate.

In the summer of 1908 a portion of a field of Volusia silt loam, then growing a crop of buckwheat, had the buckwheat plowed under while in bloom. Lime was applied at the rate of about 600 pounds per acre, 1 ton being used on the 3¼ acres set off for treatment. In the fall this land was sown to rye and timothy, and in the spring of 1909 seeded to clover, yielding in 1910 over a ton and a half of first-class mixed clover and timothy hay per acre, it being the first successful catch of clover in 10 years on any part of this field. The expense of this treatment was slight, even charging in the probable value of the buckwheat had it been sold as grain, while the yield of hay on this piece over that produced on the remainder of the farm was not only an increase in quantity, but in quality as well. Much of the land in this portion of the county is now used for buckwheat production, simply because it alone thrives under present conditions. Its use as humus-forming material, aided by liming, would in the greater number of cases fit the land for the growing of clover and indirectly for other more remunerative crops than buckwheat.

In the upland section of Erie County the influence of Lake Erie is not felt and the soils are of a character that precludes development along the same lines as on the lake plain. In this section dairying, stock raising, and general farming are the branches of agriculture that are best suited to the existing conditions. That these conditions can be greatly improved and these branches of industry made far more profitable than they now are is very apparent.

Where dairy farming is carried on many good individual cattle are seen, and the tendency seems to be toward their improvement. It is unfortunately true, however, that in most of the herds the proportion of these is too small to make up for the loss incurred in keeping a number of inferior animals. The cost of keeping an inferior milker is just as great as that of maintaining a first-class animal, and not until this is fully realized will the business of milk production be as remunerative as it should be. A good percentage of the individuals of some of the herds could be disposed of with a very small reduction in the herd's milk yield, while effecting a considerable decrease in labor, cost of feed, etc. The demand for milk in the city of Erie is constantly increasing with the growth of the city, and the efforts made by the Erie County Milk Association indicate a continuance of the growth of this branch of agriculture on a profitable basis.

Sheep raising as an industry is practically abandoned in this county. There has been a noticeable decrease in the number of sheep in the last 20 years, notwithstanding there is on every farm sufficient waste land to afford abundant pasture for a small flock.

The market for lambs is and has been for some time good, and while it might not be wise to go into sheep raising on an extensive scale, the presence of a small flock would be an element of profit on every farm. Pasturing on otherwise waste land and subsisting mainly on roughage during the winter, the wool clip can generally be relied upon to cover the cost of their keep, leaving the money derived from the sale of lambs as profit.

An increasing interest in horse raising is indicated by the number and quality of stallions owned in the county. Shires, Clydesdales, Percherons, and coach horses, both German and French, are breeds that are represented by well-bred sires in this county. Much interest is taken also in trotting and pacing horses, and at the race meetings home-bred and home-trained colts have shown considerable quality. The recently inaugurated annual stallion parade will do much to keep up interest and extend horse raising in this county.

In the production of forage crops, both on the dairy farms and on those where but a few head of stock are kept, but little advance has up to this time been made in growing alfalfa. This is attributable to the present condition of much of the land, not to the lack of suitable soils for this plant as a general proposition. The occasional fields seen show that when given proper preparation the soils of this section support a good growth of this plant. There is no real reason why there should not be an alfalfa field of greater or smaller extent on every farm in this section, for while it is true that in their present condition some of the fields will not grow it, it is also true that many of them can be readily put in condition suitable for its growth. The soils of this section are as a rule deficient in lime, and there are many poorly drained fields. Neither of these conditions is beyond remedying, however, and while few in number and extent there are some alfalfa fields that as far as quality is concerned leave nothing to be desired. These fields are simply the result of intelligent effort.

So much has been written and said of the wonderful virtues of alfalfa as a producer of forage and renovator of lands that it is no wonder that its establishment has been so frequently attempted on the "poorest" piece of land in the farm, frequently a piece upon which buckwheat has failed, and the preparation of the land has been about the same as for that crop, with a succession of failures as a result. If the culture of this valuable plant is to be attempted, it should be on one of the "best" pieces of land in the farm. There is not a farm in this section that has not at least one fairly well drained location, in spite of the generally poor underdrainage of the Volusia soils in this area. Good underdrainage is essential, and, if necessary, tiling must be resorted to, but areas of from 1 to 5 or more acres can generally be found on practically every farm where there is no necessity to resort to this method.

The preparation of the land must be very thorough. It must be deeply plowed and thoroughly harrowed, as a good, deep seed bed is most essential. Most of the land in this section will require liming in addition. The previous behavior of clover is a good guide in this respect. If the land has failed to give a good catch of clover it is useless to attempt to grow alfalfa until it is limed. Any well-drained land upon which clover will grow abundantly will generally produce alfalfa satisfactorily without further treatment in this respect. Inoculation with soil from an alfalfa field should be practiced whenever possible and to obtain the best results is absolutely necessary.

Weeds are the most dangerous enemies of young alfalfa, and in the preparation of land for an alfalfa field every effort must be made to get it free from weeds of every description. This can generally be accomplished by repeated harrowing when the land is being prepared, especially if during the previous season it was in a worked crop. In this section alfalfa has been sowed with good results as late as September, though in order to get it well established before its first winter a somewhat earlier sowing would seem advisable. Existing fields in this county are now yielding about 1½ tons of cured hay to the acre at each of three cuttings during the season.

Corn is largely grown throughout this section, both for grain and for ensilage. In the latter form it constitutes the chief ration on the dairy farms. While its value for this purpose is unquestioned, there can be no doubt that were it supplemented with a ration of alfalfa the results would amply justify the expense of the production of the latter.

Oats form one of the chief crops of this section, both in extent and production, in many instances being the only small grain grown. Buckwheat is an important crop throughout this section, its present prominent position being in no small measure due to the condition of the soils, which in many instances have been allowed to become so depleted that other crops, more exacting in their requirements, do not succeed. Frequently, too, the yield of buckwheat is small, and in many cases the production of this crop is very unremunerative. A large proportion of the lands in this section are in grass for mowing, the hay being consumed off the farms. Much of this land is in need of drainage, and the persistent growth of sorrel shows that it would be greatly benefited by liming. While it would not perhaps be practicable to go to any great expense in installing drainage systems under much of the land of this character, nevertheless by the use of lime both the yield and quality of the hay would be greatly improved.

Potatoes form the money crop of many of the farms of this section. The Volusia silt loam is well adapted to their cultivation and with good management good yields are obtained. In some locations in the larger creek valleys cabbage growing is quite extensively carried

on. Where the facilities for shipment are as good as they are in many parts of this section of Erie County this industry, together with the production of other not easily perishable crops, could be greatly extended with profitable results. Fruit growing as a business is entirely neglected through this section, though it abounds in good orchard sites, upon many of which the soil conditions are all that could be desired for apple and pear culture. These industries were in the past evidently important ones in this section, as is shown by the many remnants of former orchards that are yet in existence. Many of these are reduced to a few trees, which although entirely neglected, nevertheless produce some fruit of good flavor and color. The persistent efforts of these old, neglected trees are forcible reminders of what apple growing once was in this section, and there is no reason why it could not be profitably taken up again, following out modern methods both of culture and handling the fruit. The impression that the recent developments in apple culture in other sections of the country leave no room for commercial orchards in this section is entirely erroneous. While not denying that the fruit of certain sections possesses as a rule a somewhat higher color than the usual product of this section, it is nevertheless believed that it is in no way superior when judged by flavor, keeping qualities, and the other factors that go to make a first-class product.

The feasibility of reclaiming some of the existing old orchards by regrafting or top working has been discussed. It is believed that in most cases this method of procedure would be only a waste of time and money. The majority of the trees are too old and have to a considerable extent lost much of their vitality.

If it is desired to regraft trees of bearing age it should only be done when the original trees are comparatively young and in vigorous health. Trees of this character will often repay the labor and time necessary in effecting the change to a better variety. The Volusia loam, silt loam, and clay loam are all well adapted to apple culture. The heavier soils are, however, not apt to produce such a vigorous growth, but the trees will be less subject to winterkilling, as the wood "hardens off" more completely than the more vigorous growing shoots produced on the lighter soils. A somewhat elevated location should be selected in order to get as good air drainage as possible, and the site should possess good surface drainage and underdrainage. In the preparation of an orchard site the land should be broken up as deeply as possible, and in the care of the orchard for the first few years the deeper it can be plowed the better, avoiding disturbing the roots of the trees by plowing more shallow as the rows are approached. During the first few years, or until the trees make sufficient shade to interfere with their development, crops of cabbage, potatoes, beans, or anything requiring similar treatment can be

grown between the rows of trees, not closer to them, however, than 4 feet the first year, the distance gradually increasing each year as the trees develop. Small grains should never be planted in an orchard; whatever crop is selected should be one requiring cultivation. The surface of the strip left unplanted should be kept well stirred.

