SOIL SURVEY

OF

DELAWARE COUNTY, INDIANA

BY

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DESCRIPTION OF THE AREA.

Delaware County, comprising an area of 399 square miles, or approximately 255,360 acres, is situated in the east-central part of Indiana, in the second tier of counties from the Ohio state line. The county is rectangular in outline, 19 miles from east to west and 21 from north to south. Grant and Blackford counties bound it on the north, Jay and Randolph on the east, Henry on the south and Madison on the west.

The surface is level to slightly undulating, except near stream courses, where erosion has rendered it more broken and in places even hilly, or where moraines exist. The descent to the stream courses is often abrupt or precipitous. The banks along the larger streams generally rise in two distinct terraces to the broken country, which merges rapidly into the broad level plain. Numerous old filled-in valleys in the area indicate that the preglacial topography was much more irregular than that of the present time. The most prominent of such valleys is one east of New Burlington, crossing Perry Township near the center and connecting with White River, and another lying parallel to the Granville Pike northeast of Muncie, known as "Muncie Prairie." The greatest surface relief is found in the northeast and southeast portions, particularly near Prairie and Stony creeks in Perry Township and Easley's Creek in Nile Township. Scattered throughout the county are many morainic knolls and ridges which frequently rise to an elevation of several feet above the general surface adjacent. A number of kames or rounded hills of gravel and sand are to be seen in the county, the most important ones being found between Muncie and Granville and between Muncie and Smithfield. There are several in and about Muncie, but much of the gravel has been removed from them. A prominent chain of asars, or long, narrow ridges of sand and gravel, extends from a point two miles east of Granville to a short distance northeast of Muncie. Its elevation is about 30 feet above the general surface. The watershed between
White and Mississinewa rivers present the largest expanse of level till plain, and it is in this section that the greatest acreage of "black land" occurs. The watershed between Buck and Bell creeks is also rather level, with but little relief except as the stream is approached. The better drained uplands are seldom more than a few feet above the depressions in which the darker soils are found.

The average altitude is between 900 and 1,000 feet above sea level. The general slope of the surface is from east to west.

A heavy mantle of glacial drift of the late Wisconsin ice sheet covers the entire area, the depth of which is conjectured as ranging from 50 to 250 feet. The surface clays are either yellow where thoroughly oxidized or gray where oxidation has not taken place. A bluish or gray color characterizes the clays beneath the surface. The first water-bearing gravel is reached at depths varying from 10 to 60 feet.

No rock outcrops occur in the area, but it is in places sufficiently near the surface to be quarried, the largest quarries being located in the vicinity of Muncie and Yorktown.

The Mississinewa and White river with their tributaries drain the county, the Mississinewa, having as its chief tributaries Easley's, Half Way, Pike and Campbell creeks, receives the drainage of the northern one-third. White River drains the remainder, Prairie, Buck, Mud and Bell creeks being the largest tributaries. Kilbuck Creek flows into the White River in Madison County. A noticeable feature of several of the tributaries of these two rivers is that they parallel the rivers for a number of miles short distances apart. Pike Creek parallels the Mississinewa River for several miles before flowing into it; Mud, Buck and Kilbuck creeks also parallel White River for a number of miles. There are indications that Mud Creek was an original channel of White River, or was at least a prong of that river, for in times of high water a portion of the overflow from White River floods through this valley. Most of the waters of Mud Creek Valley flow west into White River near Yorktown, but less than a mile of the valley sends its waters east into this river near Muncie. A similar condition exists in a more or less distinct valley tributary to Kilbuck Creek, which discharges most of its waters west into White River through Kilbuck Creek, but also contributes waters for a mile or more to the Mississinewa. However, there is evidence in this case that flood waters pass through the valley from one river to the other.

The natural drainage is fairly well established except in the
central and northwestern sections, and the entire county presents sufficient surface relief to insure thorough drainage of all the land if the natural drainage is supplemented by artificial. The channels of almost all the smaller streams have been straightened and deepened by dredging throughout their entire length, and recently the question of straightening and deepening the channels of White and Missisinewa rivers has been agitated. In the last few years many of the open drains have been converted into underground or "blind" ditches by the use of tiling, and fields thus dissected are now even and unbroken. Many thousands of dollars have been spent by private and community enterprises to establish the excellent system of drainage which now obtains throughout the county. Tile drainage of individual farms has been practiced so extensively that almost no land remains not available for agriculture, though an even more thorough and systematic drainage is required to secure the highest efficiency of the various soil types.

The Delaware tribe of Indians, from whom the county received its name, were the first inhabitants, but the first permanent settlement made by white men was along the banks of White River in 1820. County government was granted in 1827. The earliest settlements of the area, Smithfield, Muncie, the county seat—formerly known as Muncietown—Yorktown and New Burlington, are situated along the course of White River and the old state road. The earliest settlers came chiefly from the states to the east and from Kentucky.

The population has grown steadily since the organization of the county in 1827. In 1860 the census recorded a population of 15,753. According to the 1910 census there are now 51,414 people in the county. Of this number about 40,000 live in Muncie and the other towns and villages of the area, the remaining population being distributed rather evenly over the rural sections.

Muncie, the county seat and largest town in the county, is situated on White River in Center Township, a little south of the center of the county, and 55 miles northeast of Indianapolis. It is not only the center of a rich agricultural region, but is the intersecting point of four steam roads and the terminus of two steam and five trolley lines. It is also the site of many important manufactures, including the largest glass fruit jar factory in the world, steel bridge works, piano factory, automobile factory, wire fence factory, silver plate works, several canning factories and numerous small manufacturing interests. The population, including suburbs, is approximately 35,000. It is the sixth largest city
in the State and modern in every respect. Muncie Normal Institute, which has an annual enrollment of more than a thousand students, is located in Normal City, a suburb. Muncie is the leading market and trading center of the county.

Eaton, Albany, Gaston, Selma and Yorktown are other important towns in the county. They are shipping centers for the rich agricultural territory surrounding them and also have some manufacturing interests. The greatest impetus in the growth of these towns came in 1884 upon the discovery of natural gas. Eaton is the pioneer gas town of Indiana. At the present time the supply of gas is very much depleted and is used by the farmers chiefly for domestic purposes. A portion of it also is used in the smaller towns and villages as well as in Muncie, but the greater part of the gas now consumed in Muncie is piped from West Virginia fields. Since the depletion of the gas supply a few of the towns have lost a part of their manufacturing interests and the population has declined to some extent. Every town in the county and all but four villages are situated on either railroad or trolley lines and many of them on both. In the vicinity of Selma a rather extensive oil field has been developed and is gradually being enlarged.

The first railroad in the county was the Big Four, built in 1852-53 from Indianapolis through Muncie. At the present time the county possesses a most excellent railroad system. Six steam roads and five trolley lines make transportation and shipping facilities adequate for all needs. The Lake Erie and Western Railroad enters near the center of the west boundary and leaves not far from the northeast corner; the Chesapeake and Ohio traverses the area from northwest to southeast; the Logansport and Muncie division of the Pennsylvania system enters near Wheeling and terminates at Muncie; the Big Four enters near the southwest corner and leaves not far from the center of the eastern boundary; the Ft. Wayne, Cincinnati and Louisville Railroad has an almost due north and south course through the center of the county; the Central Indiana Railroad enters near the same point as the Big Four and has a northeast direction to Muncie, its terminus. Traction lines affording both freight and express accommodations parallel the Big Four and the Ft. Wayne, Cincinnati and Louisville railroads throughout their course in the county, and a traction line also parallels the Lake Erie and Western Railroad from Muncie to Albany.

