

# Soil Survey of Grant County, Indiana.

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## DESCRIPTION OF THE AREA

Grant County, with an area 418 square miles, or 270,720 acres, is located somewhat north and east of the geographic center of Indiana. It is a rectangle in outline, and is 19 miles wide from north to south and 22 miles long from east to west. It is bordered by nine counties, Wabash and Huntington on the north, Wells and Blackford on the east, Delaware and Madison on the south, and Tipton, Howard, and Miami on the west.

The surface of the county is essentially a plain, dissected by the Mississinewa River and its many tributaries. The only surface relief developed is due to the gradual deepening of the various stream valleys and gullies and the constant lowering of the surface by erosion. Hence, the rougher topography occurs in the vicinity of the stream courses, particularly along the Mississinewa River and along the larger creeks, which have cut their valleys 50 to 100 feet deep through the glacial drift to the river level. The topography here may be described as undulating to hilly, although the crests of the hills are on a level with the plains back from the river. The western, southwestern, eastern, and northeastern parts of the county are comparatively level. The central and northern portions are more broken and are naturally better drained.

The elevations of the county range from 805 feet above sea level at Marion to 939 feet at Upland, the average elevation being approximately 845 feet. Swayzee, in the western part of the county, has an elevation of 862 feet; and Fairmount, in the southern part, an altitude of 880 feet. Van Buren, in the northwestern part, is 842 feet above sea level.

The Mississinewa River and its tributaries form the main

drainage system of the county. The river enters the county at the southeastern corner and traverses it in a general northwesterly course. The chief tributaries include Jocinah, Hummel, Lugar, and Walnut Creeks on the east, and Deer, Boots, and Catt Creeks on the west. Black and Little Black Creeks drain the northeastern portion of the county, and Grassy and Middlefork Creeks the southwestern part. Pipe Creek and Taylor Creek, its main tributary, drain the western and northwestern parts and flow in a general northwesterly course out of the county. Many of these streams head in former lake beds, ponded areas, or old filled-in valleys which were formerly in a semi-swampy condition. By means of dredging, the original winding and sluggish water-courses have been converted into deep and comparatively straight channels which form the main outlets for the poorly drained sections of the county.

The first white settlers in the territory now, included in Grant County, came chiefly from North and South Carolina and Ohio. The county was in 1831. From that time forward there was a steady growth in population until 1900, since which year a decline has taken place. The census of 1880 gave the total population as 23,618. The discovery of natural gas in 1887 caused a rapid growth of the towns, and the census of 1900 reports 54,693 inhabitants, as compared with 51,426, reported in 1910. The falling off in population is attributable not so much to a change in rural as in industrial conditions. Upon the depletion of the natural-gas supply, which afforded cheap fuel, some of the factories in various towns throughout the county ceased operations, although many important plants are still operated. Natural gas is at present used chiefly by the farmers for domestic purposes, and is not available in sufficient quantity to supply the needs of the city of Marion and the other towns of the county.

The rural population of Grant County comprises 51.2 per cent of the total, the inhabitants of towns of less than 2,500 population being classed as rural by the census. The 1910 census reports the total population in the various towns and villages of the county outside of Marion as 14,030, and the farming population is thus placed at 18,037. The combined population of Marion and the smaller towns and villages is almost double the farming population.

Marion, the county seat, with a population of 19,359, is the largest town in Grant County. It is situated on the Mississinewa River, near the center of the county. It is the center of a rich

agricultural region and has a number of manufactories. Gas City, Fairmount, Jonesboro, Van Buren, and Upland are other important towns, shipping and trading centers for the rich agricultural territory surrounding them. These towns also have manufacturing interests. There are a number of small towns and villages throughout the county.

The first railroad, the Pennsylvania line, was constructed through Marion in 1868, and the Cincinnati & Wabash & Michigan (now the Big Four) in 1875. Since then two other railroad lines have been built and the county has adequate transportation and shipping facilities in all sections, being served by four trunk lines of steam railroad and two electric lines. The county has good traffic connections with Indianapolis, Logansport, Muncie, Chicago, Cincinnati, and other large cities.

Toll roads, such as the Strawtown, Jonesboro, Delphi, Huntington, Bradford, Salem, and Wabash, Pikes connecting the principal towns, were the first improved highway. Within recent years the pikes have been opened by the county to public use and supplemented by an excellent sectionized public-road system, giving every farm easy access to towns, markets, schools, and churches. Gravel is abundant for constructing and repairing the roads and very few miles of unimproved road remain, most of the highways having been surfaced with this material and put in excellent condition. Some macadamized roads have been built in recent years and at the time of the survey surfacing with a commercial preparation was becoming general. The streams are spanned by modern steel bridges.

The principal markets for produce sold outside the county are Indianapolis, Chicago, and Cincinnati. Marion is 69 miles from Indianapolis and 151 miles from Chicago.

#### CLIMATE.

The data shown in the table below, giving the normal and extreme temperature and precipitation by months and seasons, and for the year, are compiled from the Weather Bureau records kept at Marion, and are representative of the climatic conditions throughout the county.

## NORMAL MONTHLY, SEASONAL AND ANNUAL TEMPERATURE AND PRECIPITATION AT MARION.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1895).	Total amount for the wettest year (1892).	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December.....	30.7	66	—12	2.44	3.27	1.60	5.3
January.....	26.9	68	—25	2.47	1.84	1.41	9.0
February.....	26.4	67	—20	2.30	0.51	3.21	7.7
Winter.....	28.0	68	—25	7.21	5.62	6.22	22.0
March.....	38.7	85	— 2	3.51	2.16	2.87	6.1
April.....	50.7	89	17	3.14	1.71	5.63	1.1
May.....	61.2	96	26	3.96	0.81	10.65	0.1
Spring.....	50.1	96	— 2	10.61	4.68	19.15	7.3
June.....	70.2	100	35	4.21	1.37	7.52	.....
July.....	74.2	105	37	2.89	0.80	6.18	.....
August.....	72.3	101	40	3.10	1.37	5.46	.....
Summer.....	72.2	105	35	10.20	3.54	19.16	.....
September.....	66.0	101	29	2.95	2.46	5.53	.....
October.....	53.9	91	15	2.02	0.91	T.	0.1
November.....	39.9	75	2	3.13	5.42	4.52	2.0
Fall.....	53.0	101	2	8.10	8.79	10.05	2.1
Year.....	50.9	105	—25	36.12	22.63	54.58	31.4

The county is not subject to frequent occurrences of marked extremes of heat or cold. High temperatures are not uncommon in July, August, and September, but are seldom of long duration except when accompanied by extremely dry weather. Snow in severe winters, sometimes lasts for several weeks, but usually the ground remains frozen only a few weeks, and a general thaw is expected in February or March.