After the orchard is well established the humus content of the soil should be maintained by the use of cover crops, clover sowed in late summer and plowed under early in spring being suitable for the purpose. After plowing it under and during the time that elapses up to the time of sowing again the surface should be kept free from grass and weeds and kept well cultivated. On the soils of this county liming at the time of setting out the orchard will generally be required. This treatment should be repeated as often as is necessary to keep the land in condition for the production of clover. The deep initial preparation and those for whatever crops are produced in the earlier stages of the growth of the orchard will enable the action of the lime to be of greater benefit to the trees, as well as to the annual crops, than if it had been plowed shallow. Moreover, a portion, at least, of the manure or fertilizer applied to the intergrown crops will find its way into the deeper layers of soil, from which it will eventually be of use to the trees. In the established orchard where commercial fertilizers are used the proportion aimed to be applied is about 1½ to 2 per cent of nitrogen with 6 to 10 per cent of phosphoric acid and from 10 to 12 per cent of potash, from 600 to 1,000 pounds being applied per acre. The use of potash is said to produce a high color in the fruit. Usually sufficient nitrogen will be obtained by the use of clover as a cover crop, and this can be supplemented by the use of acid phosphate and potash in proper proportions and amounts.

Experience has shown that standard trees should not stand closer than 32 to 40 feet apart. In some instances orchards are set 16 by 32 feet or 20 by 40 feet, with the intention of obtaining a crop or two from all of the trees and then cutting out every alternate one before interference becomes serious.

There is nothing at all improper in this method if the grower has determination enough to cut out the mid-distance trees at the proper time. He seldom has, however, and all are allowed to stand until the whole orchard is considerably damaged by overcrowding. The use of peaches, plums, dwarf apples, and pears, and other expedients of a similar nature are frequently recommended for this purpose of providing means of obtaining an income from the land until the standard trees come into full bearing, on the theory that such trees are shorter lived and will die out before their presence becomes a serious menace. It must be remembered, however, that these shorter lived

trees must receive the same care and attention in the way of spraying, pruning, etc., that the standard trees do, and that they will give no returns whatever for a few years. The utilization of the spaces between the rows of standard trees for the production of annual crops produces a revenue from the land each year, and the cultivation and fertilization given these crops will naturally benefit the trees also.

Scattered throughout this section, the remnants of former orchards, bearing trees of Yellow Transparent, Red Astrachan, Grimes Golden, Jonathan, Esopus, Spitzenberg, Baldwin, Roxbury Russet, Northern Spy, Rhode Island Greening, Winesap, and other varieties may be found. From among these it is possible to make a selection of varieties that are suited to the soil and climatic conditions and to the market demands. It should be borne in mind, however, that the demand of the market for first-class fruit is constant at remunerative prices, though frequently there is no demand at all for an inferior product, and too much care can not be exercised in grading, packing, etc. A safe guide in selecting varieties is to study the trees in the immediate neighborhood, where similar soils and conditions exist, and to select from whatever varieties are found those that are best suited to the proposed environment. In selecting trees also it is advisable to procure them from near-by nurserymen, whose climatic and soil conditions are similar to those of the locality where the orchard is to be located, and if possible after a visit to the growers' establishment, where the comparative vigor, etc., of different varieties may be noted while growing under similar conditions. This is in itself usually a safe guide to the suitability of surroundings.

Much that has been said of apple orcharding might be repeated as regards the growing of pears, the opportunities that exist for the production of this fruit being equally numerous, and a few pear orchards being found in this section. Some of these have been quite recently set out and the trees present a thrifty appearance. The cultivation of this fruit should by no means be neglected in a region where the conditions are as favorable for its growth as they are over a large portion of this county.

On the plateaus of the first ridge back from Lake Erie, but within the sphere of its climatic influence, grapes are now being grown successfully on the Volusia soils. The Volusia silt loam and gravelly loam are the predominating types of the series in this locality, and both appear to be well adapted to the production of this fruit. Success in this line depending, however, to such an extent on immunity from frost, the extension of this industry on a commercial scale into the higher lands beyond the influence of the lake is not to be recommended, though many small areas suitable for home vineyards may be found throughout this section.

In like manner strawberries and bush fruits, particularly the red raspberry, may be successfully grown in this section, though crops are produced with more certainty in the section closer to the lake. These crops have proved themselves among the most profitable that can be grown, and the area devoted to them is being gradually enlarged.

The agricultural practice in this county is quite variable, but on the whole it is good. Improved farm machinery is in general use, though too often expensive machines do not get the care their cost entitles them to receive. While in some cases the machinery when not in use is kept under cover, it is too frequently "housed" under the most convenient tree, or allowed to stand in the field until wanted again. If a mower or binder were regarded as so much money invested, and received a small part of the thought that is bestowed on an investment of the amount it cost, there would be less complaint about the worthlessness of modern farm machinery and a saving in repair bills that would soon amount to more than the cost of providing means for its proper care. In one instance during the progress of the work in this county a farmer was met with whose methods are worthy of imitation. On his place every implement is housed, and as soon as its work in the field is done it is carefully gone over and put in first-class order, plows, harrows, and binders all receiving like treatment, with the result that when wanted for use there is no delay in getting it ready. This forehandedness has more than once repaid tenfold the trouble and expense incurred. In many cases manure spreaders are used, and the manure is hauled out as it is made, but when the manure is allowed to accumulate it is rarely if ever sheltered, entailing great waste. In case it is desirable for any reason to allow the manure to accumulate it should always be protected from the weather. The shelter may be of the rudest construction, but should include a good roof, otherwise the most valuable part of fertilizing ingredients is leached out by the rain and melting snow and lost. In every case where manure is to be kept the use of ground-rock phosphate, not acid phosphate, is recommended. The ground rock should be added in the proportion of a pound or two daily for each animal in the barn. This treatment preserves much of the nitrogen that would otherwise be lost, and enriches the manure in phosphoric acid. This will also be found to be the most economical way of applying small amounts of phosphate, the mixing of the ground rock with the larger bulk of manure making its even distribution much more simple. If potash is to be used also, it should not be added until the time of application of the manure. Fifteen pounds to the load of manure, well scattered through it, has been found to give good results when in form of sulphate or muriate. Manure thus fortified is preferable to either manure alone or com-

mercial fertilizers used in the ordinary way, since it contains the most desirable qualities of both. It is by far the most economical method to use in growing tomatoes, potatoes, cabbage, celery, and other truck crops, and the benefits derived from the use of the humus-forming material of the manure so necessary in the production of crops of this character are greatly increased.

The organic content of the soils of Erie County is low. No matter what system of cultivation and fertilization is practiced the best results can only be obtained after an increase of humus in these soils. This is true of the soils of the lake plain as well as of the uplands, and the use of green manuring crops for this purpose is the directly feasible and economical method of effecting this. Good results follow the use of rye and of buckwheat for this purpose, but in all cases where it is possible to obtain a catch of clover or some other legume it should be used in preference to any other crop for this purpose. Where permanent improvement is desired the first step to be taken is to prepare the land so that it will support a growth of clover, which can usually be done by the use of lime, the failures in this respect being generally due to a lack of lime in the soil or to poor drainage or both; but in either case the fault is remediable. The use of lime in this county should be more general, and the fact that the farmers are showing a great deal of interest in it, as shown by numerous inquiries relative to its action, method of use, etc., is a hopeful sign that the day is near at hand when there will be no more complaints that the land is so "worn out" or so "clover sick" that it does not pay to sow clover seed.

In discussing the agricultural conditions of Erie County, both as regards the lake plain and highlands, much stress has been laid upon the necessity for the use of lime and the need in many cases of artificial drainage for the improvement of these soils. In the prosecution of the soil survey of this county many inquiries were made by farmers relative to these subjects, and while it is impossible in a report of this kind to treat them exhaustively, the following paragraphs will, it is believed, sufficiently answer the inquiries most frequently made.

LIME.

It is now recognized by the authorities that lime in the form of carbonate is necessary for many of our cultivated crops, and it is further recognized that if it be lacking in the soil, notwithstanding the presence of a sufficient amount of all of the other essential elements, certain plants can not develop normally.