The first improved roads were constructed under the toll pike
system, which connected the principal towns usually by the shortest route and centered at the county seat. Such were the Centennial, Granville, Center, Wheeling, Bethel, Jackson Street, Yorktown, Middletown, Newcastle, Macedonia, New Burlington, Smithfield and Selma pikes. Within the last twenty-five years these toll roads have been opened by the county to the public and supplemented by an excellent sectionized public road system, so that now every farmer is within easy access to market. There are very few miles of unimproved roads, most of them being surfaced with gravel and in excellent condition. Unlimited quantities of gravel are available for constructing and repairing the roads. In recent years many macadamized roads have been built. Several of the main highways leading out from Muncie have been paved with vitrified brick for a distance of one to three miles into the country. Modern steel bridges span the various streams of the county.

Telephone lines and rural mail routes connect all parts of the county. Excellent churches and schools are accessible to every section. The county has been a pioneer in the movement for consolidation of schools. Outside of the cities and towns there are nine or ten township high schools and there is an annual expenditure of, about $185,000 on the school systems, exclusive of cities and towns.

The average annual temperature of the county is 50.8 degrees F., the absolute maximum 102 F. and the absolute minimum .24 F. The maximum and minimum temperatures quoted are ordinarily of short duration. High temperatures are not uncommon in July, August and September, but rarely continue long unless accompanied by extremely dry weather. The annual snowfall is 29.3 inches. In extreme winters snow may remain several weeks, or even months. Zero weather occurs, though periods of such low temperatures seldom last long. Ordinarily the ground remains frozen only a few weeks and a thaw is expected in February or March.

The county rarely suffers from extreme drought or excessive moisture conditions, since precipitation is rather uniformly distributed through the year. The greatest rainfall occurs during May and June.

The length of the growing season is about five and one-half months, the average date of the first killing frost in autumn and the last in the spring being October 10th and April 25th, respectively. The earliest recorded date of a killing frost in autumn is September 6th and the latest in spring May 21st.
Agriculture.

The first white settlers who came in 1820 to the region now known as Delaware County found it a dense forest of hardwoods, broken only by an occasional open swampy prairie. Natural advantages caused them to stake their claims along the larger stream courses. The streams afforded access to outside markets by raft or flatboat and furnished power for mills, including those used for marketing the lumber, while the bottom lands, enriched annually by stream overflow, offered easy and profitable farming. Because of its adaptability to bottom land soils, corn became the main crop. Large yields were also obtained when the uplands in the vicinity of the rivers were first cleared, these having in general better natural drainage than the more remote uplands. The first settlements made in the county were along the west fork of White River, near the present towns of Smithfield, Muncie and New Burlington.

A considerable section of the county was originally poorly drained and in its natural condition unfit for agriculture. A relatively large proportion of the land was, however, well suited to farming. The cost of installing artificial drainage in the so-called "black lands" and in many cases the lack of adequate drain outlets prevented the use of these soils by the early settlers, but they have since been made the richest and most valuable lands of the county by the deepening, straightening and widening of the natural drainage ways by ditching and dredging. Many thousands of dollars have been expended by private and community enterprises to reclaim the black lands and bottom lands along the more shallow streams. The first method employed in artificial drainage was the construction of open ditches, but in recent years they have been converted into blind ditches by tile drains.

The county's greatest wealth has always consisted of its fertile fields. The native timber was cut off when the revenue obtained from the sale of it was a trifle compared with the present value of such lumber. Some large steel, glass and other manufacturing interests flourished in the county seat and principal towns of the area upon the discovery of gas in the early eighties, though many of them have since ceased operations. The construction of railroad and traction lines which have opened up ready access to the larger markets have been an important factor in the development of the agricultural resources of the county.

Corn, wheat, oats, rye, flax and potatoes were among the early
crops grown in the area. Hay was cut from the open prairie. Corn has always been the leading crop of the area and it is the aim of most of the farmers to further increase the production of this grain. In some cases this has led to a depletion of the fertility of the soil, but the more progressive farm operators have avoided it by efficient methods of crop rotation. The acreage of this crop has steadily increased from 52,061 acres in 1880 to 71,706 in 1910, with a corresponding increase in production of 1,528,876 bushels in 1890 to 3,135,530 bushels in 1910. The largest yields are obtained from the Clyde and Genesee soils, which produce approximately twice as much as the lighter colored clay soils (Miami). They are rated among the best corn soils in the State, and yields of 70 to 80 bushels per acre are not uncommon. The yields from the clay or Miami soils can generally be increased through better cultural methods, including fertilization and seed selection. Barnyard manure is the chief fertilizer for corn, little commercial fertilizer being used. Crop rotation, green manuring, subsoiling, deeper plowing, winter cover crops are the best methods of maintaining the fertility of the soil, but these may be supplemented to advantage by fertilizers.

Experiments with ground limestone have shown that an application of two or more tons to the acre upon clover sod, especially upon the lighter colored soils, will when turned under with the sod increase the yields of corn. The effect of such an application will be even more apparent in the wheat and clover crops which follows the corn. Similar results have been obtained by subsoiling the clay lands or deepening the soil bed without turning too much raw material to the surface. A gradual deepening of the soil is generally recognized as beneficial. Too often the ground is plowed to the same depth year after year so that a form of hardpan is produced which greatly retards the free circulation of air and moisture. The relative percentage of phosphoric acid and potash required to properly fertilize the different grades of land varies with the local conditions, but in general the lighter colored soils yield better returns from the use of phosphoric acid, while the black lands are lacking in potash. Proper rotation of crops will maintain the nitrogen supply. For the black lands a fertilizer of ten parts of phosphoric acid and five of potash or eight parts of phosphoric acid and four of potash is recommended. This soil usually contains sufficient nitrogen but is deficient in the other two elements of plant food. The best way to apply phosphoric
acid is to mix acid phosphate with barnyard manure at the rate of thirty pounds of the former to a ton of the latter and spread at the rate of eight tons to the acre. This should be applied to timothy or clover sod and turned under in the spring.

An important factor in increasing the yields of corn is the selection of the variety best suited to the soil on which the crop is to be grown. Too often no attention is given to this matter or to the testing of seed corn. The seed to produce the best results should be strong in vitality and the kernels graded to uniform sizes, in order to drop from the planter evenly. The best varieties to grow on the different kinds of soil should be worked out by the farmers themselves. The seed corn selected from the clay land should be planted on the clay lands, so far as practicable, and that selected from the black lands should also be kept for the black lands, selecting from experience the varieties best adapted to each grade of land. Well-selected home-grown seeds are generally preferable to any other on any soil. Attention to these methods will materially increase the quality and yields from these lands.

The use of the cheek drill in planting corn permits the crop to be cultivated both ways and hoeing is not often required. In general three to four cultivations are given to the crop, though five are not infrequent. Riding cultivators are used almost exclusively. The use of power corn cutters has also reduced the labor of harvesting this crop. In the last few years a large per cent of the corn has been cut and stored for ensilage. The practice is being rapidly extended as the value of silo feeding becomes better understood. The planting of cowpeas and soybeans in the corn should be practiced more extensively. The advantage of having a legume growth in connection with corn can readily be appreciated, as it adds nitrogen and organic matter to the soil. Ensilage is frequently prepared from corn and peas thus grown together. The keeping qualities are probably not so good, however, as it is when corn alone is used.

The acreage and yield of wheat in Delaware County in 1910 was 14,766 acres and 190,963 bushels respectively. Wheat is recognized as not a paying crop commercially but its value as a nurse crop for clover warrants its continued cultivation. The lighter colored Miami soils of the area show the greater adaptability to this crop. The application of two or more tons of finely ground limestone to the acre will be even more beneficial to the wheat than to the corn. The limestone should be applied to the wheat ground
prior to seeding. The increased yields from subsoiling will also be noted, which should be repeated in three to five year periods. Too much attention cannot be given to the selection of suitable varieties of wheat for the soil, as well as a proper grading of the seed. Rotation, fertilization, treatment of seed for disease, and the combating of insects require careful attention to insure the largest returns from this crop. The Purdue Experiment Station recommends the use of 300 pounds per acre of a fertilizer analyzing two per cent. of nitrogen, eight per cent. of available phosphoric acid, and two per cent. of potash. This can be applied at the time of seeding by using a drill with fertilizer attachment. When clover has been turned under for corn and the latter is followed by wheat an application of 50 to 100 pounds of nitrate of soda is generally advisable, which can best be applied as a top dressing in spring. Where barnyard manure is used the most profitable results are secured when it is turned under with the clover sod preceding the planting of corn.