The average annual rainfall of 36.12 inches is so uniformly dis-

tributed throughout the year that neither extreme drought nor excessive rain is common, except at the time of the annual freshets, which usually come in the early spring. May and June generally have the greatest rainfall. The average annual fall of snow is 31.4 inches.

The length of the average growing season is about 5 months. The average date of the last killing frost in spring and of its first in autumn are May 9 and October 4, respectively. The earliest recorded killing frost in autumn occurred September 5, and the latest in spring, June 7.

#### AGRICULTURE.

Agriculture in Grant County began with the planting of small patches of maize and other crops by the Indians, but real development dates from the time the white immigrants, an agricultural people, began to clear and improve their homesteads. Progress was necessarily slow because of the lack of capital, labor-saving implements, and adequate facilities for clearing and draining the land, and the absence of markets and roads. The early settlers found the land covered with a dense growth of hardwood, interrupted only occasionally by an open, swampy prairie; small woodlot pastures of 10 to 40 acres upon the average farm are all that remains of the forest growth. Much of the forested area also was in a poorly drained condition throughout the greater part of the year. The lack of drainage outlets and the cost of installing artificial drainage in the wet areas prohibited their use for cultivation, and for several decades after the first settlements were made only land having good natural drainage could be cultivated. For this reason, the rolling lands near the Mississinewa River and the larger creeks were the first to be homesteaded. The rich alluvial lands, productive of large yields of corn, were a further inducement to the early settlers to locate near the river, which by the use of rafts or flatboats gave access to outside markets. The clay, soils of the uplands were better suited to wheat and oats and were utilized largely for the growing of these crops. Corn, wheat, oats, rye, flax, and potatoes were important among the early crops grown in the county. Hay was cut from the open prairie.

The development of the county was very gradual until the late seventies or early eighties, when the so-called black lands or wet areas became available for cultivation through the installation of adequate drainage outlets, the channels of the smaller creeks and branches being deepened, straightened, and widened

to serve as such. The drainage of individual farms was effected through open ditches, but the disadvantage of having the fields cut up with ditches led later to the laying of tile drains. Thousands of dollars have been expended for drainage, but the rapid increase in land values has offset the expense many times, the rise in price being commensurate with the increased crop yields. Land values have advanced from about \$40 an acre in 1880, to \$100 and \$200 or more an acre at the present time. The building of improved roads, the construction of good farm buildings, schools and churches, and the excellent shipping and marketing facilities have all contributed to this advance in land values.

Corn, oats, and wheat are at present, as in the past, the staple crops of the county. Corn has always been the leading crop. Wheat remained second in order of production until after 1900, the 1910 census showing a production of oats nearly  $3\frac{1}{2}$  times that of wheat. The total value of all cereals produced in 1909 is reported by the census as \$2,285,952.

The census statistics from 1850 to 1910 show a steady increase in the production of corn from 361,318 bushels in 1849 to 3,299,221 bushels in 1909. No acreage statistics are available for census years previous to 1880, but beginning with that period the average yield per acre has been 32, 30.1, 43.8, and 49 bushels, respectively, for each succeeding year. The increase in production is due for the most part to the higher yields obtained from the "black lands," which have contributed a large percentage of the increase in acreage from 47,871 acres in 1879 to 67,391 acres in 1909. Careful seed selection and better cultural methods have also contributed to the increase in corn yields. The average yield of corn per acre for 1914 is reported by the county agricultural agent as 40 bushels. It is estimated that the "black lands" yield on an average, 10 to 20 bushels per acre more than the "clay lands." As corn is the most profitable of the cereal crops, naturally more attention is given to its production than to that of other crops. Without the large production of corn, the \$1,683,609 of revenue received from the sale or slaughter of live stock, as shown by the 1910 census, would hardly be possible or would at least represent a smaller proportion of profit. It is estimated by the county agricultural agent that two-thirds of the corn crop is fed locally, three-fourths of the quantity used for local feeding, being confined to hogs. The tendency is to limit the production of corn only by the acreage of land adapted to its requirements.

The production of oats is now next to that of corn, the crop of 1909 being nearly  $3\frac{1}{2}$  times as large as that of wheat, which up to about 1900 exceeded oats in production. In the period from 1849 to 1909, the production of oats increased from 40,973 bushels to 985,806 bushels, or more than 24-fold, this increase being nearly 3 times the proportionate increase in corn production for the same period. The fluctuation in the acreage yield of oats has been less than  $2\frac{1}{2}$  bushels in the four census years from 1879 to 1909, the yields being 31.6, 30.2, 32.6, and 32.2 bushels per acre, respectively. The effect of the increase in the cultivated acreage of "black land" has been to increase the production of corn rather than that of oats. One reason why the "black lands" are given preference for corn is that a much larger proportion of the oat crop is destroyed by lodging upon these lands than upon the lighter soils. Oats have never been rated as a money-making crop, but they fit in well with the customary rotation and are especially valued for the straw, which is used as bedding for stock or is baled and sold to the strawboard mill at Marion. The grain is used to some extent locally or on the farm where grown, for feed, but the bulk of it is disposed of at the grain elevators situated in all parts of the county. The introduction of cowpeas, soy beans, and alfalfa should tend to decrease the acreage of oats and wheat in the future, since these legumes will to an extent supplant clover, for which oats and wheat, especially the latter, have been largely grown as nurse crops.

The acreage in wheat remained fairly constant from 1880 to 1900, so far as shown at the three census periods included, the area in wheat being 30,783 acres in 1879, 32,823 in 1889, and 29,396 in 1899. The 1910 census shows a sudden decrease to 16,840 acres in 1909. The average yield per acre as shown by the census reports is so variable as to admit of no definite deductions regarding a general increase or decrease in yield from 1880 to 1910. The average yield in the four census years was 20, 12, 8, 7, and 17 bushels, respectively. It is generally considered that there has been a gradual decline in the average yield of wheat except where commercial fertilizers have been used. The use of wheat as a winter cover crop and as a nurse crop for clover warrants its retention in the usual rotation of corn, wheat or oats, and clover, but commercially wheat is generally rated as unprofitable where less than 20 or 30 bushels per acre are obtained. As a nurse crop wheat is considered better than oats, since the straw is lighter and shades the clover less, and wheat is not likely to

lodge. Practically the entire crop, aside from that saved for seed, is sold to the local milling companies or shipped through the local dealers, the bulk of the production being consumed outside the county. The screenings and the wheat of poorer grades are usually fed to poultry.