The soils of Erie County are as a rule deficient in lime, and from what can be learned of the early agricultural practice always have been. In this respect they are similar to the soils of similar origin

in other portions of the country; that is, to the Volusia series of soils wherever found. Much is said by the farmers of this county of the beneficial results formerly obtained as a result of the use of wood ashes, and there is no doubt that much of their value on these soils is due chiefly to the lime which they contain. Unleached hardwood ashes contain about 35 per cent of lime in the form of carbonate and in addition potash and a small amount of phosphoric acid, and while the benefit following their use is due to some extent to the latter, the large proportion of lime makes it seem probable that the principal benefit is the result of this ingredient.

Conditions have changed and there is no longer available the supply of wood ashes that was readily obtainable a generation ago, and as the supply diminished no substitute was used, resulting in a tendency to the present depletion of the lime content of these soils. Briefly stated, important results of the application of lime to soils appear to be its action on minerals of the soil and its effects upon the growth of organisms in the soil. Certain minerals containing potash or phosphoric acid are believed to be so acted upon by lime as to render the potash and phosphoric acid more soluble.

In the decay of the remains of plants and the decomposition of organic manures in soils deficient in lime certain substances which are unfavorable to some of our most valuable crops are produced. Alfalfa and the clovers, in general, are notable examples of crops that are benefited by lime. In all cases where drainage is good liming is the most effective as well as the most economical remedy when so-called acid conditions exist. By keeping a sufficient amount of lime in the soil this unfavorable condition is prevented.

In addition to making the soil a better home for the roots of crop plants lime plays an important part in the bacterial life in soils. The change of ammonia and of nitrogen in organic matter into the form of nitrates, the form in which it is used by plants, as well as the utilization of atmospheric nitrogen by the leguminous plants, are greatly assisted by the presence of lime. In fact, many of the useful bacteria of soils require the presence of lime carbonate for their best development and growth.

Lime also exerts a physical influence upon the soil, rendering clayey soils more open and porous, thereby assisting drainage and aeration, which is conducive to a greater root development of the plants. Liming also prevents to a great extent baking and crusting of soils of this nature. Light sandy lands are frequently rendered more compact by liming, and when in addition to the lime these soils are supplied with organic matter they are rendered much more loamy.

But few of our cultivated plants have failed to show marked benefits from liming, the number including nearly all garden vegetables,

grasses, clovers, the cereals, tobacco, and alfalfa. Among the small fruits red raspberry, gooseberry, and currants have been the subjects of experiment with good results, as have the plum, quince, and cherry.

Corn and rye are but little benefited by the use of lime; with potatoes, while the whole yield is not materially increased, frequently the size of the tubers is increased. Contradictory results have followed the use of lime on tomatoes, peaches, apples, pears, and grapes, and it is thought that excessive liming is somewhat injurious. In orchard and vineyard practice, however, the use of lime in sufficient quantities to insure a catch of clover for a cover crop and for green manuring is by no means the excessive use liable to produce injury to trees or vines. Radish, blackberry, and blackcap raspberry are undoubtedly injured by lime and its use on soils where these plants are growing should be avoided.

Lime has been found effective in checking the root disease of alfalfa and "club root" and similar diseases in cabbage, turnips, etc. Where potato scab is present in the soil the use is not to be recommended immediately prior to planting potatoes, the resulting alkaline conditions of the soil seeming to render it favorable for the growth of the fungus. There is little danger, however, from this source when lime is applied at an earlier stage in the rotation for the purpose of securing a catch of clover, the clover sod to be turned under later as a source of humus for the support of a subsequent potato crop. At any rate, it is always a wise precaution to treat seed potatoes with formalin or some other fungicide if scab has ever been found among potatoes grown on any field, whether it is intended to use lime or not.

Frequent applications of lime are seldom necessary, nor is it recommended that liming be practiced with a view to making the soil very alkaline. The prevention of acidity is what is most needed. Practice has shown that once the present acid condition is corrected a neutral condition can be usually maintained on well-drained soils by applications of from 600 to 1,000 pounds per acre once in every five or six years, though the amount necessary to correct existing acid conditions may be much greater. By reason of their susceptibility to the effects of lime beets can be used as an indicator with very accurate results. Plats of land should be laid out and carefully measured and then given like amounts of the same fertilizer and varying amounts of lime. A comparison of the growth and yield of the beets will furnish a basis for estimating the amount of lime required. A plat 4 feet wide and 55 feet long contains approximately one two-hundredth part of an acre; hence 10 pounds on such a plat would mean 1 ton to the acre.

When it is intended to lay down fields in permanent grass it is good practice to apply much more lime than is commonly used on cultivated lands, the use of 1½ to 2 tons per acre for this purpose not being excessive.

Lime may be obtained on the market in several forms—as lime carbonate in finely ground shells or limestone, as quicklime or caustic lime obtained by heating these materials, and as air-slaked lime. Which of these will be the more economical to use is a practical question whose solution depends largely on market and transportation conditions. Certain facts should be borne in mind, however. One hundred pounds of lime carbonate are equivalent to 56 pounds of pure freshly burned lime. This latter substance will gradually take up moisture and carbon dioxide from the atmosphere and become a white powder, in which form it is called air-slaked lime. This process may be hastened by throwing over it a small amount of water. If sufficient water be added the slaking takes place rapidly and but little carbon dioxide is absorbed from the air. In the process of slaking its bulk and weight are increased by the water added or absorbed, so that a bushel of unslaked lime will measure and weigh considerably more after slaking. Hence the advisability of buying unslaked burnt lime as it comes from the kiln to avoid paying for water and carbon dioxide that nature would supply for nothing, unless the air-slaked lime can be bought at a lower price, and even then the transportation of the heavier air-slaked lime should be considered.

The use of specially devised machines for spreading lime is rapidly growing in those sections where liming is generally practiced. If such a machine is not at hand the unslaked lime is placed in small piles at short intervals throughout the field. After a few days the slaking process is completed and the material can be easily spread with shovels. The object should be to get as even a distribution as possible. After spreading, the field should at once be well harrowed in order thoroughly to mix the lime with the soil to a depth of 2 or 3 inches.

If the stone lime is allowed to become thoroughly air-slaked it may be used without injury at any time. Where quicklime or lime but recently slaked is used it should be applied in autumn, allowing from a week to 10 days to elapse before seeding.

Where lime is bought in bulk it should be kept under cover during the slaking process if a spreader is to be used, especially if any length of time is to elapse before spreading. Otherwise if exposed to rain it may cake and run into lumps, preventing the satisfactory operation of the machine. Lime in slaking, especially if the process is hastened by the addition of water, gives off considerable heat during the process, and if a large quantity is put in one pile damage

by fire might follow. By storing it in an open shed and preventing actual contact with wood, straw, or other easily combustible material, the danger from this source is very slight.

DRAINAGE.

The problem of underdrainage in this county is an important one, there being hardly half a dozen farms in the entire area that do not include one or more fields that could be materially improved by the installation of a drainage system. In many cases a single line of tile would suffice.

The causes of poor underdrainage are either the low topographic position of the field or the structure of the subsoil. As a result of the former a field receives upon its surface not only the rain falling upon it and that flowing from the surface of the adjacent land, but in addition much seepage water from the surrounding higher country gradually accumulates in the lower layers. While there are soils in this county which, being underlain by strata of material which permit free passage to the surplus water, possess almost ideal natural subdrainage, there are other types quite as rich in natural fertility but much less productive because by reason of their structure they retain too much water. It is chiefly the peculiarities of the structure of the soils of this area rather than their position that is in most cases the cause of insufficient internal drainage. Many wet spots exist on the slopes in the hilly and rolling portion of the county, well elevated above the intervening valleys. Fortunately in this section the conditions are highly favorable for surface drainage and the character of the country is such that suitable outlets for tile systems occur frequently.

As can readily be understood, the presence of an unproductive area in a field means a reduction of the actual as well as of the proportionate yield of all products while increasing the cost of production. If in a field of 40 acres there is a "springy place" which with its outflow affects 5 acres, causing a decrease in normal production on the land thus affected as compared with the remainder of the field, there is then only a little more than the normal product of 35 acres from the whole field, against which must be charged the cost of preparation and cultivation of the whole 40 acres.