Although oats are not generally considered a paying crop, this grain fits in well with the customary rotation and is especially valued for its straw, which, when fed for hay in conjunction with ensilage, makes excellent roughage for stock. The acreage in oats in 1910 was 25,205 with a production of 678,661 bushels. The average, however, is usually 30 to 40 bushels per acre. Yields of 50 to 60 bushels are not uncommon. Oats are usually sown with an end-gate attachment at the rate of two and one-half to three bushels per acre. Cowpeas and soybeans are being tried by many of the farmers as a substitute for oats.

Delaware County is not rated as a potato-growing county, but the number of acres devoted to this staple in 1910 was 1,927 with a yield of 150,162 bushels, or about 78 bushels per acre.

With the increased demand for canned tomatoes the cultivation of this crop is gradually being extended. The crop fits well into a system of rotation and when properly handled gives twice the profit per acre of a corn crop. Many growers are netting a profit of $70 to $100 per acre where proper cultural methods are employed. More attention should be given to the breeding of earlier varieties and to methods of maturing the crop before it is killed by frost. The selection of profitable varieties is also often overlooked. It is recommended that 500 or more pounds of fertilizer containing two per cent of nitrogen, ten per cent of available phosphoric acid and six per cent of potash be used as a working
basis for fertilizing the tomatoes. This formula must be varied to meet the requirements of local conditions. It is suggested that sulphate of potash rather than muriate of potash be used. From the 890 acres planted in 1911 to tomatoes 4,886 tons were harvested.

The growing of English peas offers another source of revenue to the farmer. A crop of this character is profitable not only from the sale of the peas but because of its value as a nitrogen-storing agent to the soil. It is especially beneficial preceding the sowing of alfalfa, since it aids in the inoculation of the soil for the later crop. It is also beneficial to clover.

The number of acres in clover in 1910 was 2,885 with a yield of 3,365 tons, or a little more than a ton to the acre. The small acreage sown to this crop accounts largely for the low percentage of humus in the clay lands. Clover is not generally included in the rotation of crops, or if so it is turned under without being cut for hay, a practice which was not observed during the course of the survey. It was observed, however, that both the hay and seed crops were removed. The cutting of the second crop for seed robs the soil of much valuable humus. The acreage of timothy is being rapidly reduced as its soil-robbing properties become more generally known.

The growing of alfalfa is receiving more attention each year, but its value as a feed is evidently not fully realized or it would be more extensively cultivated. This crop is especially well adapted to the second bottom lands or high terraces on account of their porous subsoils, but with proper preparation it can be grown successfully on almost any soil in the county except muck. Aside from its value as a money crop its value as a nitrogen-storing agent should recommend its culture, especially upon the lighter colored Miami soils which are low in humus. It is advisable that alfalfa be sown not later than August 10th, for unless it makes sufficient growth to withstand freezing it is liable to winter-kill. It may, however, be sown as early as the latter part of April. When sown on wheat land it is possible to get the seed in between July 15th and August 10th. To succeed with alfalfa it is necessary that the land be well drained, that it be limed, that it be thoroughly inoculated, and that it be well prepared and free from weeds. It is sometimes necessary to re-seed the crop the second and even the third year, and for this purpose about six pounds of seed to the acre is recommended. Too often the crop is neglected after the first stages of development and the fields become "spotted" and
weedy, a result which has a tendency to retard rather than encourage the growing of alfalfa.

Fruit growing has been made a profitable industry in a few cases where proper attention has been given to spraying, pruning, etc., but in general the orchards are neglected. Many of the older orchards are infested with diseases and insect pests which spread to the more recent plantings. The present tendency is to plant too large orchards to which sufficient attention is not given, while smaller orchards well sprayed and pruned would yield more profitable results. State inspection and modern methods of control are needed to make fruit culture a paying industry. The more rolling type of Miami silt loam and the Miami loam are particularly well adapted to the growing of fruit.

The farmers of Delaware County who cultivate their own farms usually practice some form of crop rotation. The three-year rotation of corn, wheat and clover is most commonly employed. This requires sowing wheat in the corn either before it is cut or in the stubble among the shocks. In either case the seeding is unsatisfactory and a good stand is rarely secured. To overcome this difficulty a four-year rotation of corn, soybeans, wheat and clover is recommended. The use of rye as a winter cover crop between the corn and soybeans would be an additional soil enricher. In planning a crop rotation the purpose in view should be: 1st, to get larger yields and profits directly or indirectly; 2d, to distribute the work more evenly throughout the year; 3d, to give a more certain and regular income than is possible with a one-crop system; 4th, to maintain, or better to increase, the fertility of the soil; 5th, to reduce to a minimum the injury from weeds, insect pests, and diseases that so often accompany shiftless methods of farming. Small grains, hay, and cultivated crops are the three main crops to be considered in a scheme of rotation. It is thus a question requiring more study of individual problems than lies within the province of the soil survey. However, every system of rotation should include one or more legumes as a soil enricher.

The county is a stock-feeding rather than a stock-raising area. Cattle are imported from the western states, fattened on the farm produce and then put upon the market. However, this practice has not been so profitable in the last few years on account of the scarcity of range cattle in the West.

The dairying industry is confined to supplying the local markets of the area, but the excellent shipping advantages warrant its extension to markets outside the county.
The price of land in Delaware County has kept pace with the advance in other sections and but little, if any, of it can be bought for less than $125 to $150 per acre. Well improved farm lands frequently sell for $200 to $225 an acre. The high price of land is due in part to the fact that the more prosperous farmers are satisfied with their holdings and refuse to sell unless offered a price commensurate with the advantages afforded by a highly developed county such as this.

The average farm wages range from $20 to $25 per month with board, lodging, washing, and feed for driving horse furnished, or in the case of a married man, house, feed for horse, cow, etc., are furnished. Harvest hands and extra laborers receive from $1.50 to $2.50 per day. The manufacturing and public works in Muncie offering shorter working hours and the various attractions of city life have drawn heavily upon the labor of the county, and desirable farm labor is scarce. Those who operate a farm of 160 to 240 acres seldom employ more than one regular helper, the work being done largely by the owner and his family.

SOILS.

Glacial till left upon the recession of the ice sheet at the close of the late Wisconsin epoch covers the entire county to a depth of 50 to 200 feet. It is a heterogeneous mass consisting chiefly of clay intermingled with sand, gravel and silt. The material of the drift varies with the character of the rocks over which the glacier passed, granite, gneiss, limestone, sandstone and shale from the Lake Superior region being intermixed and ground up with it. Niagara limestone underlies the glacial deposits throughout the county but no rock outcrop occurs, though in a few places it is near enough to the surface to be quarried.

The glacial till is the source of the upland soils of the area. The alluvial soils or bottom lands are stream-deposited material formed chiefly of wash from the upland soils. On account of their depth the underlying rocks have had little part in the formation of the soils of Delaware County, though they may have contributed to the ice-ground mantle covering the uplands from which the various types are derived.