Minor crops grown in the county include rye and barley. The greatest production rye, as far as is shown by the census reports, was in 1889, when the 876 acres seeded to this crop produced 14,544 bushels. The census of 1910 records 636 acres, with a production of 9,627 bushels. Barley and buckwheat also had their maximum production in 1889, the area in barley being 444 acres and the production 9,779 bushels. For 1909, only 16 acres are reported in barley. The 144 acres in buckwheat in 1889 produced 1,560 bushels, or about 11 bushels per acre. For 1909, the census reports only 2 acres buckwheat in the county.

The census of 1880 records a production of 80,432 bushels of flaxseed. By 1890 the production had declined to 109 bushels, and the 1910 census does not report any flax grown in the county. Of minor grains and seeds grown, there is a small production of dry peas and edible beans, in addition to green peas grown to some extent for the local canneries.

Of the hay and forage-crop production, which according to the 1910 census amounted to 41,037 tons from 28,617 acres, 22,244 tons were of timothy alone. Timothy yields average about 1.4 tons per acre. Of clover alone, 4,140 tons, from 3,161 acres, were produced, and from clover and timothy mixed, 10,111 tons, from 7,133 acres, the yield here also averaging about 1.4 tons per acre. Millet or Hungarian-grass production declined from 335 tons in 1899 to 251 tons in 1909, although the average yield per acre remained about the same, 1.7 tons.

The census makes no mention of alfalfa previously to 1910, although it was grown many years prior. From the 160 acres devoted to this legume in 1909, 499 tons, or on an average, 3.1 tons per acre, were obtained. The growing of this crop is being rapidly extended, particularly by those farmers who are dairying or who feed milk cows, and both the county agricultural agent and the State Agricultural Experiment Station are engaged in efforts to increase the acreage in alfalfa. On account of the porous subsoils the second bottom or high-terrace lands are especially well suited to alfalfa, but with proper preparation of the land it can be grown successfully on almost any soil in the county except Muck and Peat. Its efficacy as a nitrogen-storing



agent, as well as its value as a money crop, favors its culture, especially upon the lighter colored Miami soils which are low in humus. The land for alfalfa should be well drained, limed, thoroughly inoculated, and free from weeds.

Only a small amount of hay of any kind is shipped into the county, and no considerable quantity is disposed of in outside markets, except in the immediately surrounding country. The greater proportion of the crop is fed to stock upon the farms where it is produced, the hay sold being chiefly that produced on rental farms where cash rent is paid or a division of the crops is made. The total value of the hay and forage crops produced in the county in 1909 is \$350,826.

The acreage in special crops is comparatively small, but in the vicinity of Marion and some of the smaller towns the growing of special crops, chiefly potatoes and tomatoes, forms an important interest. In 1909, 223,409 bushels of potatoes were harvested, the yield averaging about 110 bushels per acre. The bulk of the potato crop is consumed locally, but there is not sufficient production to supply the local demand, and hundreds of bushels of potatoes from Michigan and eastern districts are consumed in the county annually. The tomatoes are grown chiefly for the local canning factories. The net income from this crop ranges ordinarily from \$50 to \$100 an acre, but the profit is quite variable with the season, and tomatoes are sometimes grown at a loss.

The growing of sugar beets has been experimented with in the last few years by many farmers, particularly those having small holdings. The industry promises to increase in importance. The beets are grown under contract with a sugar-manufacturing company, which has a plant located at Decatur, in Adams County, 46 miles east of Marion. The company provides seed, implements, and labor, making a stated charge per acre for these essentials. The grower furnishes and prepares the ground and cultivates and aids in harvesting the crop. The cost of production varies but averages \$20 to \$25 or more an acre, not including the grower's labor and the value of use of the land. The contract price has averaged about \$5 per ton, f. o. b., cars at the shipping point. The returns are said to net the growers from \$25 to \$40 or \$50 an acre. In some cases the growers are unable to give the sugar-beet crop the required attention and yields are below the average, being not infrequently unprofitable.

Trucking and fruit growing are carried on in the vicinity of

the larger towns and largely meet the local requirements, since only a very small quantity of fruits and vegetables is shipped into the county, except from southern or subtropical regions. A home garden furnishes most of the farmers with fresh vegetables throughout the growing season, the surplus being frequently disposed of. The total value of vegetables, including special crops, produced in 1909 was \$194,184. Fruit growing is restricted almost entirely to small orchards of apple trees, with some pear, cherry, peach, and plum trees, on practically every farm. There are only a few commercial orchards in the county, and these are not important. The census shows 10,967 apple trees in the county in 1890, the number increasing by 1900, to 82,601. The census of 1910 reports 65,380 apple trees, 22,094 cherry trees, 20,063 plum trees, 15,964 peach trees, and 15,049 pear trees. The production in 1909 of other fruits enumerated, includes 127,652 pounds of grapes from 8,156 vines, 19,950 quarts of strawberries from 24 acres, and 11,548 quarts of raspberries and loganberries. The total value of all fruits and nuts produced in 1909 is reported by the census as \$65,285. The apple is not considered a commercially profitable crop, since the average farmer cannot devote the time required to spray, prune, and properly care for the orchards. The crop of 1915 was one of the largest in the history of the county. In some cases the apples were hand picked and prepared for the market, but for the most part, only those were hand picked which were intended for home storage, the balance being made up into cider, fed to stock, or allowed to rot on the ground. Hogs were usually turned into the orchards to eat the fallen fruit, but even with this makeshift, hundreds of bushels of apples went to waste.

The value of the production of live stock and live stock products for 1909, totaled \$2,352,619, which is \$66,637 more than the value of all the cereals produced, and is more than double the value of live-stock products for 1889. The total includes \$1,683,609 in animals sold or slaughtered; \$273,919 in dairy products, excluding those used in the home; \$370,971 in poultry and eggs, and \$24,120 in wool. Animals sold or slaughtered on farms included 85,284 hogs, 3,026 calves and 7,230 other cattle, 7,729 sheep and goats, and 1,661 horses and mules. The live-stock activities deal mainly with the raising and fattening of hogs, cattle raising being of minor importance in comparison. The fattening of cattle was carried on extensively prior to the increase in the price of feed stuffs, the cattle being imported from

the West and kept for 30 to 60 days, but in recent years feeding has become unprofitable and is gradually being displaced by sheep raising. State and local laws protecting sheep against the ravages of dogs and safeguarding the industry in other ways have done much to encourage sheep raising.