It is sometimes urged that when such conditions exist, for instance, in a field originally prepared for and planted to corn, and owing to excessive wetness of a portion of the land the crop on it fails to start, there was yet time to sow to buckwheat or some other crop, so that there is no loss in the end, while the season may be such that the original crop would grow. This, however, is by no means true. The whole field having been prepared for the original crop, a second

preparation is required for the substitute crop, even though it be less thorough than the original, so that in the case in point against the product of 5 acres of whatever crop is used must be charged the cost of two preparations. Moreover, areas affected by these causes are usually irregular in outline, which adds to the cost of cultivating the remainder of the field, the cost of this extra labor amounting in a few seasons to more than that of installing a suitable drainage system. If the circumstances are such that for any reason the drainage of a spot of this character is not feasible, it is surely far more economical to avoid the expense of preparation entirely by utilizing it for permanent pasture or like purpose. It is certain that the net results will in the end be more profitable if the remainder of the field only is used for cultivation. The presence of these "springy" or "seepy" places frequently affects much of the adjoining land, so that the advantage from draining them is not purely local, but results in improvement of the whole field.

The object of drainage is simply to provide channels through which the surplus water may pass off. The effect of the removal of this surplus water is productive of beneficial results in various ways. It should always be borne in mind that whatever means are employed for the purpose it is the surplus water only that is removed, the soil moisture necessary for the support of plant life remaining undisturbed, being held too firmly by the soil grains to be affected by gravity, the force that causes the outflow of the water. This moisture envelopes each soil grain in a thin film, leaving in a well-drained soil a space filled with air between each moisture-coated soil grain and its neighbor. It is in these places that the surplus water collects, making drainage necessary. It has been shown that the presence of air in the soil is not only necessary for the best development of plants, but that its presence is highly important in connection with the proper performance of many of the functions of the soil itself. Moreover, the soil air requires renewing, and as the rain falls upon the surface and sinks into a well-drained field it displaces the air already in the soil by filling the spaces it occupied with water. As the water passes off through the drainage channels a new supply of air follows the outgoing water, refilling the spaces from which it had been temporarily displaced. Enough of the water, however, remains in the form of moisture to renew the film that covers each soil particle. Drainage, then, accomplishes more than the mere removal of the surplus water; it also aerates the soil, so that it is not an exaggeration to say that drainage is soil ventilation.

Among the benefits resulting from good drainage and the consequent aeration of the soil is the effect on the soil temperature. In a well-drained soil the frost goes out and the land is in condition to be made ready earlier in the spring. Stiff and heavy soils are rendered

more porous and open, permitting a deeper penetration and greater development of plant roots. Many bacteriological processes which require a certain amount of air for their proper functioning are encouraged. By these means is practically accomplished the making of new soil, the action of the oxygen of the air thus brought in contact with the material of the subsoil reducing it and rendering it suitable for plant use. Another highly important feature of the air in the soil is that of diluting, displacing, or decomposing certain substances present in the soil which are of themselves injurious or poisonous to plant life. All of these and other important functions are, of course, prevented by the presence of surplus water in the soil, and all are encouraged and rendered efficient by good underdrainage.

Land requiring drainage has always one or more points to which all of the surplus water naturally endeavors to find its way. From this point its removal should be effected in the most direct manner. The varied conditions existing on lands requiring drainage prevent more than a brief outline of the best practice in effecting this result being set forth here.

The first point to be considered is the location of the outlet. This point must, of course, be lower than the area to be drained. In much of this county the numerous small streams occupying the valleys between the higher lands, together with the natural surface-drainage courses that lead to them, make this a comparatively simple matter. This point selected, the mains should lead directly to it. This can generally be accomplished by locating them along the lines of the surface flow. When, however, the surface flow follows a tortuous course, the sharp angles should be cut through and the line made straight or laid out to form a continuous gradual curve. The laterals or individual lines that lead to the mains should be placed sufficiently near to each other for the effect of one line to reach that of the next, this distance depending upon the character of the soil, those in loose, porous soils being effective over a wider range than those in stiff, retentive soils. In practice, in clay and loam soils from 40 to 80 feet has been found to be satisfactory, and good results have been obtained in sandy loam and lighter soils where the distance was 150 feet, each line taking care of 75 feet on each side. The size of the tile depends in a great measure also on the character of the soil, as well as upon the distance apart of the lines and the rainfall.

Under average conditions in this county tile smaller than 3 inches should not be used for laterals, and mains should be from 5 to 8 inches in diameter, the size of mains depending upon the amount of land to be taken care of and the number of laterals entering into it. A good plan is to install a main sufficiently large to admit of an increase in the number of laterals originally laid; then, if the laterals placed a given distance apart are found to be insufficient, intermediate ones

can be laid without disturbing the entire system. Laterals should run parallel to each other and should enter the mains by a Y branch rather than a T. The amount of fall to be given should be never less than 1 inch to each 100 feet, and care should be exercised in grading the bottoms of the ditches to see that the proper grade is maintained continuously throughout their entire length. A drop followed by an incline would result in the formation of a trap where the water would accumulate and defeat the object of the whole system. Drains laid at from 2½ to 3 feet below the surface have proved highly satisfactory in soils of the character of most of those in this area requiring drainage and should in no case be placed deeper than 4 feet.

The actual cost of draining land in the same section of country varies greatly with the nature of the soils, and the price of labor and material being subject to change, it is impossible to make even a general statement concerning it.

The ultimate question that must be answered in connection with the installation of any system of drainage is, "Will it pay?" This depends largely upon the uses to which the soil is to be put. The reclamation of a field of muck suitable for intensive onion or celery culture would pay, even though the expense were ten times that of the cost of draining a piece of wet land used only for general farm purposes. It is estimated, though, that the same labor bestowed on tile-drained land will produce yields of the cereals from 20 to 50 per cent greater than those obtained on undrained fields or similar soils.

While the installation of an elaborate system of underdrainage for the general improvement of a large farm may not be feasible in all cases, notwithstanding the probable benefits to be derived from it, there is no reason for permitting wet spots or seepy places to exist on any farm; and when it is considered that upon the average farm the necessary work of installing a suitable and efficient system for this purpose is seldom of such magnitude or cost as to be beyond the means of the average farmer, neglect in this direction is inexcusable.

SOILS.

The soils of Erie County are all of glacial origin, and when classified are found to belong to four soil series, all of which are common to much of the glaciated region in Pennsylvania and New York. The most extensively developed of these soil series is the Volusia, which occupies practically all of the county south from the Lake plain to the southern boundary.

The Volusia soils are made up of glacial débris of foreign origin, which has been added to a material resulting from the disintegration and glacial grinding of the underlying shales and sandstones that form the bedrock of this section. The amount of glacial till dis-

tributed over the surface of this section varies from a few inches to several feet in depth. This material not having been subjected to any great amount of violent reworking, remains to-day in much the same condition as when deposited by the ice. The topography of this section is hilly and rolling, interspersed with some comparatively level elevated plateaus. The intervening valleys between the ridges are usually deep, with rather sharply sloping sides confining the small streams that traverse them to narrow gorgelikè courses. The sharpness of the descent toward these streams is frequently too great to permit of agricultural development. Where, however, the larger streams have brought down the outwashed material from the hills and have spread it out over the broader valleys they have formed fertile bottom lands. The reworking of this transported material gives rise to the Chenango soil series.

Notwithstanding the topography of the Volusia soils is such as to afford ample surface drainage, the soils of this region are very frequently found to be poorly drained even upon the sharpest slopes and on the highest elevations. There is scarcely a farm in this section that has not one or more fields requiring artificial subdrainage.

The soils of the Volusia series are light colored, usually ranging from gray to yellow or light brown, resting upon yellowish, grayish, or mottled subsoils. In the surface layers the light shades predominate; the darker tints found in cultivated areas are usually the result of the presence of decomposed organic matter. In both soil and subsoil of all types there is a considerable quantity of shale and sandstone fragments, gravel, and glacial bowlders, the latter in some cases being of great size. The presence of this stony material, however, does not of itself affect the classification of these soils, except when accompanied by evidence of a marked influence upon them, rendering them so stony as to be classed as stony loam.

The soils of this series in Erie County are now largely devoted to dairying and to the growing of oats, corn, buckwheat, and potatoes. They are, however, when suitably located, well adapted for apples and pears, and many highly desirable orchard sites can be found in the section where they occur. Alfalfa could be grown on many of the dairy farms, and the cultivation of this valuable forage crop should be extended.