The various agencies of weathering, water, air, etc., have been at work upon the glacial deposition of drift or debris to form the present soils. The drift material to a depth of 10 to 15 feet is a very light brown to pale yellow or grayish mixture of clay, fine
sand, and silt, carrying a large proportion of gravel and small stones. The latter consist largely of granite, schistose, gneissic and limestone fragments. The limestone fragments are more conspicuous below five to six feet. Artificial exposures of the till usually weather to a loose, friable, silty to fine sandy loam or loam. It is generally calcareous and responds readily to the action of HCL. In many cases this material is supplemented with beds of gravel, particularly along the stream courses. The upper portion of the glacial till to an average depth of 22 to 24 inches consists of a uniform silt or silty clay layer which from its mechanical composition and general appearance is strongly suggestive of a loess. It is possible to attribute the regularity in depth of this silty mantle to the freezing and thawing of the soil, the depth to which the soil is pulverized by such action being fairly uniform. The covering is for the most part light colored, due to a lack of organic matter and is quite uniform in texture. These upland soils are known locally as "clay lands."

Because of the formation of ponds, marshes, and small lakes by the advance and recession of the ice sheet a certain per cent of the area was always in a semi-swampy condition until drained artificially. These ponds and lakes have been filled up gradually by the decay of the native vegetation which invaded them, or were gradually silted up through the deposition of fine materials washed in from the adjacent uplands. These areas constitute the "black" lands of the county. As the silting-up process continued the timber growth gradually encroached upon the open prairies so that only the deeper ponds and lakes remained unforested.

Five series of soils were mapped in the county, the Miami, Clyde, Rodman, Fox and Genesee. An undifferentiated type of muck and peat was also encountered.

The Miami series is the most extensive and widely distributed. It consists of two types, the Miami silt loam and Miami loam, the former occurring in three phases, level, undulating, and rolling. The differences are due chiefly to surface configuration. The level and undulating grade into each other so imperceptibly that no boundaries were ascribed to them. The more rolling phase of the type was mapped but not with arbitrary boundaries. The level phase is the predominating soil throughout the central and eastern portions of the State. The rolling phase is more often found in the vicinity of stream courses where the agencies of erosion are more active. The Miami loam is of more or less morainic origin
and is confined largely to a single body in the southwestern part of Liberty Township, though a few isolated areas are found elsewhere. These types are derived from glacial till and are characterized by their light brown to brown surfaces.

The Clyde series, including the loam and silty clay loam types, also occupy the uplands and are of glacial till origin. They differ from the Miami in having black soils and in occupying poorly drained areas, favoring the accumulations of organic matter. The Clyde silty clay loam includes the greater proportion of the "black land" series while the loam type occupies only a few rather small scattered areas which were originally open, swampy prairies. The adjacent uplands have contributed some washed-in soil material to these depressions.

The Rodman silt loam is confined to a chain of basins lying northeast of Muncie. This type together with the Miami and Clyde soils constitute the upland soils of the county.

The first bottom lands subject to overflow were included in two types of the Genesee series, the loam and silty clay loam. They represent brown-colored alluvial material washed from the uplands by stream overflow. The loam is confined almost entirely to the bottom lands along the larger streams which are more sandy owing to the wash from the silty upland soils and also from exposure of the coarser substratum. The silty clay loam occurs along the smaller streams where drainage has been more sluggish and the bottom lands are silty. The Genesee silty clay loam type grades so imperceptibly into the Clyde silty clay loam that often no definite boundaries between them can be determined. The origin of the two is frequently very similar, the Genesee being developed along the smaller streams which often occupy old filled-in valleys while the Clyde originates in shallow basins or depressions.

Fox loam represents the second bottoms or terraces built up by overflow waters when the streams were flowing at higher levels than at present. The Fox loam differs from the Clyde silty clay loam in having a lighter color as well as a lighter texture, and in occupying better drained situations.

Muck and peat represent the accumulations of organic matter in lakelets and ponds in various stages of decomposition. Their extent is limited to a few small areas, the largest of which is Big Prairie in Washington Township.
MIAMI SILT LOAM, FLAT PHASE.

The surface soil of the Miami silt loam—flat phase—to an average depth of about 8 inches is a compact silt loam of a gray to yellowish-gray color when dry, or of a darker gray or brown color when moist. Below 8 inches and to a depth of 15 or 18 inches the texture passes from a silt loam to a silty clay loam and the color becomes a mottled gray and brown. Below 18 to 20 inches a rather stiff yellowish-brown to dark brown mottled silty clay is encountered and at 24 to 30 inches this grades into a similarly colored friable silty to sandy clay, bowlder clay. The substratum below 3 to 4 feet is an intermixture in varying proportions of clay, sand and gravel of a lighter brown to grayish color.

The Miami silt loam, flat phase, is the most widely distributed and extensive soil type in Delaware County, as it is in all of central Indiana. It occupies the greater proportion of the better drained uplands and ranges in topography from level or undulating to rolling or hilly. So far as practicable the latter conditions were mapped separately as a rolling phase of the type. Two other phases, the level and undulating, are distinguished by local variations but they pass into each other so gradually as to make it impracticable to separate them. The two phases may be distinguished in the field by the description. The term "clay" land is applied locally to this soil to distinguish it from the "black land." The term thus applied probably has reference to the tendency of the soil to clod or run together, as its texture is that of a silt loam and not a clay. The tendency of the soil mass to adhere is due chiefly to the lack of sufficient humus but is also due in part to the fact that it is plowed when too wet.

The surface of the type throughout the area is a fairly uniform silt loam, the local differences being chiefly that of drainage, surface configuration, and color. Where the surface is more undulating the texture is slightly coarser, darker in color, or more brownish, and less coherent. A few chert, granite, limestone, and quartz pebbles are encountered in the soil profile particularly below 24 to 30 inches, or upon the surface where erosion has carried away the finer soil particles. The occurrence of bowlders was not infrequent when the land was first put under cultivation but on account of the introduction of labor-saving machinery, which necessitated their removal, only a few remain. They have been appropriated largely for building purposes.

The level phase of this type is characterized by an even surface
and an ash-gray or leached color. The subsoil is distinguished by its gray mottling, denser structure, and cold, clammy nature, as if waterlogged, a condition which is indicative of its poor natural drainage. It generally occurs closely associated with the Clyde silty clay loam and is seldom elevated more than a few inches above the level of that type. Areas of this phase of the type too small to be shown on the map were included with the "black lands." Small areas of the Clyde silty clay loam were also included with this phase of the Miami silt loam. Owing to its low situation and poor natural drainage it has been necessary to install artificial drainage on this phase in order to obtain the best results. The use of subsoil plows and lime to render the subsurface soil more open and porous is recommended. Numerous tests with litmus paper gave a decided acid reaction, a condition which can be corrected largely by the use of lime. Since the soil is already deficient in humus lime had probably best be applied in the form of finely ground limestone. Liberal applications of barnyard manure, commercial phosphates, and the turning under of large quantities of vegetable matter under proper conditions will tend to balance the chemical and physical requirements. This soil is generally less productive than the undulating phase of the type, and is sometimes referred to as "poor, thin land." The occurrence of this phase of the type is confined chiefly to the western half of the county, interspersed with the more extensive areas of the Clyde silty clay loam.

The Miami silt loam is found in all parts of the county, and is the predominating type, but the largest acreage occurs in the eastern half, where the undulating and rolling phases are most extensively developed. This is due to the better natural drainage of that section. The level phase of the type always occupies the broader watersheds where the natural drainage is least developed. As the drainage courses are approached there is usually a gradual shading off in color from the ash-gray of the level phase to the brown or yellowish-gray of the more undulating type, or the dark brown color of the rolling phase bordering the stream courses. In the early settlement of the county the pioneers naturally showed a preference for this type because of its better drained condition, the black lands being in a semi-swampy condition and in many cases having no apparent drainage outlets. When first brought under cultivation the type was rich in organic matter and much more productive than at the present time, as is shown by the greatly reduced yields of wheat, a crop to which this soil is well adapted.
Continued cultivation without recourse to proper methods of crop rotation has greatly reduced the natural store of humus, and to this depletion of organic matter is due the light color or leached appearance of the soil and its tendency to run together when wet, and clod.