A large proportion of the live stock raised is marketed outside the county, going mainly to the larger packing plants in Chicago, Cincinnati, and Indianapolis, although animals are also disposed of to several local plants, the largest being located at Marion. Only a very small percentage of the meat retailed in the cities and towns is obtained directly from the farmers. On the other hand, a very large proportion of the beef consumed on the farms is obtained through the retail merchants, particularly during the summer and at harvest time. The pork products consumed on the farms are chiefly produced at home.

Animal diseases are continually menacing stock raising, but through the cooperation of the farmers with various Government and State institutions the losses have been greatly reduced. Cholera was quite prevalent in some parts of the county at the time of the soil survey; every effort was being made to isolate and control the disease. In 1915, 3,000 head of hogs were treated with vaccine or virus.

Poultry and eggs and dairy products not only produce a large part of the farm income but are also important subsistence commodities used on the farm. Very few farmers make a specialty of dairying or poultry raising, but practically all have production above that required for home needs, and this is usually disposed of at the local markets or to collectors of dairy or poultry products who call regularly at the farms throughout the year. A few dairies located near the larger towns deliver milk and cream, at retail, mostly in units of bottled pints and quarts, the product being generally sterilized or pasturized.

The local creameries and ice-cream factories utilize the greater part of the cream and milk collected on the daily rounds among the farmers. In most cases the cream is separated on the farm, sold, the separated milk being fed to the younger stock. The practice is quite general among the farmers to buy butter in exchange for cream, in the interest, it is said, of economy as well as of reduction in farm work.

The principal adaptation of crops to certain soils is that of wheat to the lighter colored soils and of corn to the black soils. No attempt is made to confine these crops to any particular type

of soil. The yield of corn upon the lighter colored soils average about half that upon the black soils, but the grain is conceded to be better in quality and more putritive. Tomatoes are grown usually upon the dark soils, because of the heavier yields obtained.

Breaking of the land seldom, if ever, precedes the seeding of oats, as the crop is almost invariably drilled in on the stalk land of the preceding year's corn planting. Disking and harrowing constitute about the only preparation given the land. Breaking is sometimes done in advance of the sowing of wheat but for the most part wheat is drilled between the corn rows. With breaking of the land the stand is more certain, and the crop is less susceptible to injury by extremes of wet or drought. Often the desire to get the crops in early leads to plowing before the ground has attained the proper physical condition, or when it is too wet, and clods are formed which can not be reduced readily by subsequent cultivation. This undesirable condition is more often encountered on the so-called clay lands.

The harvesting of corn is done largely with labor saving devices, the most popular being the corn binder, Practically no corn is cut by hand. The harvesting of wheat and oats is done exclusively with self-binders of the most improved type. Grain is threshed under co-operative methods, a number of farmers combining their labor. A variety of harvesting machines are used to cut, rake, and load hay, and the unloading and storing of hay in the barn are also done with labor-saving machinery. Little hand labor is used in the handling of hay and the other farm crops

Rotation in some form is practiced by most farmers. The one usually followed includes corn, wheat or oats, and clover, the purpose being to produce as much corn as possible without depleting the productiveness of the soil. The growing of cow-peas, soy beans, and alfalfa does much to maintain the humus supply, and the phosphoric-acid content is maintained by the use of artificial fertilizers, which are usually applied to the land at the time of the sowing of wheat. The phosphatic fertilizers are more often applied to the lighter colored soils and usually contain 6 to 8 or 10 per cent phosphoric-acid. Applications range from 150 to 200 pounds per acre. It is generally conceded that the use of these fertilizers improves both the yield and quality of wheat. Fertilizers high in potash, or muriate of potash at the rate of 100 to 150 pounds per acre, are sometimes applied to corn on the "black lands," particularly where the soil is high in organic matter or "chaffy." The application of lime in the

form of ground limestone at the rate of 2 to 4 tons per acre has been especially beneficial to the "clay land" for the correction of acidity of the soil. Commercial fertilizer, if depended upon alone for increasing crop yields, will ultimately injure, rather than improve the soil, but if used judiciously in connection with the growing of clover and other legumes, to enrich the soil in humus, they in general, increase the productiveness of the land. In 1909, a total of \$12,580, or an average of \$40.98 for each of the 307 farms reporting outlay, was expended for fertilizers in Grant County.

The total number of farms in the county in 1909 was 2,886 of an average size of 85.5 acres each. The value of all property on each farm averaged \$10,629, of which 74.3 per cent represents land, 14 per cent buildings, 2.2 per cent implements, and 9.5 per cent domestic animals. The more improved farms exceed this valuation many times. The farm houses in Grant County are commodious and sometimes elaborate. The barns and other outbuildings afford ample rooms and convenience for handling the crops and live stock. The farms in the oil-bearing section, or the eastern and southeastern parts, of the county were neglected during the more prosperous years of the oil boom, when returns from leasing the lands for oil were far in excess of the profits obtained from farming. These farms are gradually being brought up to a higher standard of improvement.

Wages of farm hands vary with the character of the work and length of service. Harvest hands are paid \$1.50 to \$2 or more a day. The average wages by the month range from \$25 to \$30, in addition to board or a house, the keep of a horse and cow, and a garden patch. The labor is generally efficient and laborers are expected to handle all kinds of farm machinery. A large percentage of the farm work is done by the owner and his family. The total expenditure for labor in Grant County in 1909 was \$264,670, an average outlay of \$176.92 for each of the 1,496 farms reporting.

The census of 1910 shows 64.4 per cent of the farms of the county to be operated by owners, practically all the remainder being operated by tenants. The average rental for improved farms is \$6 or \$8 an acre. In many cases two-fifths or one-half of the grain goes to the owner, with a cash consideration for the use of pasture and hay lands. Usually, however, when a farm is operated on a share basis the net proceeds are divided equally between tenant and owners.

The price of land varies with its location and state of improvements. The average value in 1910, as given by the census was \$92.32 an acre, but it is doubtful if any improved land can be bought for that price at the present time. Land values vary from \$125 to \$250 an acre, the average improved farm bringing from \$150 to \$175 an acre. Grant County is in a highly developed condition and not many of the farms are offered for sale.