Extending from the south shore of Lake Erie inland from 2 to 4 miles, except toward the western line of the county, where the Volusia series extends to the water's edge, the soils belong to the Dunkirk series. The area occupied by these soils is a series of generally level or gently rolling terraces of lower elevation than the Volusia soils, and upon them can be traced a succession of ancient beach lines that mark the former limit of the greater body of water that preceded the present Lake Erie. From the waters of this lake the soils of the

Dunkirk series were either deposited by sedimentation or were reworked by lake wave action. Subsequent agencies have produced many minor changes in the topography of this section and many small hummocks and ridges occur throughout this region. Sand dunes have been formed, and the stream courses that cross it show a considerable amount of erosion. The present immediate shore line of the lake is blufflike, with but little beach development.

The texture of the soils of the Dunkirk series covers a very wide range, about 10 types occurring in the area occupied by it. These range from gravel to clay and also show considerable intergradation between the distinct types. In many of the types the presence of shale fragments or gravel is a noticeable feature and one of considerable importance.

As a rule the soils of this series are well drained; there are, however, some slightly depressed areas where the use of drain tile is necessary. In color the soils of this series range from brown to gray and yellow, the lighter shades predominating. The color of the subsoil is usually about the same as the surface layer, though in cultivated areas where the surface soils have received considerable additions of organic matter it is somewhat lighter, and not infrequently it is mottled. But little difference exists in the texture of the soil and subsoil, though layers of sand or gravel are frequently encountered at varying depths in all types, even though the amount of those materials in the surface soil be but slight.

From their favorable location the soils of the Dunkirk series are especially adapted to the production of crops susceptible to light unseasonable frosts, their proximity to Lake Erie rendering this region comparatively immune to damage from this source.

In the eastern portion of the section occupied by this series the gravelly loam type is largely devoted to the production of grapes, to which it is especially well adapted. The soils of the series generally outside of this section are now used for general farm crops. The areas devoted to truck and canning crops and fruit growing should be greatly extended, especially on the lighter types. On many of the so-called mucky spots occurring in these soils onion culture is now carried on. There are besides many more of these mucky areas now used for general crops over which this industry, as well as that of celery growing, could be extended.

Lying along a majority of the streams in this county are found to a greater or less extent alluvial first bottoms. These vary very greatly in width, those along many of the smaller streams being narrow strips ranging from a few yards to 200 feet in width—much too small to admit of representation on the map. In other cases the extent and character of these soils is such as to make them of the highest importance, particularly along the valleys traversed by Leboeuf and

French Creeks. The soils found in these bottoms are formed of the outwashed material from the glacial débris of the hills, and when thus brought down, reworked, and deposited constitute the soils of the Genesee series. The soils of this series vary greatly in texture, ranging from sands to heavy loam or clay loam, and are distributed in such a manner that many types are frequently found in a comparatively small section of the county. Moreover, the gradation is often very gradual and the types themselves extremely variable. The color of these soils is as variable as the texture. Though usually some shade of brown, they may be generally described as being of a light, medium, or dark brown, with yellowish-brown, brown, grayish, or mottled subsoils of texture similar to the surface. Many of these bottoms being subject to overflow, they are of value only for pasture; where they are sufficiently safe from danger of loss from this source they are used for the production of corn, potatoes, and truck crops.

Closely allied to the Genesee soils in process of formation, but occupying the terraces that lie intermediately between the bottoms and the uplands, are found the soils of the Chenango series. The soils of this series are also reworked glacial débris, having been brought to their present location through the action of the streams that poured out of the glacier front during the period of the melting of the ice sheet. The soils are usually stratified and contain much rounded gravel, gravel beds being of frequent occurrence.

The soils of this series in this county range from sandy and gravelly loam to loam and silt loam. They are usually brown, with yellowish-brown subsoils of much the same texture as the surface soil. As a rule they are productive and well drained. In some cases the presence of deep layers of gravel in the subsoil results in excessive drainage, causing them to be subject to drought. The lighter types of these soils being in every way adapted to the production of truck crops, their use for this purpose should be extended.

In many depressed areas the accumulations of the decayed remains of the water-loving vegetation that found in them a congenial environment has resulted in the development of spots of mucklike soil, which have been mapped as Clyde sandy loam. When these are capable of being drained, they have proved to be extremely productive, and the cultivation of onions and other crops to which they are adapted has been found profitable. In many of these areas the layer of true muck is quite shallow, so that in a few years after they are brought under cultivation the operations of tillage result in the mixing of the material of the subsoil with that of the surface layer, considerably modifying their original condition. This is especially marked in much of this type occurring in areas of the Dunkirk soils, where the underlying material is of a distinctly sandy nature. In these instances the result is the development of a

sandy loam, very rich in organic matter and somewhat darker than the surrounding soil types, but well adapted to all uses to which the true Muck areas could be put. At present many of the areas of this soil are included in the general system of cultivation given the surrounding soils. They would, however, if used for special purposes, be found to be much more profitable than when cultivated indiscriminately with other soils.

The following table gives the names and areas of the several soil types shown on the accompanying map:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Volusia silt loam	211,712	42.1	Chenango silt loam	2,368	0.5
Volusia clay loam	99,136	19.7	Dunkirk shale loam	1,600	.3
Volusia loam	45,248	9.0	Genesee silty clay loam	1,536	.3
Dunkirk gravelly loam	25,344	5.0	Dunkirk fine sand	1,408	.3
Volusia gravelly loam	21,056	4.2	Clyde sandy loam	1,024	.2
Dunkirk fine sandy loam	19,072	3.8	Volusia stony loam	832	.2
Genesee loam	17,728	3.5	Dunkirk gravel	704	.2
Chenango gravelly loam	14,528	2.9	Genesee silt loam	640	.1
Dunkirk silt loam	4,672	2.4	Genesee sandy loam	576	.1
Heavy phase	7,552		Chenango sandy loam	448	.1
Dunkirk gravelly sandy loam	11,008	2.2	Dunkirk clay	384	.1
Dunkirk sand	7,168	1.4			
Chenango loam	3,904	.8	Total	502,400	
Dunkirk loam	2,752	.6			

VOLUSIA GRAVELLY LOAM.

The surface soil of the Volusia gravelly loam, to the average depth of about 10 inches, consists of a light-brown, yellow, or gray loam, containing a large proportion of shale chips and rounded gravel. The subsoil is a grayish or yellowish gravelly loam frequently approaching a sandy clay and in places becoming much more sandy. The sand of the subsoil varies considerably within a single field.

The Volusia gravelly loam occurs largely within the valleys and upon the slopes. It is derived from morainal deposits and the topography is rough. The soil is usually well drained and, except for its topography, is not difficult to till. Its occurrence in small areas among the more extensive development of the other types of this series is quite common. This type is used for grass, oats, corn, buckwheat, potatoes, and beans, and could no doubt be profitably devoted to orcharding where found in a suitable location.

VOLUSIA CLAY LOAM.

The soil of the Volusia clay loam, to a depth of 6 or 8 inches, is a heavy loam or clay loam of a yellowish, grayish, or brownish color. The subsoil is a pale yellow, drab, or mottled clay loam to sandy clay.

Both soil and subsoil contain shale fragments, and large bowlders may be present upon the surface and in the subsoil.

The topography varies from rough to gently rolling. While the natural slope of the surface aids in drainage, the soil is sufficiently dense to prevent the rapid movement of water through it, and frequently the drainage is defective. Much of the type would be benefited by underdrainage.

This type is used for general farming and dairying throughout this county. Much improvement in crop production on this type of soil has followed the use of lime wherever it has been applied, especially in the case of grasses grown for hay, oats, and clover.

VOLUSIA SILT LOAM.

The soil of the Volusia silt loam, to an average depth of 6 to 8 inches, is a light-brown, gray, or yellow silt loam. The subsoil is a light-yellow, gray, or mottled smooth silty loam. Both the soil and subsoil contain a large amount of flat fragments of shale and sandstone. The stone content tends to make the soil appear somewhat lighter in texture than it really is and materially aids in the drainage of the type. Frequently in the area occupied by the Volusia silt loam rock is found at a depth of from 18 inches to 3 or 4 feet; though occasionally, where small moraines have been formed, the depth of the soil is several feet.

The surface of this type is hilly to rolling. It occupies many of the more gently rolling or flattened tops of the high elevations in the southern part of the county, and also extends down the sides of many of the steeper hills. While the natural drainage is fairly good, small swampy areas are frequently seen, even upon the steeper slopes.

The Volusia silt loam is well adapted to the production of grass, oats, buckwheat, and potatoes. Of the grasses, timothy, redtop, and bluegrass are grown to the best advantage. Dairying is carried on extensively. Much of this type throughout the county is greatly in need of lime, as shown by the character of the plant growth upon it, and in many cases it is so deficient in this respect as to be almost useless for the production of clover. Good alfalfa is produced on some fields where care has been taken in the selection and preparation of the soil.