The extent of this type in any particular field can usually be distinguished from that of the black soils not only by the lighter color but also by the more vigorous growth of the latter type in the early development of the crops, especially corn, oats and hay. With the exception of wheat the average yields of crops on the Miami silt loam are but little more than half that obtained from the Clyde silty clay loam. However, the better quality of grain produced on the Miami soils tends to counterbalance the larger yields of the black lands. The type is well adapted to wheat and the best soil in the county for that crop.

In order to force the crops in season this type is often plowed in the early spring when too wet. The result is that heavy clods are formed which are not reduced to proper tilth by subsequent cultivation and the physical and structural condition of the soil thus modified affects its productivity. Fall plowing has been recommended to offset this condition and to aid in storing moisture. A winter cover crop will help to correct this tendency of the soil to clod and should always be sown upon this type. The wheat crop should be estimated not only by the actual yields obtained but also by its value as a winter cover crop. The turning under of rye after it has served as a winter cover crop has proven successful in keeping the soil loose and moist. Where tests were made this soil, as stated before, showed a decided acid reaction, indicating the need of lime. Subsoiling, supplemented with deeper plowing each year, and liberal applications of ground limestone are recommended to improve the condition of this type and increase the yields. These tend to correct the sour condition of the soil by the more thorough aeration thus brought about. The turning under of such crops as clover, cowpeas, Canada field peas, soybeans, rye and oats stubble, will all tend to improve the physical condition of the soil as well as furnish a store of food supply for the plants.

Potatoes, tomatoes, beans, peas, sugar corn, and small fruits grown upon this soil are firmer and less subject to decay than the same crops grown upon the black lands, but the yields are seldom so large. Owing to the smaller yields on the Miami soils preference is usually given the Clyde silty clay loam when tomatoes are
grown for canning purposes. This soil is better adapted to fruit
growing than the darker soils, but for such purposes the rolling
phase of the type is preferred.

The original forest growth consisted of beech, black walnut,
white oak, yellow poplar, red oak, shell bark hickory, red bud, wild
plum, flowering dogwood, etc.

Although this type is never valued so highly as the black lands,
some of the best improved farms in the county are located on it.
Land values range from $125 to $200 per acre. Where modern
methods of culture are used the returns from this soil are being
increased, the crops being more certain than upon the Clyde soils.

**MIAMI SILT LOAM.**

The surface soil of the rolling phase of the Miami silt loam to
an average depth of 10 inches is a brown or yellowish-brown loose,
mellow silt loam grading into a heavier silt loam and clay loam.
Below 15 to 18 inches a dark brown heavy silt clay is encountered
which in turn is underlain at 20 to 24 inches by a more friable
silty to sandy bowlder clay. Below 3 to 4 feet the substratum
materials are more heterogeneous, being a mass of clay, sand,
gravel, and rock fragments. In the vicinity of stream courses
pockets of stratified sand and gravel are frequently encountered in
the lower substratum.

The surface soil is usually slightly coarser in texture than its
associated type, the undulating phase of the Miami silt loam. The
color is also darker, due to better drainage with higher oxidation
and aeration of the soil and subsoil. Where the type occurs on the
knolls and ridges the surface is somewhat sandy. Such areas are
usually of only an acre or two in extent. Where erosion is exces-
sive along the steeper embankments varying amounts of gravel and
other course materials are found, the finer materials having been
carried to lower levels by the excess surface drainage. The bowlder
clay is not infrequently exposed where the slopes have been deeply
gullied. The gravelly areas are confined to narrow strips along
the steeper slopes approaching the deeply dissected stream valleys,
or upon the narrow morainic ridges and sharper knolls.

The boundaries between this type and the Rodman silty loam
were drawn largely from the character of the substrata, which was
determined by borings with the auger and by the cross sections in
gravel pits. Where this type merges into the Miami silt loam the
boundaries are not definite ones.
Practically all of the type can be cultivated with labor-saving machinery, but if more attention were given to contour plowing the tendency of the soil to wash could be greatly checked. So far as practicable this phase of the Miami silt loam should be allowed to remain in pasture a greater portion of the time. When it is cultivated the plowing should be deep so that more of the surface water will be absorbed, and the run-off with its attendant erosion be lessened.

This type is usually found bordering the stream courses. It is most extensively developed in the northeastern and southeastern parts of the county. A high table land occurs in the vicinity of Cross Roads, in the southeastern part of the county, which is similar in color to this soil.

The type is well suited to wheat and fair yields are obtained, but as a rule the yields of corn are low. It is probably the best fruit soil in the county owing to the better aeration of the soil and subsoil. Apples and pears have better keeping quality and are more highly flavored than those grown upon the heavier soils. Where orchards are planted for commercial purposes and on a large scale a soil of this character should be considered.

**MIAMI LOAM.**

The Miami loam is of morainic origin and is undulating to slightly rolling in its surface configuration. The surface soil to an average depth of 12 to 15 inches is a brown to slightly reddish-brown silty to fine sandy loam, or light loam. The subsoil is a yellowish-brown or slightly reddish-brown heavy sandy loam or a friable silty to fine sandy clay. The line of demarcation between the soil and subsoil is not sharply drawn but is rather a shading off in color and texture from one to the other. The tendency is for the soil to become lighter with depth, or more yellow.

This type is confined chiefly to an area of one square mile in Liberty Township and includes parts of Sections 19, 20, 29, and 30, T. 20, R. 11. Smaller areas are found in Section 30, T. 22, R. 11, and in Section 8, T. 19, R. 11.

The type is cultivated to the usual farm crops without reference to any one crop or crops to which it is best adapted. Because of its loose, friable structure it admits of a free circulation of air and moisture, responds readily to the use of fertilizers, and is easy to till. Unlike the Miami silt loam it does not run together or bake. A soil of this character warms up rapidly and is especially well
adapted to trucking purposes. Small fruits, potatoes, melons, cucumbers, and root crops of all kinds should yield better returns from this soil than can be obtained from the usual farm crops. It should also be well adapted to alfalfa if limed. The soil is deficient in phosphoric acid, which is required to produce the maximum yields, especially if wheat is one of the crops grown upon it.

This type along with the Miami silt loam is valued at $150 to $175 per acre when well improved.

**Rodman Silt Loam.**

The surface soil of the Rodman silt loam to an average depth of 8 to 10 inches is a brown silty loam grading into a darker brown silty to sandy clay. This is underlaid at 30 to 36 inches by a sandy, gravelly loam. Below four to five feet stratified layers of sand and gravel are sometimes encountered. These gravel deposits, however, seem to be confined to pockets rather than underlying the entire esker or kame in which they occur. The extent of the deposits could not be determined by borings with the three-foot auger but prospectors for gravel have found such conditions to exist.

The type is for the most part confined to a broken ridge or chain of eskers with a general northeast-southwest course across the county, starting from a point about two miles northeast of Muncie. The average elevation above the surrounding country is from 20 to 30 feet.

The soil varies somewhat with the topographic features. Where the slope is gradual the surface is a fairly uniform light silt loam, but where the descent is more rapid the underlying sandy material is often exposed, in which case the resultant soil is a sandy to gravelly loam. However, the lighter material is seldom of more than a few acres in extent in a single body.

This type is cultivated along with the Miami silt loam to the same crops. Owing to its well-drained condition it is well suited to fruit culture. Some of the largest gravel pits in the county have been opened in the ridges included with this type and its use for this purpose will probably continue until the supply of gravel is exhausted. The pits thus established ruin the land for cultivation but the revenue from the gravel greatly offsets its value for agricultural purposes.

A morainic phase of the Miami series, indicated on the map as 9M, is very similar to the Rodman loam and suggests its correlation with this type.
CLYDE SILTY CLAY LOAM.