### SOILS.

The upland soils of Grant County are derived directly from glacial till, while the alluvial or bottom lands include reworked, stream-deposited material from the uplands. On account of their depth, the underlying rocks have added but little to the various soil materials, other than that which they contributed originally to the ice-ground mantle of glacial drift which covers the area to a depth ranging from about 10 to 200 feet. This heterogeneous mass, which consists chiefly of silt and clay interspersed with sand and gravel, was left as a surface mantle upon the recession of the ice sheet at the close of the late Wisconsin epoch. The material of the drift naturally varies with the character of the rocks over which the glacier passes; these include granite, gneiss, limestone, sandstone, and shale. Niagara limestone of the Upper Silurian age underlies the glacial drift throughout the county, and exposures occur along the banks of the Mississinewa River and in the stream bed, particularly north of Marion. Well borings indicate its existence in other sections of the county. At various times, limestone quarries have been opened along the river, particularly in the vicinity of Marion, though only a few are now in operation.

Through the various agencies of weathering the glacial drift or till has been reduced to its present condition. In Grant County, to an average depth of 18 to 20 inches, the till is a rather uniform silt loam or silty clay loam, passing into a silty to sandy clay substratum. Below a depth of 3 feet the material is usually more friable, being an intermixture of silt, clay, sand, gravel, and angular stone fragments, more or less clacareous, as shown by effervescence in hydrochloric acid. Where the drainage is well established the surface material is generally light colored; otherwise it ranges from dark brown to black. In addition to weathering, the processes of chemical action, oxidation, and leaching are factors in the development of the various upland soils. These

are generally classed locally as "clay lands" (embraced in the Miami and Crosby series) and the "black lands" (included with the Clyde series), the former being the lighter colored, better drained soils, generally deficient in organic matter, and the latter comprising flat, low-lying, poorly drained soils with high organic-matter content.

The terrace soils, classed in the Fox series, include some of the best drained and most highly oxidized types in the county, excepting perhaps the Bellefontaine soil of the uplands, the latter being very similar to the Fox in character of material and color, but somewhat more irregular in surface relief.

The first-bottom soils, which are classed in the Genesee series are formed largely of wash from the uplands and necessarily, have some characteristics in common with the upland soils. They are predominantly rather fine textured. The texture of the material, however, is variable over short distances, particularly along the Mississinewa River, and the general uniformity of the upland soils forms a marked contrast to the lack of uniformity in texture in the case of the reworked, stream-deposited material of the overflow lands.

The soils of Grant County are grouped under six series, the Clyde, Miami, Crosby, Bellefontaine, Fox, and Genesee. Under these series nine types are mapped, not including Muck and Peat.

The surface soils of the Miami series are light to medium brown, or grayish, in color and are underlain by brownish-yellow or dull yellowish-brown, heavier textured subsoils. The Miami soils in the main are derived through weathering from glacial till of a general calcareous nature, and usually the subsoil below a depth of 18 or 30 inches is distinctly calcareous. The surface drainage is usually good, but owing to the low content of vegetable matter the soil material tends to run together and become compact if plowed when wet, this property being especially characteristic of the silt loam and silty clay loam, the only two members of the series mapped in Grant County. It is from this tendency of the soil to become compact that the term "clay land" is applied to the Miami types. The topography of these soils is comparatively level to undulating, but in places somewhat hilly.

The surface soils of the Crosby series are light gray or light brownish-gray in color, rather compact in structure, and of an acid character. Below the surface soil is a subsurface layer, similar in character, but somewhat heavier in texture, and of a light ashen gray color. This stratum is specked and streaked

with brown, and black iron stains, or is gray mottled with yellowish brown, and the material is decidedly acid, as shown by repeated tests with litmus paper. Below 12 to 16 inches, a dull yellowish-brown, compact, tough subsoil, consisting usually of heavy silty clay, is encountered. In the lower depths, generally at 2 to 3 feet, the subsoil is rather friable and more or less calcareous. The Crosby series is developed in level to gently undulating country, where both surface run-off and underground drainage are deficient. The Crosby series is derived from the same calcareous till that in the better drained situations usually give rise to the Miami series and under poorly drained or stagnant-water conditions develops the Clyde soils. Of the Crosby series, two types, the silt loam (mapped as Miami silt loam, flat phase, in the soil surveys of Delaware and Tipton Counties) and the silty clay loam, are mapped in Grant County. The term "clay lands" is applied locally to the Crosby soils as well as to the Miami, the material showing an even greater to become compact when wet, or break up into large clods if plowed in this condition, than is true of the Miami soils.

The soils of the Bellefontaine series are brown at the surface, with yellowish-brown to reddish-brown subsoils. The substratum below 3 or 4 feet is generally composed of alternate layers of sand and gravel, or of an intermixture of these. The topography is undulating to slightly rolling, and the drainage, both surface and subsurface, is good. Only one type of this series, the Bellefontaine loam, is mapped in Grant County.

The surface soils of the Clyde series are dark gray to black in color, underlain by gray or drab subsoils, which are mottled with yellowish or rusty-brown streaks. The soils are developed in former lake beds and ponds, or low, poorly drained areas within glacial regions, through the accumulation of organic matter and the influence of poor drainage acting either upon the original glacial till of the basin or upon accumulations of water-laid material deposited over the floor of the basin. The surface is always level or depressed, the Clydes soils naturally having poor drainage, but where they are reclaimed, they are highly productive and include some of the best farm lands in the Middle West. Only one member of the Clyde series is mapped in Grant County, the silty clay loam, locally classed with the "black lands."

The Fox series, like the Bellefontaine, has brown surface soils and yellowish-brown to slightly reddish-brown subsoils. Below 30 to 36 inches, the substratum is loose and friable, usually con-



sisting of interbedded sands and gravel. The Fox soils have typically a level topography, being drained here and there, through potholes or by valleys eroded since the deposition of the materials as outwash plains or as terraces along streams within the glacial area or flowing out of it. The soil material consists largely or wholly of glacially derived material. Only one member of the series, the Fox loam, is mapped in this county.

The Genesee series includes dark-brown to grayish-brown alluvial soils occurring as first-bottom lands along the Missis-sinewa River and its tributaries. The soils of this series are subject to annual or at least frequent overflows. For the most part, however, the overflows accrue between the harvesting and planting seasons. Of the Genesee series the loam and silt loam types are mapped in Grant County.