The type is well adapted to orcharding, and both apples and pears do well on it when planted in favorable sites.

VOLUSIA LOAM.

The surface soil of the Volusia loam, to an average depth of 8 inches, is a slightly sandy loam, of a brownish color, becoming gray or ashy when quite dry. The subsoil from 8 to about 24 inches is a yellow or mottled gray and yellow heavy silt loam. It is very com-

pact and when wet resembles clay. Below 24 inches the subsoil frequently contains a considerable quantity of very finely divided shale fragments.

The Volusia loam occupies gently rolling to hilly plateau country and is very extensively developed in the level areas in the southwestern part of the county. It is also found in the extreme northwestern part of the country where it extends to the lake shore. The type is but fairly well drained, as is shown by an extensive growth of water-loving plants on the level and depressed areas.

Dairying and the production of hay, oats, and buckwheat are the chief uses to which this type is put. Where well drained or where artificial drainage is practicable, apple and pear orchards would do well. In the portions of the county occupied by it many good orchard sites exist, especially in the southwestern areas. As is the case with other types of the Volusia series of soils in this county, the Volusia loam is greatly benefited by the use of lime, and wherever it has been used the resulting increase in hay, grain, etc., has been highly satisfactory.

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

Mechanical analyses of Volusia 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.*
24979	Soil	0.8	1.8	1.6	24.6	11.0	43.8	16.4
24980	Subsoil	2.2	2.9	1.2	18.9	5.9	49.3	19.3

VOLUSIA STONY LOAM.

The Volusia stony loam, to a depth of from 8 to 10 inches, is a heavy brown loam, quite variable in texture and frequently approaching a clay loam, overlying a subsoil of somewhat lighter color and texture. Both soil and subsoil contain a large quantity of gravel and rounded stones and flat shale fragments too large to be classed as gravel. These form so large a part of the material that borings to a depth greater than 12 to 20 inches can seldom be made.

The occurrence of Volusia stony loam in this county is in areas of small individual extent in larger areas of other soils of the same series, being seemingly local accumulations of the stony material brought down by water action from higher lands. No difference is observed in the methods of handling this soil type and other types of the series. The presence of the rock material in it generally insures good drainage, and while troublesome to work it is a productive soil. It is well adapted to fruit growing, as well as to the production of grass crops.

DUNKIRK GRAVELLY LOAM.

The Dunkirk gravelly loam consists of a light or medium brown loam, 8 to 10 inches deep, overlying a subsoil of similar texture, though frequently of a deeper shade of color with, in certain instances, a distinctly reddish tint. Both soil and subsoil contain a large percentage of rounded gravel and stones. At varying depths in the subsoil, usually, however, at not less than 3 feet, layers of sand and of gravel are found to occur. Notwithstanding the presence of the large amount of gravel and stone, the tillage of this type is far less difficult than it would appear to be, no doubt in a great measure due to the rounded character of the stone content. Moreover, the presence of this material prevents clodding and baking of the soil, making it feasible to work it under a wide range of moisture conditions. The subdrainage of this type is usually excellent, though as a result of the level topography of much of the section where it is found there are some local areas that would be improved by the use of tiles. It is a good soil for general farm crops, and is especially suited for the production of grapes. Grasses, clovers, and alfalfa also do well on this type. The maintenance of the organic content in this soil is, especially in the vineyard section, of the utmost importance. This can readily be accomplished by the use of cover crops grown for the purpose of plowing under. The clovers and vetches are the most desirable plants for this purpose, though rye is often used. The failure to obtain a catch of clover on this soil can usually be traced to the acidity of the soil itself. This condition can be corrected by the use of lime in such amounts as to achieve the neutralization of the acidity without danger of injury to the grape vines, which an excess of lime is said to bring about. From 450 to 600 pounds of lime per acre has been found sufficient for this purpose.

DUNKIRK GRAVELLY SANDY LOAM.

The Dunkirk gravelly sandy loam is a medium sandy loam in texture, carrying in both soil and subsoil a large amount of gravel, the amount of this material frequently approximating about 30 per cent. Excluding the gravel and rock fragments, the interstitial material or true soil is a loose, somewhat incoherent sandy loam of a light to medium brown or yellowish-brown color, overlying a subsoil very similar in texture, but usually of a lighter color. The darker color of the surface is more pronounced in well-cultivated fields and is the result of the presence of decomposed manure and other organic matter. Besides the change effected by this means in color, the presence of the substances thus formed imparts to the surface soil a more loamy feel than that found in the subsoil, though there is but little actual difference in the texture of the surface soil and subsoil. By reason of its

structure and texture the subdrainage of this soil is usually found to be excellent. Only when its topographical position is relatively lower than the surrounding country is it at all deficient in this respect.

Liberal applications of stable manure or the frequent plowing under of green manuring crops is of the utmost importance in the handling of this soil type in order that it may be kept well supplied with humus-forming material. By this means its moisture-holding capacity will be increased and it can be maintained in a better state of tilth.

At present much of this type in this area is used for general farming; it is, however, well adapted for truck crops and for small fruits. Alfalfa would do well on this type also.

DUNKIRK GRAVEL.

The Dunkirk gravel consists of beds of rounded gravel with which is mingled a small percentage of sand and fine earthy material. There is usually a thin surface covering of a dark-gray or brown color, resulting from the accumulation of a small amount of earthy material and organic matter, the darker color being the result of the oxidation of the latter material. Much of this gravel is waterworn shale fragments and the materials of the type are usually stratified, though occasionally they occur as small hummocks or ridges of unassorted stones carrying little or no earthy material. Owing to the loose and porous structure the passage of water through them is rapid and the type is of little agricultural importance. Areas of this type are found throughout much of the lake plain, usually occupying relatively high topographic positions, many of them being too small for representation on the map.

Many of the ridges occupied by this type are well suited for the production of bush fruits and strawberries, as well as for peaches and prune plums.

If blackberries are to be grown on this type the use of lime should be avoided, although other fruits will very probably be improved by applications of from 400 to 600 pounds per acre.

DUNKIRK FINE SAND.

The Dunkirk fine sand consists of a yellowish, light-brown, or grayish-brown fine sand, from 8 to 12 inches deep, underlain to a depth of 3 feet or more by a subsoil of very similar or the same material, though usually of a lighter yellow or brownish color than the surface layers. As is frequently the case in soils of this character, fields to which much manure has been added are somewhat darker on the surface than are those that have not been so treated and which contain less organic matter. Frequently the change in color is the only difference between soil and subsoil.

The topography of this type is extremely variable, ranging from nearly level to hummocky, and many very small areas are scattered throughout the section of the county bordering on Lake Erie. It is poor in moisture-holding properties, except where well supplied with humus-forming material. It does, however, warm up rapidly in the spring, and when well supplied with the necessary organic matter is well adapted to all truck crops. Its use for the production of early garden truck would prove more profitable than its devotion to general farm crops. The type is not particularly well adapted to grasses, but when well supplied with lime, alfalfa and the clovers do well upon it. The frequent use of a green manuring crop on soils of this character, when devoted to truck growing, in order to keep up their organic content, is a necessity. Both vetch and red clover are suitable for this purpose. Good yields of potatoes have been obtained from soils of this character, following the plowing under of a good clover sod.

DUNKIRK LOAM.

The Dunkirk loam is a brown or yellow loam soil, with an average depth of 8 or 10 inches, resting on a subsoil of the same general color as the surface, usually, however, a somewhat lighter shade, and becoming heavier in texture with increase in depth, until at from 24 to 36 inches it passes into a sandy clay or clay loam. Layers of fine or very fine sand are frequently present at from 12 to 24 inches below the surface.

Flat shales and sandstone fragments are found in both soil and subsoil in moderate proportions. This type is better suited for fruit culture or other specialized industries than for general farming, though corn and potatoes do well upon it, and the yields of small grains and grass exceed those of the lighter types of the Dunkirk series. Frequently the depressed or level areas give evidence of the need of better subdrainage, and where tile have been used the results have been satisfactory. Much of the type is deficient in organic matter, and the use of green manuring crops or stable manure and lime would be attended with better results than where commercial fertilizer alone is used.

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

Mechanical analyses of Dunkirk 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.*
24967	Soil	1.9	2.9	2.9	9.4	28.6	34.5	19.7
24968	Subsoil	.8	2.2	2.2	7.0	34.5	33.9	19.2

DUNKIRK FINE SANDY LOAM.