The surface soil of the Clyde silty clay loam to an average depth of 8 or 9 inches is a dark brown to grayish-black heavy silt loam or silty clay loam. The subsoil is first a bluish-black silty clay and then grades into a drab to slate-blue heavy plastic clay. The color gradually lightens with depth to about 18 to 20 inches where a gray and drab, brown-mottled, stiff, rather impervious clay is encountered. Below 30 to 36 inches this heavy material is underlain by a more friable, silty to fine sandy clay of a light gray color and highly stained with iron, or the latter material may consist of a low grade of marl or quicksand, both of which are deeply stained with iron. Where this type occupies old partially filled-in glacial channels the lower substratum is composed largely of coarse sand and gravel. These filled-in valleys have been the chief source of the gravel supply for those counties in which no morainic ridges occur.

The Clyde silty clay loam comprises the greater part of the so-called "black land" of the county. The term applies to the dark surface soil which was in part formed from the decay of the native vegetation while these areas were in a semi-swampy condition. The content of organic matter determines largely the depth of color of the soil. The lower situations favoring the accumulation of vegetable matter are naturally darker than the better drained portions where the type gradually shades off into the lighter color of the upland soils. This deepening of the color toward the lower level is due to the movement of the surface waters in that direction carrying in suspension the finely divided soil particles and organic matter from the adjacent uplands, and also to the fact that originally the water remained longer in the lower depressions and supported a more luxuriant native growth of aquatic sedges and grasses which on decomposing added to the store of organic matter. The amount of organic matter present also affects the chemical and physical properties of the soil by giving it an extra store of nitrogen and increasing its ability to assimilate moisture. It also counteracts the tendency of the soil to run together and permits it to mellow more readily, making cultivation easier.

The Clyde silty clay loam occupies the swampy and poorly drained depressions of the late Wisconsin glaciation and is largely residual from materials composing that formation. It was originally covered with water throughout a greater portion of the year, but with the installation of open and tile drainage the surface waters are now removed almost as rapidly as they fall. Practically
all of the type is under cultivation and constitutes some of the richest lands in the county. The relative value of farm property is frequently rated by the number of acres of black land which it contains. It was one of the last types to be brought under cultivation owing to its lack of natural drainage outlets. Open ditches were at first installed but these have gradually been replaced in recent years by underground or tile drains which permit the cultivation of the land formerly occupied by the open ditches, and also make it possible to cultivate the type in larger bodies.

The boundary between the Clyde silty clay loam and its associated type, the Miami silt loam, is usually not definite, the transition from one to the other being gradual. This intermediate condition may be classed as a lighter phase of the "black lands." It constitutes one of the best soils in the area. It is particularly well adapted to the growing of tomatoes and produces heavy yields. However, the keeping properties of this crop are better when grown on the lighter-colored Miami soils.

The type occupies irregular shaped depressions which occur widely distributed throughout the area are found most typically developed in the northwestern part of the county. The largest unbroken areas occur in the vicinity of Gaston in Washington and Harrison townships. It is also rather extensively developed in Hamilton and the southern part of Union townships. The type is fairly uniformly distributed in the southwestern portion of the county and is least developed in the northeastern and southeastern portions. It occurs as low-lying or depressed areas among the uplands and forms the main background of the soil map upon which the Miami silt loam stands out in slightly more relief.

The Clyde silty clay loam is rated as one of the best corn soils in the State and yields of 60 to 70 bushels per acre are frequently obtained. Oats yield 50 to 60 bushels an acre, but in wet seasons this crop lodges badly with considerable loss except when it is cut and used for hay. The part that becomes lodged is valuable as a green manure when turned back into the soil. Alsike and red top clover and timothy produce from one and a half to two tons of hay per acre. Experiments on this soil have demonstrated that the yields of corn and oats can be greatly increased by the use of a potash fertilizer. When commercial fertilizers are used a mixture of 8 per cent phosphoric acid and 8 to 10 per cent of potash is recommended. Nitrogen is not generally needed for this soil but where it is deficient it should be supplied by legumes grown in the usual crop rotation.
With proper draining and liming of the soil alfalfa can be grown successfully on this type. The yields will be larger than that upon the lighter colored soils but the quality will not be so good and more time will be required to cure it properly.

The native forest growth upon the Clyde silty clay loam consisted of swamp white oak, pin oak, white elm, silver maple, burr oak, black ash, green ash, prickly ash, and some of the characteristic plants of smaller growth were the button bush, spice bush, and wild rose.

**Clyde Loam.**

The Clyde loam differs from the Clyde silty clay loam largely in its content of organic matter. Its occurrence as low-lying wet prairies in its virgin state is another distinguishing feature.

The surface soil of the Clyde loam to an average depth of 9 or 10 inches is a black, mucky silt loam or heavy loam. The high content of organic matter not only contributes to the fertility and friable, mucky nature of the surface soil but to it is also due its dark color. However the amount of organic matter in the soil is not sufficient to justify its classification as Muck.

The subsoil of the Clyde loam is a heavy black to bluish-black silty clay loam which grades below 10 to 12 inches into a slaty blue to grayish silty clay and this in turn into a mottled brown, drab and gray rather stiff, plastic clay. At a depth of 30 to 36 inches a friable silt to fine sandy clay or low grade marl is encountered which is generally light gray in color, deeply stained with brown iron stains. As the depth increases the content of fine sand or other coarser materials generally increases, and in some cases a wet, loose fine sand, similar to quicksand, forms the basic material of the lower substratum.

The Clyde loam type never supported a growth of timber and the pioneers always referred to it as "prairie land," a term usually applied to all treeless soils whether well drained or low-lying areas. The native growth included a variety of sedges, grasses, cattails, flags, button bush, and willows. The better drained portions supported a heavy mantle of native prairie grasses which was the chief source of hay for the early settlers. Its use for pasture and hay was the only value attached to this type of land until within recent years, when adequate drainage has been established and the land put under cultivation. The annual decay of this native prairie vegetation imparted to the Clyde loam its high content of organic matter. It is frequently referred to as "made land," a term which
is more applicable to the type Murk and Peat. "Chaffy land" is also a name given to the looser, deeper phases of the type which more nearly resemble Murk. The "chaffy" condition is more noticeable when the type is first put under cultivation following its reclamation by artificial drainage. Corn planted upon the chaffy areas makes a vigorous growth in the early stages of development but usually turns yellow or "burns" before maturity. This condition may frequently be corrected by the free use of barnyard manure, deeper plowing and more thorough cultivation in order to aerate and sweeten the soil as much as possible. The use of commercial fertilizers containing potash and phosphoric acid in the proportion of about two parts of the former to one of the latter has generally proven profitable in the increased yields from this type.

The largest single body of the Clyde loam is found in Sections 29, 30, 31, T. 22, N. Range 9 E. The next largest body forms the outer border of Big Prairie in Sections 16 and 21 of the same township. Smaller areas are found throughout the county, including portions of the valleys occupied by Prairie Creek in Perry Township and Muncie Prairie in Hamilton Township. This type usually occurs closely associated with the Clyde silty clay loam, or Murk.

This type is rich in natural fertility, particularly humus, but the best results have been obtained from the use of barnyard manure and commercial fertilizers, as previously suggested. The soil is more often deficient in phosphoric acid and potash, especially the latter. Potash fertilizers on corn and oats have proven profitable through increased yields. Ground limestone is recommended as beneficial, though the large amount of humus present in the soil would permit the use of lime in the more soluble forms.

It is only within recent years that satisfactory yields have been obtained from this soil since it occupied old filled-in valleys and shallow lakes or ponds and had no natural drainage outlets. But with the establishment of artificial drainage practically all of the type has been brought under cultivation. Corn is the chief crop. Oats produce a rank growth and are liable to lodge. This tendency may be overcome to some extent by sowing the oats thicker than is generally practiced upon the lighter colored soils.