The miscellaneous classification of Muck and Peat includes areas, of small extent and widely scattered over the county, where the material consists wholly or largely of organic plant remains in varying stages of decomposition.

The following table gives the name, acreage, and proportional extent of each type mapped:

AREAS OF DIFFERENT SOILS

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Clyde silty clay loam.....	89,472	34.0	Fox loam.....	3,648	1.4
Crosby silt loam...	53,568	20.3	Genesee loam....	3,008	1.1
Miami silty clay loam.....	48,832	18.5	Bellefontaine loam.....	704	.3
Miami silt loam....	38,336	14.5	Muck and Peat..	640	.2
Crosby silty clay loam.....	20,608	7.8			
Genesee silt loam..	4,864	1.9	Total.....	263,680	.....

## MIAMI SILT LOAM.

The surface soil of the Miami silt loam to a depth of 6 to 8 inches is a light-brown to brownish-gray silt loam, passing rather abruptly into a yellow to brownish-yellow friable silt loam, which extends to a depth of 8 to 12 inches and is in turn, underlain by a brown silty clay loam, mottled with drab. This grades into a darker brown silty clay. Below 20 to 24 inches, the typical dark-brown silty to sandy boulder clay is encountered. This although,

stiff and heavy, readily breaks up under pressure, owing to an appreciable content of coarse sand and fine gravel. The coarser material increases with depth to about 30 to 36 inches, where a more heterogeneous admixture of clay, sand, gravel, and rock fragments of a gray to drab color, is encountered. The rock fragments are generally calcareous and effervesce readily when tested with hydrochloric acid. In the vicinity of stream courses, pockets of stratified sand and gravel occur, which are commercially developed as gravel pits.

The type is, in general, quite uniform, except where erosion has been sufficiently active to expose the coarser subsurface material at the surface, in which situations small rock fragments may occur in patches along with the boulder-clay exposures, as is the case at the heads of certain gullies and along some of the steeper stream slopes.

The Miami silt loam is most typically and extensively developed in the vicinity of the Mississinewa River, particularly in the northern and northwestern parts of the county. It also occurs extensively along the general course of Pipe Creek. The type occurs in every township in the county except Van Buren, and covers a large proportion of Pleasant, Richland, Mill, Jefferson, Center, and Fairmount Townships.

The topography of the Miami silt loam varies from almost level to slightly undulating to rolling or hilly, the greatest relief being developed along the river bluffs and the larger creeks. The typical Miami silt loam is undulating to rolling, but where flat areas occur near the deeply cut stream channels the subsurface drainage is frequently sufficient to permit the necessary oxidation so that the typical Miami is developed, distinguishing the type from the Crosby silt loam, which occurs in similar situations but where subsurface drainage is deficient.

The Miami silt loam includes some of the best drained upland in the county and drainage is adequate for all crops. The steeper slopes along the streams occasionally need protection from erosion by terracing, but for the most part the type is not excessively drained.

Practically all the Miami silt loam is under cultivation, the exceptions being occasional patches of timber or woodlots which are preserved on most farms for shaded pasture and as a source of wood for domestic use. These wooded areas frequently include land of the rougher topography.

Wheat, oats, and hay are the principal crops grown on the

Miami silt loam. The type embraces some of the most productive wheat lands in the county, although the present yields are considerably lower than those which were obtained from the early clearings. Corn is not so generally grown as wheat and oats, as it gives lower yields than on the darker colored soils, although the lower yield is said to be compensated for in part by better quality,, or feeding value. The use of the type for corn has increased in the last few years, since corn has become the most profitable crop in the farming system of the county.

The Miami silt loam is adapted to a wider range of agricultural use, and when properly handled the yields over an extended period compare favorably with those of any other type in the county, since this type is not so readily affected by extremes of wet and drought. As the Miami silt loam is well drained, crops mature earlier and more fully than on the more poorly drained soils, and a better tilth is possible.

The ordinary yield of wheat is from 20 to 25 bushels per acre,<sup>1</sup> although where commercial fertilizer is used yields are generally higher. The wheat grown is of good quality. Oats produce from 35 to 50 bushels per acre. Oats are not so likely to lodge on this type as upon the darker soils and the quality of the oats is better. Timothy and clover mixed produce from 1 to 2 tons of hay per acre, the average yield being about  $1\frac{1}{3}$  tons. Corn yields on the average about 37 bushels per acre, although a return of 50 bushels per acre is not uncommon in favorable seasons, following the use of fertilizer upon wheat.

The Miami silt loam, next to the Bellefontaine loam, is the easiest of the upland soils to cultivate, and a loose, mellow seed bed can be obtained if care is taken to plow when the moisture content of the soil is favorable. If it is plowed when too wet large clods are formed which cannot be easily reduced by subsequent cultivation. This unfavorable tendency, however, is not so great as with the Miami silty clay loam, which has a higher content of clay and is more deficient in humus.

The resulting increased yields and better quality of the grain have led to a more extensive use of commercial fertilizers upon the wheat lands at the time of seeding. As upon the other, lighter colored soils, fertilizers high in phosphoric acid, containing from 8 to 10 per cent, are applied at the rate of 150 to 200 pounds

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1. The statements made in this report as to yields of crops are based upon estimates obtained from farmers.

per acre. Some prejudices exist in regard to the employment of commercial fertilizers, but their use is increasing.

Few transfers of real estate have been made upon this type in recent years, but farms upon which it occurs are valued by the owners at \$100 to \$150 an acre. In the vicinity of the towns and villages, and where the farms are well improved, \$200 an acre or more is asked.

The Miami silt loam is well adapted to alfalfa, soy beans, and other legumes, particularly where ground limestone is applied to the soil to correct any acid condition which may exist, and their culture could well be extended. Clover, though valuable as a soil-enriching crop, does not meet the full requirements for maintaining maximum crop yields. It has been shown by local tests that alfalfa turned under is more beneficial than clover for soil enrichment.

#### MIAMI SILTY CLAY LOAM.

The surface soil of the Miami silty clay loam to an average depth of 7 to 8 inches is a brownish-gray, compact, heavy silt loam, which on drying, becomes light gray at the surface. The subsoil in turn to a depth of 10 or 12 inches is a friable silty clay loam, and grading into stiff, heavy, rather plastic silty clay, dull yellowish-brown in color, streaked with gray and rusty brown. Below 16 to 20 inches, the color is predominantly brown, and the material when treated with dilute hydrochloric acid effervesces rather freely, indicating calcareous influence. In the lower depths brown to black shale, and occasional limestone, fragments are encountered. Exposures of the underlying material below 4 to 5 feet are dull gray, similar in color to a ledge of the Niagara limestone if viewed at a distance. The term "clay land" applied to all the lighter colored soils, is particularly applicable to this type, it probably carrying a higher content of clay than any other type in the county.