The Dunkirk fine sandy loam is a brown or yellowish-brown fine sandy loam with depth ranging from 6 to 10 inches, overlying a subsoil of yellowish medium to fine sand to a depth of 3 feet or more. The subsoil frequently becomes somewhat more loamy with increased depth and is occasionally mottled with gray. Both soil and subsoil contain varying quantities of fine gravel.

The type is well drained and warms up early in the season, is easily tilled, and is well adapted for the production of small fruit, truck crops, etc., maturing crops of this kind more rapidly and to better advantage than the heavier types of soil in the same region. Asparagus of good quality and earliness can readily be produced. It is also well suited to potatoes.

To obtain the best results on soils of this character organic manures should be largely used, in order to keep up the necessary supply of humus. They may, however, be supplemented by the application of commercial fertilizers to advantage. Alfalfa does well, except on extremely level or depressed areas, whose position renders them too retentive of moisture. It will prove quite as profitable as the production of the general farm crops, while effecting a lasting improvement of the soil. For success the soil must be limed and inoculated. The utilization of this type for the production of truck crops, however, especially onions, is recommended. When the organic content can be maintained, especially by the use of stable manure, this type is well adapted to onion culture. Some areas are used for grapes, but the fruit is considered inferior in flavor and shipping qualities to that produced on the heavier soils.

DUNKIRK SHALE LOAM.

The characteristic feature of the Dunkirk shale loam is the presence in considerable quantities in both soil and subsoil of flat, regular shale fragments, varying in size from 1 inch to 1 foot or more in length. The interstitial soil material is a yellowish variable loam, frequently very silty or clayey in local spots, extending to a depth of 36 inches without material change in color or texture.

The type is, as a rule, well drained and adapted to the production of grapes, for which purpose its entire area is now used. The Concord grape is largely grown upon it, and it seems better suited to the needs of this variety than to any of the others grown in this region. It is found in localities well suited for grape culture and is distinctly a grape soil.

DUNKIRK SILT LOAM.

The Dunkirk silt loam consists of from 8 to 10 inches of grayish or yellowish-brown silt loam, underlain to a depth of 36 inches by a subsoil of light-brown or yellow, compact silt loam. Both soil and

subsoil are generally entirely free from stones or gravel. Layers of sand occur occasionally through the subsoil at depths of 24 to 36 inches, and in a few instances streaks of silt or clay may be found; these are, however, of small extent.

The surface is usually level to gently rolling or undulating, and owing to the topography and the compact nature of the subsoil drainage is apt to be unsatisfactory.

This soil, where suitably located and well drained, is well adapted to orcharding, and many varieties of apples, as well as pears and cherries, would do well on it. The type, as a rule, is a good productive soil, and is well worth improving where local conditions demand it. The use of lime on this type would, by making it more friable, materially lessen the tendency to clod so frequent in soils of this character.

Heavy phase.—The Dunkirk silt loam, heavy phase, consists of 8 or 9 inches of light-brown or yellowish-brown heavy silt loam resting on a silty clay or heavy clay loam of about the same color as the surface layer or somewhat mottled with gray and extending to a depth of 3 feet or more. The soil when wet is sticky and plastic and inclined to be very compact when dry. Occasionally stones or bowlders occur on the surface, and near the margins of the areas some stones are found in the surface soil. The type is found among the soils of the grape belt and is well suited for the production of this fruit. Owing to the generally level or gently rolling topography of much of this type, it would be greatly benefited by underdrainage. In vineyard management applications of from 500 to 600 pounds of lime have proved to be very beneficial, insuring a good catch of clover for a cover or green manuring crop, as well as rendering the soil more open and porous.

DUNKIRK CLAY.

The Dunkirk clay consists of 6 to 8 inches of light-brown or yellowish-brown clay loam, resting upon a subsoil of about the same color, but growing heavier with increased depth. At about 36 inches it becomes a very heavy tenacious clay. As a rule the type is poorly drained, owing to the impervious nature of the subsoil, but when sufficient drainage is established it is being successfully used for the production of grapes. Soils of this character are difficult to handle, because they must be broken when neither too wet nor too dry or clodding and baking will result, and the reduction of the clods thus formed is well-nigh impossible. If, however, they are handled when conditions are right, they can be gotten in good tilth, and are easily maintained in this condition. The introduction of organic matter into this soil would greatly improve it, and plowing under crops of buckwheat or rye would be a feasible method of accomplish-

ing this, although of course clover, if it will catch, would be preferable. The use of rye or buckwheat as catch crops will in many cases be necessary.

DUNKIRK SAND.

The Dunkirk sand consists of a surface layer of yellowish to brown medium sand, overlying a subsoil of about the same texture, but somewhat lighter in color. The darker color of the surface layer, which varies in depth from 2 to 4 inches or more, is due to weathering and to the presence of a small amount of organic matter. Both soil and subsoil are loose and incoherent, so that drainage is apt to be excessive. The introduction of organic matter will, however, correct this to some extent.

The conditions existing on much of this type render it adapted to the production of truck crops, and if properly prepared by the use of lime and inoculation there is little doubt that alfalfa could be successfully grown on it. On soils of this character large amounts of manure are generally necessary to maintain productiveness. Where commercial fertilizers are used for this purpose fractional applications are the most economical, owing to the loss by leaching when applied all at once.

GENESEE SANDY LOAM.

The soil of the Genesee sandy loam, to a depth of about 8 or 9 inches, is a brown or yellowish-brown sandy loam becoming gray when quite dry. The subsoil is a somewhat lighter colored material of the same texture as the soil. As developed in this area the proportion of fine sandy material is quite variable, giving it in places the feel of a fine sandy loam, while beds of fine gravel and sand of different grades not infrequently appear, extending from the subsoil to the surface layer. These are usually stratified and perhaps exert a certain amount of influence on the soil, chiefly in the matter of drainage, though they are of small individual extent.

The areas of this soil are generally level, but the character of the materials of which it is composed insures good drainage where there is sufficient elevation above the adjacent streams. It is an easily worked warm soil, and under ordinary care has shown itself to be quite productive, good yields of corn, oats, hay, and potatoes being obtained from it.

GENESEE SILT LOAM.

The Genesee silt loam is a dark grayish to dark brownish gray silt loam, having an average depth of 8 to 10 inches. The darker shades of color being the result of the presence of decomposed organic matter, they are formed only in the cultivated areas. The subsoil of this type is a very compact, somewhat heavy silt loam of similar color to the surface soil, though of a lighter tint. It is not

infrequently mottled. It is quite uniform in texture, and both soil and subsoil are generally free from gravel or other fragments.

Occupying level areas, usually with but slight elevation above the adjacent streams, it is frequently subject to overflow, and owing to its level character surface drainage is effected but slowly and the dense, compact, silty nature of the subsoil makes artificial subdrainage in much of this type a difficult problem. Where, however, the drainage conditions are fairly good and the location is such as to render the risk of loss from overflow slight, the Genesee silt loam is found to be in many respects a very desirable soil. It is easily worked and can readily be kept in excellent tilth, producing good yields of corn, potatoes, cabbage, tomatoes, and other farm and garden crops. When subject to inundation it is, if allowed to become set in permanent grasses, valuable for grazing, or if used for mowing land it yields good crops of hay.

GENESEE LOAM.

The soil of the Genesee loam is a brown to grayish-brown somewhat silty loam, extremely variable in texture. It is underlain at from 6 to 12 inches by a subsoil of much the same character as the soil, though usually somewhat more compact, of a grayish-brown, gray, or mottled color.

It is found as first bottom along many of the streams in the county, and is composed of the outwashed material of the higher lands deposited by the streams in time of high water. The bottoms thus formed vary greatly in width, depending upon the size of the stream and the extent and character of its drainage basin. Small gravelly to distinctly stony spots occur in many places, scattered through the areas of this type.

The greater part of the Genesee loam is devoted to permanent pasture. It is, however, when cultivated very productive, and good yields of farm and garden crops may be obtained. Its successful use for these purposes depends very largely on its immunity from overflow and the natural drainage conditions. When it is underlain by gravelly strata the drainage is usually sufficient, but where the subsoil is to a great depth made up of the usual compact loamy material the movement of the water is greatly impeded.

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

Mechanical analyses of Genesee 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.*
24975	Soil	0.4	2.4	2.1	3.9	18.8	46.1	26.4
24976	Subsoil	1.5	3.9	1.8	1.6	3.9	65.9	21.4

GENESEE SILTY CLAY LOAM.