**FOX LOAM.**

The soil of the Fox loam to an average depth of 12 inches is a brown to slightly reddish brown light silty loam, or loam, grading
into a yellowish-brown silty clay loam. Below 18 to 20 inches the subsoil is a brown friable silty to sandy clay, with a variable inter-mixture of coarse sand and gravel. The content of coarser material increases with depth. Below 30 to 36 inches a sandy gravelly loam is generally encountered which in turn is underlain by stratified layers of sand and gravel. The surface soil is subject to local variations including small areas of sandy loam or gravelly sandy loam which were too small to be mapped separately.

The Fox loam is generally referred to as second bottom land although it may occupy both second and third terraces. The term "sugar tree flats," is sometimes applied to it, but the terraces are generally quite narrow in this county so that the term is not so applicable as in Hamilton, Marion, and other counties where the Fox loam spreads out over considerable areas. The boundary between the first bottoms and the terraces is usually more distinct in this area than that between the latter and the uplands. Only in a few instances was a bluff line found marking the latter condition. But it is not infrequent to find a high, steep bluff marking the descent to the streams where no terraces intervene.

The Fox loam differs from the Miami soils in the darker color and coarser texture of its surface and the position it occupies upon the terraces along the larger stream courses. The soil of the former type contains less silt and the subsoil a much larger percentage of gravel than either of the Miami soil types except the Miami loam. The open, porous nature of the subsoil permits a free movement of moisture. For this reason it warms up more quickly and the crops make a more rapid growth. It is an easy soil to cultivate and a mellow seed-bed is readily obtained.

The type is confined largely to the terraces along White River in the southern and Mississinewa River in the northern parts of the county. The largest bodies are situated in the vicinity of Albany and Eaton along the Mississinewa River and Muncie and Smithfield along the White River. Other smaller bodies occur intermittently along these streams. A number of small bodies were also mapped in the valley previously mentioned as occupied by Prairie Creek in the vicinity of New Burlington. The Fox loam is probably of alluvial origin, having been deposited when the streams along which it occurs were flowing at a higher level than at present.

This type is especially well adapted to alfalfa and in other sections of the State good yields are usually obtained, particularly where lime is liberally applied. This soil is also well adapted to
potatoes, tomatoes, peas, beans, etc., and where markets are accessible profitable returns can be had from these crops.

The predominating timber growth was hard maple, from which fact the type receives its local name of "sugar-tree flats." Other hardwood growths included black walnut, beech, white oak, etc.

This type along with the first bottom lands is valued at $150 to $200 an acre.

**GENESEE LOAM.**

The surface soil of the Genesee loam to a depth of 12 to 15 inches is a medium to dark-brown loam or silty loam except in the immediate vicinity of the streams, where it is generally sandy, the latter material being deposited by the swifter currents which transport the coarser particles. The subsoil is quite variable in texture and structure but is similar in color to the overlying materials. The substratum materials are not infrequently of the same general character as the surface soil but the tendency is for the texture to become lighter with depth or more sandy, sometimes being underlaid with a loose medium to fine sandy or gravel below 24 to 30 inches. Owing to the uneven distribution of the alluvial materials the type is subject to local variations. Where the currents are swifter at times of overflow, which occurs where the first bottoms are narrow, the alluvial materials thus deposited are more sandy than that deposited in the outlying bends where the waters are less active. In the latter case the resultant soil is a silt loam or heavy loam somewhat darker in color than the coarser-textured phase of the type.

The Genesee loam is subject to frequent overflow and the constant additions of alluvium aid in the maintenance of its fertility, but the crop yields have shown a gradual decline since the land was first cleared and drained. This condition is due largely to the tendency to cultivate corn to the exclusion of other crops. Some form of rotation should be followed as with other soils and the use of some legume such as cowpeas, soybeans, etc., in the corn is recommended as a soil enricher. Where this soil is lighter in texture and well drained it is one of the best trucking soils in the county. It responds readily to the use of barnyard manure and commercial fertilizers and is easy to cultivate. It is especially well adapted to root crops, cucumbers, cantaloupes, etc. The overflows seldom come at a season of the year to interfere seriously with the use of this soil for trucking purposes.
The Genesee loam is confined almost entirely to the first bottom lands along the Mississinewa and White rivers. The largest expanse of the type is found southwest of Yorktown, covering parts of Sections 20, 21, 29, 31 and 33, T. 20, R. 9. The next largest is found in the vicinity of Eaton in Sections 23, 25, 26, T. 22, R. 10. Another area of considerable extent occurs just south of Albany. The type occurs continuously throughout the course of the two rivers in varying widths. The areas mentioned are those in which the valleys reach their maximum widths.

The Genesee loam, as stated above, is an alluvial soil composed of reworked materials from the upland glacial soils that have been redeposited by the streams along which it occurs, and the surface is generally level. The greater portion of the type is under cultivation and but little of the native timber remains standing. However, enough remains to designate the character of the original forest growth—silver maple, white elm, buckeye, red oak, sycamore, and hickory. The areas not under cultivation have been cleared of underbrush and are used for pasture. Where this soil was low-lying and poorly drained, ditches have been constructed to carry off the excess water. The open structure of the soil and subsoil permits the ready percolation of the surface waters so that the soil dries out rapidly after floods.

**GENESEE SILTY CLAY LOAM.**

The Genesee silty clay loam occurs as first bottom lands along the smaller stream courses, being most extensively developed along Kilbuck, Jake, Bell, Buck, Stony, Prairie, and Easley's creeks, which form the principal tributaries of the Mississinewa and White rivers. It occurs in narrow strips seldom exceeding one-fourth to one-third of a mile in width. The largest area occurs along Kilbuck Creek in the northwestern part of the county.

The surface soil to an average depth of 8 to 10 inches is a medium to dark-brown heavy silt loam or silty clay loam, which grades into a darker brown, almost black, silty clay, and this in turn into a drab to slate-blue stiff plastic clay mottled with dark-brown or reddish-brown iron stains. The stains may in part be due to the decay of roots from the native vegetation which have penetrated the subsoil. The color of the substratum becomes lighter with depth. Where this type merges into the Clyde silty clay loam the boundary between them cannot be definitely fixed as the characteristics of the one blend into the other. When the type occurs in
old partially filled-in valleys its origin is somewhat similar to the
Clyde silty clay loam where the latter type occupies ponded areas
and elongated depressions. Along Stony Creek in Perry Township
the surface soil is more loamy, being similar to the Genesee loam,
though the subsoil is quite heavy.

The Genesee silty clay loam is for the most part formed of
reworked glacial till deposited by the streams along which it occurs,
or is composed of wash from the adjacent uplands. The dark color
of the soil is due to the accumulation of organic matter from de-
cayed vegetation since these bottom lands were low and semi-
swampy until adequate drainage was established by dredging. Nar-
row strips of sandy material are sometimes encountered adjacent to
the stream but the limited extent of these areas did not warrant
their separation. They should be correlated with the Genesee loam.
The heavier materials were deposited in the lower situations.

Most of the streams along which this type occurs have been
straightened and deepened by dredging and practically all the land
is under cultivation which was formerly poorly drained. Some of
the largest yields of corn in the county have been obtained from
this type. It is subject to overflow but the floods generally come at
the season preceding the planting of the crop. Yields of 70 to 80
bushels per acre are not uncommon and the average is between 50
and 60 bushels. Heavy yields of oats are obtained where they do
not lodge and the full crop can be harvested. It is also one of the
best grass soils of the county and yields of one and a half to two
tons are obtained.

When the seasons are favorable a good tilth is obtained with
this soil but too often when the spring planting has been delayed by
unfavorable weather conditions the soil is turned up wet and forms
large, compact clods which cannot be broken down readily by sub-
sequent cultivation. Thus haste to get the crop in frequently
impairs the physical condition of the soil for even more than one
season. Owing to the profitable returns from corn grown upon
this soil the tendency is to grow it continuously, and rotation is
practiced only to a limited extent. Although the fertility is main-
tained in part from the constant additions of alluvium the yields
from this soil will decline unless rotation is practiced. The soil is
generally deficient in potash and experiments have demonstrated
that the yields can be considerably increased when potash fertilizers
are used. When this type is well drained heavy yields of toma-
atoes are obtained.
The original forest growth consisted of silver maple, white elm, swamp white oak, burr oak, pin oak, black ash, cotton wood, and other hardwoods.