The Miami silty clay loam occurs chiefly in the north and east-central parts of the county, being confined almost exclusively to that portion east of the Mississinewa River. Its main development is in Washington, Center, Monroe, and Jefferson Townships, where it occurs as the predominant type. It occupies a large proportion of the rolling to hilly uplands and for the most part is more broken in topography than the Miami silt loam, although the slopes are precipitous only in the immediate vicinity of, or adjacent to, stream channels. The uneven character of the

surface usually assures ready drainage, and drainage for the most part is adequate for the general-farm crops to which the type is adapted. The tough nature of the subsoil retards somewhat the downward movement of any excess of moisture, so that the underground drainage is not always as good as the surface would suggest. In wet seasons the soil is sometimes saturated upon slopes, in situations where the Miami silt loam or Bellefontaine loam would be adequately drainage. The pale-yellowish and gray mottling of the upper layer of the subsurface material is a manifestation of this water-logged condition.

In point of extent the Miami silty clay loam ranks third (?) in the county. Practically all of the land is cleared and in use for general-farming purposes. Only a small proportion of the type is too rough for cultivation, and this is used for pasture. Some of the steeper slopes that were formerly cultivated have been given over to permanent bluegrass pasture. The type is used largely for wheat, oats, and hay, timothy being the main hay crop. Corn also is extensively grown, the yields, however, being considerably lower than upon the darker soils, particularly in wet seasons, as in 1915.

The agricultural use of the Miami silty clay loam is restricted almost entirely to general farming, although two of the largest dairy farms in the county are located upon this type in the vicinity of Marion.

The yields of wheat vary from 15 to 25 bushels per acre, the average being about 19 bushels. Oats average about 30 bushels to the acre, although larger yields are frequently obtained. The yields of corn vary from 25 to 40 bushels per acre, with an average yield of about 35 bushels. Timothy, the main hay crop, yields 1 to 1½ tons of hay per acre.

Commercial fertilizers, as in the case of the other lighter colored soils, are applied to part of the wheat lands on the Miami silty clay loam, and their use could be extended with profit.

Prices of land in the eastern part of the county were unstable for several years following the discovery of petroleum, and farms were rated above their present value for agricultural purposes. During the period of the oil boom many of the owners abandoned their farms to live in Marion and the small towns. Now that the oil is largely exhausted land values have again become stable and \$100 to \$150 an acre is asked for farms located upon the Miami silty clay loam.

The extensive growing of timothy for hay on the Miami silty

clay loam has done much to deplete the soil of its humus content. Growing alfalfa more extensively to be plowed under would do much to increase the present impoverished content of organic matter.

#### CROSBY SILT LOAM.

(Mapped as Miami silt loam, flat phase, in Delaware and Tifton counties.)

The soil of the Crosby silt loam to an average depth of about 8 inches is a compact silt loam of a "leached" or light-gray color when dry, but darker or broonish-gray when moist. The sub-surface material to 12 or 15 inches is somewhat heavier in texture, or a light silty clay loam, and typically is characterized by a mottling of pale-yellow or yellowish-brown and gray, and is decidedly acid. Below this to an average depth of 24 to 30 inches the subsoil is a yellowish-brown to rusty-brown, compact, tough silty clay, streaked somewhat with gray, and grading in the lower depths into a more friable silty to fine sandy clay, darker brown in color. This stratum below 3 feet becomes still less compact, and lighter in color and contains an appreciable amount of sand and fine gravel. The latter material is distinctly calcareous, as shown by its effervescence with hydrochloric acid, the reaction being naturally more vigorous with the coarser particles, which are more often fragments of limestone or chert.

The Crosby silt loam is confined almost exclusively to the western and southwestern parts of the county or that portion west of the Mississinewa River. It occurs for the most part in irregular, disconnected bodies a few acres to several hundred acres in extent, and is widely distributed. The largest development of the type being in Pleasant, Richland, Green and Liberty Townships. Where the Clyde silty clay loam is most extensively developed the areas of Crosby silt loam are small, and very irregular in outline, with a flat surface, and the type is but slightly elevated above the surrounding Clyde soil. It is in these situations that the typical Crosby silt loam is developed, which is naturally poorly drained. Where the bodies are more extensive the topography is not usually so flat. It is somewhat undulating, the soil is better drained, and the line of demarcation between the Miami silt loam and the Crosby silt loam is less distinct, so that the graduation from one type to the other frequently necessitates the drawing of an arbitrary line of separation. The distribution of the Crosby silt loam has a direct relation to the

natural drainage development, the surface and underground drainage of the type being generally deficient.

Owing to the extent and wide distribution of the Crosby silt loam it is one of the most important soils of the county, practically all of the type being under cultivation. It is used for growing all the grain crops, as well as clover and timothy, but the yields are considerably lower than upon the darker soils except in the case of wheat. This grain shows more adaptation to the lighter soils and so far as practicable the type is used for wheat. When first brought under cultivation the soil was richer in organic matter and much more productive than at present, as is shown by the marked reduction in the yields of wheat. The natural store of humus has been depleted by the continued cultivation without rotation of crops and to this depletion of organic content is due the light color or leached appearance of the soil and its tendency to clod when wet. Owing to the acid condition of the soil and the inadequate drainage, difficulty is sometimes encountered in getting a full stand of clover. The acid condition may be corrected, in part at least, by the application of finely ground limestone.

The use of the type is restricted largely to general farming, since a large proportion of the farm land in the sections of the county where the type occurs is made up of this soil. Some specialized crops and fruits are grown, but preference for growing these products is generally given to the lighter textured, better drained soils of the county.

The average yield of corn upon the Crosby silt loam is from one-third to one-half less than upon the black lands, being between 35 to 45 bushels per acre. The yields of wheat vary from 15 to 30 bushels per acre, with an average of about 10 bushels. The ordinary acreage yield of oats is about 30 to 35 bushels, although larger returns are frequently obtained. The hay produced upon this type, particularly in the case of timothy, is of good quality and yields ordinarily from 1 to 1½ tons to the acre.