Between the surface soil of the Genesee silty clay loam and that of the Genesee silt loam there is little difference, either in texture or color. The subsoil is, however, much more dense and plastic. To a depth of from 9 to 12 inches the Genesee silty clay loam is a heavy silt loam of a dark-brown or grayish-brown color. The subsoil consists of plastic silty clay of a somewhat lighter shade of gray or bluish gray, in some instances somewhat mottled with yellowish brown.

By reason of the dense structure of the subsoil the natural underdrainage is usually poor, and the generally level surface and low topographic position of the areas make the removal of the surface water a slow process. While this soil would undoubtedly be greatly improved by artificial drainage, the characteristics of this type are such that a very elaborate system would be required, making the cost of installation so great that it would not seem expedient. It is well adapted, in its present conditions, for permanent pastures, or in the case of the more favorably located fields, to hay. In many cases where so used the construction of open ditches would be beneficial. Applications of moderate quantities of lime would improve both the yield and quality of the grass, to the production of which much of this type is devoted.

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

Mechanical analyses of Genesee 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.*
24977	Soil	0.4	1.3	1.8	5.2	8.1	56.3	27.0
24978	Subsoil	.4	2.0	2.0	6.0	8.9	54.2	26.5

CHENANGO SANDY LOAM.

The Chenango sandy loam consists of about 8 inches of light to medium brown sandy loam of medium texture, overlying a somewhat incoherent yellowish-brown sandy loam or sand extending to 3 feet or more. An accumulation of small pebbles, usually of quartz, is sometimes found upon the surface. These also occur throughout the soil and subsoil.

This type, in common with others of this series, is found on the terraces adjoining the bottoms formed along the stream courses in this area. It is easy to cultivate and is well drained. When under cultivation it is, by reason of its loose loamy nature, easily depleted

of its organic matter, and, when used for the production of crops requiring clean cultivation, should receive liberal applications of organic manures. It is well suited for the production of all truck crops and small fruits, and its use for these industries would prove profitable. Alfalfa could readily be produced on much of this type, with a proper preparation of the land, the usually existing good drainage found on it being especially favorable for the growth of that crop.

CHENANGO LOAM.

The Chenango loam consists of 7 to 9 inches of a porous mellow loam, at times quite silty, overlying a subsoil of very similar character to a depth of 3 feet or more. The color of the surface soil is yellowish to reddish brown, growing lighter with increased depth, the subsoil at a depth of about 3 feet being often mottled with yellow, brown, and grayish brown. There is usually present, but largely confined to the surface layers, some fine shale fragments and rounded gravel. This type is easily worked and, as a rule, possesses good underdrainage. In some of the more level areas a small amount of tiling might be advantageous.

The Chenango loam is a productive soil for general farm crops, and is also well adapted for cabbage and potatoes. Where suitably situated it is also an excellent soil for small fruits, producing fine black and red raspberries, strawberries, etc.

CHENANGO GRAVELLY LOAM.

The soil of the Chenango gravelly loam, to a depth of 7 to 10 inches, consists of a brown or grayish-brown loam, in which is incorporated a considerable amount of gravel and some very coarse sand. Local variations occur, in which the soil may contain more or less than the average amount of silt, clay, or sand, so that the interstitial material ranges from a silty loam to a somewhat heavy loam. The subsoil to a depth of 3 feet or more is a yellowish or light-brown gravelly loam, quite similar in character to the surface layers. The gravel in this type consists of rounded, waterworn fragments of shale and other rocks. Notwithstanding the surface is frequently thickly strewn with these rounded stones and gravel, they interfere but little with cultivation.

The loose, open nature of the subsoil insures good natural drainage, but where, as sometimes happens, much gravel has accumulated in a rather deep layer the drainage may be excessive, so that crops may suffer during periods of very dry weather. The type is well adapted to the general farm crops and good yields of corn, oats, and potatoes are obtained on it. It is particularly well adapted to many

truck crops and to small fruits, and where a desirable site can be secured, plums, cherries, and peaches should do well upon it.

CHENANGO SILT LOAM.

The surface soil of the Chenango silt loam, which has a depth of 8 to 10 inches, is a somewhat variable silt loam of a light to medium brown color. This rests upon a subsoil of silt loam of a light shade. The texture of the subsoil is, like the surface layer, somewhat variable, and at the lower depths it frequently changes to a silty clay. The occurrence of spots in which there is an excessive amount of fine sand is noticed throughout the type.

This soil occupies level to rolling positions and possesses good underdrainage. It is easily tilled and is a productive soil for general farm crops when supplied with organic manures, the type, as a rule, being somewhat deficient in this respect. It produces good corn, grain, and grass crops, for mowing as well as for grazing, and where suitable orchard sites can be selected is adapted to apple and pear growing.

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

Mechanical analyses of Chenango 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.*
24953	Soil	0.3	1.5	1.8	4.1	4.4	65.1	22.5
24954	Subsoil	.2	1.5	2.1	7.3	11.1	59.0	18.7

CLYDE SANDY LOAM.

Lying along and parallel to the shores of Lake Erie, at a distance inland of from one-half mile to over 1 mile, is a chain of level or slightly depressed areas, where the continuous growth of water-loving plants has produced a mucklike soil covering, from 2 to 6 or 8 inches in depth. Many of these areas are only a few rods in width, however, and are cultivated and treated in the same manner as the surrounding soils. In some cases they have been kept separate and devoted to onion culture or to some other crop, distinct from that grown on the adjoining lands. In their present state the successive cultivations that have been given many of them have so thoroughly mingled the subsoil material with the shallow covering of true Muck that they are in reality loams or sandy loams carrying a very high percentage of organic matter. They are largely used in the western part of the lake plain for the production of onions, and the remaining

areas, which are yet undrained could, no doubt, be reclaimed and this industry profitably extended. These soils are also well adapted to the growing of celery.

SUMMARY.

Erie County forms the extreme northwestern part of the State of Pennsylvania and is the only portion of the State bordering upon the Great Lakes. It has an area of about 502,400 acres, or 785 square miles.

The city of Erie is the county seat and largest town. Corry is the second city in the county, and is a railroad and manufacturing center of importance. A number of smaller towns are located in the county, among them being North East, Union City, Waterford, Elgin, Edinboro, Girard, and Albion. These places have good railroad connections and render the shipment of agricultural products a matter of ease.

The county has a fine system of wagon roads, and nearly every point in the county can be conveniently reached by railroad from Erie City. Trolley lines also connect this city with the cities of Buffalo, N. Y., and Cleveland, Ohio, and with many points within the county.

The surface of Erie County is highly diversified. It may be in general divided into the lake plain, the high ridges and intervening valleys, the valleys of French Creek and its tributary streams, and the high lands south of French Creek.

The surface of the lake plain is level to undulating; the remainder of the county is ridgy and hilly, with intervening valleys. The highest points in the county are the hilltops south of Corry, which reach an elevation of 1,725 feet above sea level. Lake Erie is about 573 feet above sea level.

The drainage of Erie County is northward into Lake Erie, thence by way of the Great Lakes and Niagara and St. Lawrence Rivers into the Atlantic Ocean, or southward into the Allegheny River and to the Gulf of Mexico through the Ohio and Mississippi Rivers. The dividing ridge between these systems runs northeast and southwest at a distance of from 8 to 16 miles from Lake Erie.

The soils of Erie County are classified in five series: The Dunkirk soils, occupying the lake plain; the Volusia soils, forming the uplands; the Genesee, found along the larger creek bottoms; the Chenango series, situated on terraces adjoining the bottoms; and the Clyde soil, occupying depressed areas along the shores of Lake Erie. Agriculture is most highly developed along the lake shore, where much specialization in grape culture has occurred in the vicinity of North East. The soils of this section are susceptible of great development in truck and fruit culture. They range from sand to clay, are

generally under good cultivation, and should be developed along special lines rather than devoted to general farming.

Of the Volusia soils, the silt loam and clay loam predominate. They are largely devoted to general farming and to dairying. Owing to poor drainage and a deficiency in lime they are not at present as productive as they should be. The general crops raised in this section are potatoes, wheat, rye, oats, corn, and hay.

The bottom-land soils of the Genesee series, when not subject to overflow, are good productive soils, but in many cases can be used as permanent pasture. Where they can be drained, the results will justify the expense.

The higher-lying terraces of the Chenango soils are usually well drained and highly productive when not too open and gravelly.

The agricultural industries in Erie County must, as a result of differences in soil, in surface conditions, and in climate, be carried on along very different lines in the lake plain and upland sections. The equalizing influence of the lake is especially important in grape culture.

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