**Muck.**

This type includes the two organic soils, Muck and Peat, which are alike in origin but are distinguished from each other by the state of decomposition of the vegetable matter of which they are composed. The term "made land" is frequently applied to this type since it was built up from the remains of cat-tails, rushes, sedges, grasses, etc., which originally occupied and filled up the shallow lakes and ponds in which Muck and Peat now occur. The Muck is of a dark brown to black color while the Peat is lighter brown and is more fibrous, or consists of a less decomposed mass of vegetable matter than Muck. The depth of this material varies from several feet near the center of the area to only a few inches at the margin. There is but little change in color with depth, but the deeper material is usually in a less advanced stage of decomposition. This surface material is generally underlain by a bluish-black, stiff, plastic clay which grades into a similarly textured clay of a drab to gray color, mottled with brown. In some places a highly decomposed impure marl is encountered in the lower depths of the subsoil or substratum.

The Peat was included with the Muck since it usually occurs in too small areas to be mapped separately, though the two types show a distinct agricultural difference where they are typically developed. Muck has a very much greater value for general farming or trucking purposes. Peat is usually found near the center of the bodies where the accumulations of organic matter have been more recent and has not undergone as thorough decay, though it sometimes occurs in spots throughout the area.

The largest single body of this type occurs in Sections 16 and 21, T. 22, R. 9 (Washington Township), and is known locally as "Big Prairie." The next largest area occurs in Section 33, T. 20, R. 9. Other smaller bodies are found in Sections 4, 9, 16, and 17, T. 19, R. 9; Sections 2, 3, 11 and 12, T. 19, R. 11; Sections 29 and 30, T. 20, R. 9; Sections 1, 2, 17, and 18, T. 21, R. 9, and Sections 22, 27, 34 and 36, T. 22, R. 9.

The native grasses which grew luxuriantly upon the Muck lands were the chief source of hay for the early settlers and were used almost exclusively for hay and pasture until recent years, when they have been reclaimed by artificial drainage. The drainage was
poor owing to the nearness to the surface of the water table. Dredged outlets have since made it possible to drain these areas. At first large open ditches were constructed and these supplemented by smaller underground tile drains. Open ditches constructed along the margin of the swampy areas to intercept the drainage from the adjacent uplands will aid further in the reclamation of these lands.

The greater part of the Muck areas have been brought under cultivation, being used chiefly for corn, although considerable timothy and oats are also grown. The latter crop is not so successful as on other soils, since it makes a rank growth and lodges badly. Timothy and alsike clover do well and are easily seeded, but the two should be grown in combination to get the best results.

Crops grown upon Muck are more susceptible to injury from frost, which settles in the lower situations. It is often necessary to make one or more replantings of corn to obtain a stand, and early frosts sometimes prevent this crop from maturing.

This type is especially well adapted to celery, and its culture should be extended. Onions, cabbage, Irish potatoes, beets, turnips, cauliflower, and other garden crops also do well. The returns in northern Indiana and adjoining States from celery and other truck crops far exceed the returns from the general farm crops. The value of the land has greatly increased since being properly drained and put under cultivation.

Experiments with potash salts and phosphoric fertilizers have usually been profitable from the increased yields obtained. The tendency of the crops to "burn" on this soil can be largely corrected through the use of potash as well as from liberal applications of barnyard manure. Lime judiciously applied is also beneficial.

This land is valued at from $100 to $150 per acre.

SUMMARY.

Delaware County is situated in the east-central part of Indiana and has an area of 399 square miles or approximately 255,360 acres.

The surface varies from level to undulating and in some places broken. The central and western portions of the county are comparatively level with slightly broken areas in the vicinity of stream courses. The greatest relief is found in the northeastern and southeastern portions near Granville and New Burlington, respectively. The average elevation above sea level is between 900 and 1,000 feet.
Mississinewa and White rivers and their tributaries drain the area. The Mississinewa receives the drainage of the northern one-third, while White River drains the remainder.

The first settlement in the county was made along the banks of White River in 1820. County government was granted in 1827.

The population of the county is 51,414, of which about 11,000 is rural.

Muncie, the county seat and sixth largest city in the State, is situated on White River near the center of the county. The population is about 35,000. It has a number of important manufacturing interests. Albany, Eaton, Gaston, and Selma are important towns of the area.

An excellent system of free pikes, which were originally toll pikes, and sectionized gravel roads characterize the entire county. There are only a few miles of unimproved roads.

Six steam roads and five trolley lines afford excellent transportation facilities.

The prosperity of the county is due chiefly to its productive soils though there are also a number of important manufacturing industries, including the largest glass fruit jar factory in the world, several manufactories of automobile parts, bridge works, wire fence factory, etc.

The area is highly developed and enjoys the advantages of good homes, towns, schools, churches, excellent roads, telephone lines, electric interurban lines, and rural mail delivery.

The climate is not subject to very great extremes of heat or cold. The mean temperature for the winter months is 29.1 degrees Fahrenheit, for the summer, 71.5 degrees. The average rainfall is about 39 inches, and well distributed throughout the year. The growing season is about five and one-half months.

The leading crop of the area is corn, the average yield being about 40 to 45 bushels. Wheat, oats, and hay are also grown in considerable quantities though the combined acreage of wheat and oats does not equal that of the corn. Corn is cut and stored for ensilage, which furnishes green food for stock in winter. Cowpeas are also being grown and used for this purpose. The growing of tomatoes, peas, beans, etc., for the canning industry is profitable and promises to become more general.

Much of the farm produce is fed to live stock. Cattle from the States farther west are brought in and kept long enough to be fattened for market.

No dairying is done except that required to supply the local
markets. With the excellent shipping facilities at hand this industry could very profitably be extended to outside markets.

Trucking forms a rather important agricultural feature of the county. The products are grown for canning purposes and to supply the local needs of Muncie and the towns of the area.

Prices of land range from $100 to 225 per acre.

Five series of soils were recognized and mapped in the county—the Miami, Clyde and Rodman, which occur upon the uplands, and the Fox and Genesee, which are found upon the bottoms and terraces. The so-called "clay" lands were included in the Miami series, while the greater part of the "black" lands was classified with the Clyde.

The upland soils are derived directly from glacial till of the late Wisconsin stage. They have undergone local changes which give rise to the various types. The bottom lands are derived from reworked and redeposited materials which represent wash from the uplands.

Of the Miami series two types were mapped, the silt loam and loam. The former, including the rolling phase, is the most extensive and widely distributed in the area. The Miami loam occupies morainic ridges. The Miami soils are best adapted to wheat and fruit growing.

The Clyde silty clay loam is the predominating type of that series. Only a small acreage of the Clyde loam, the only other type of this series developed in the county, was mapped. The Clyde soils are especially well adapted to corn. Good yields of oats and hay are also obtained.

The Fox loam occupies the greater proportion of the higher terraces. This soil is well adapted to alfalfa.

Of the Genesee series two types were mapped, the silty clay loam and loam. The loam is the predominating type of the series and occurs chiefly along White and Mississinewa rivers. The Genesee soils are best suited to corn. Oats and hay also produce good yields.

The Rodman silt loam represents the only member of that series mapped in the county. It occupies eskers and kames principally in the east-central part of the county.

The undifferentiated soil, Muck, is of very limited extent in the area.

The agriculture of the area is in a highly developed and prosperous condition. Scientific farming is practiced to some extent, but much can be done to increase crop yields by more careful study of the individual soil types and their crop adaptability.