A commercial fertilizer containing from 8 to 10 per cent of phosphoric acid and 1 to 1 per cent of nitrogen, with a somewhat higher percentage of potash, is sometimes applied to wheat at the rate of 100 to 150 pounds per acre, but for the most part only barnyard manure is used, the latter being generally turned under with the clover sod.

The farms upon which the Crosby silt loam occur are generally well improved and as the type is closely associated with the

Clyde silty clay loam the two are rated close together in value, the usual selling price being from \$125 to \$200 an acre. There are but few farms for sale.

#### CROSBY SILTY CLAY LOAM.

The surface soil of the Crosby silty clay loam to a depth ranging from 5 to 10 inches, and averaging about 8 inches, is a gray, heavy silt loam or light silty clay loam. The surface material when dry has a leached or grayish-white appearance, indicating deficiency in humus, slow movement of soil moisture, and low state of oxidation. The upper subsoil is a dull yellowish-brown mottled with gray, silty clay loam, passing into a heavy silty clay which becomes quite tough at a depth of 16 to 20 inches. Below 24 to 30 inches the structure becomes somewhat more friable and the material quite calcareous, in contrast to the overlying material, which shows little or no presence of lime when tested with dilute hydrochloric acid. On the other hand, a decided acid reaction is apparent when a moist sample of the surface or sub-surface material is tested for acidity with litmus paper. This type, along with the other lighter colored soils, is locally called "clay land", the term being more applicable to this type than to the lighter textured soils.

The Crosby silty clay loam is more extensively and typically developed in Van Buren Townships in the northeastern part of the county. The same development extends into Monroe and Washington Townships, and there are smaller detached areas in Jefferson, Center, and Mill Townships. No areas of the type are mapped west of the Mississinewa River, it being confined almost exclusively to the broader level or flat to slightly undulating drainage divides which characterize the topography of the northeastern and eastern parts of the county and correspond to similar surface features of the Crosby silt loam as mapped in the southern, southwestern, and western parts of the county. As the topography is level or only slightly undulating the natural drainage is in few places adequate for the full development of the type, although the water table has been lowered and better drainage established through the drainage of the depressions, or flats and sloughs, occupied by the associated Clyde silty clay loam type. Frequently the Crosby soil is elevated only a few inches, or at most a few feet, above the surrounding more poorly drained Clyde soil.



Owing to its extent and wide distribution the Crosby silty clay loam is one of the important soils of the county. Practically all of the type is under cultivation. Although it is largely used for corn the soil is best adapted to the small grains—wheat or oats—which are used largely as nurse crops for clover, timothy being grown with the clover.

The type is restricted to general farming, to which use it is best adapted. The growing of specialized crops has received little or no attention.

The yields upon the Crosby silty clay loam are about the same as those on the other lighter colored soils, or, in the case of corn, from one-third to one-half lower than upon the "black lands." The ordinary yield of wheat is from 15 to 20 bushels per acre, although a return of 30 bushels is not uncommon. Oats yield from 30 to 35 bushels per acre, and the average yield of hay is 1 to 1½ tons.

Practically the only fertilizer used is barnyard manure, although commercial fertilizers are sometimes applied to wheat lands at the time of seeding. The fertilizer used in general is high in phosphoric acid, containing 4 to 10 per cent, and is applied at the rate of 100 to 150 pounds per acre.

The value of land of the Crosby silty clay loam cannot be definitely determined from transfers of real estate, since the farms include varying proportions of "black land" soils. The ordinary price of land in the section of the county where this type occurs predominantly is from \$100 to \$175 an acre.

The growing of alfalfa and soy beans upon this type is especially desirable as a means of stocking the soil with organic matter and nitrogen. The plowing of the soil when wet is detrimental, as a good tilth cannot be obtained under such conditions.

#### BELLEFONTAINE LOAM.

The surface soil of the Bellefontaine loam to a depth of 10 to 12 inches is a brown to slightly reddish-brown, sandy loam to loam or silty loam, underlain by a similar or brighter reddish-brown, compact silty clay loam or clay loam. This in turn, grades into a lighter or coarser textured friable clay loam which at 30 to 36 inches is loose or incoherent, generally giving way rather abruptly to beds of sand and gravel, brown to light brown in color, and quite calcareous.

The type is developed only in the vicinity of the Mississinewa

River, frequently including some of the higher bluffs. The most extensive and typical areas are found to the southeast of Marion, east and northeast of Matthews, and 2 miles southwest of Upland.

The Bellefontaine loam occupies high, rolling areas with good surface as well as subsurface drainage. The type is all under cultivation, used primarily for corn, wheat, and hay. The yields are about the same as on the Miami silt loam. Crops upon this soil are not so susceptible to injury from either excessive rainfall or drought, the yields being about the same year after year, where similar methods of cropping are followed.

The yields of corn ordinarily are from 45 to 50 bushels to the acre. Wheat and oats make an average acreage yield of about 20 and 30 bushels, respectively. The type is well adapted to small fruits, tomatoes, potatoes, and other garden vegetables. Apples grown upon this soil, not only yield well, but are of good quality.

Farms upon which this type occurs are valued at \$125 to \$175 an acre, according to the location and improvements. Very few real-estate transfers, however, have taken place in recent years.

For the commercial growing of apples or peaches there is no better soil in this section of the state than the Bellefontaine loam. It should be well adapted to alfalfa, although no alfalfa fields were observed upon the type during the soil survey field work. It is probable that some of the gravel beds underlying this type will in the future be utilized, precluding the use of part of the type for agriculture.

#### CLYDE SILTY CLAY LOAM.

The surface soil of the Clyde silty clay loam is a grayish-black to black heavy silt loam or silty clay loam, grading at an average depth of 8 inches into a bluish-black silty clay loam. This in turn quickly passes into a slate-blue to drab silty clay. Below this, from 12 to 15 to 30 inches, the subsoil is light to medium gray in color and somewhat more stiff and plastic than the overlying clay. It is also mottled with rusty-brown streaks or iron stains, the mottling being more pronounced below 20 to 24 inches. At 30 to 36 inches the heavier clay gradually gives way to a more friable silty to fine sandy clay, which in turn may be underlain whitish-low-grade marl or by sand and gravel, the latter occurring at various depths, but usually at 6 to 8 feet.

The sand, gravel, and marl are all highly stained with iron compounds. The gravel beds usually follow the course of the

natural drainage and are not infrequently exposed with the dredging of the outlets by which the type is drained. In those parts of the county not traversed by morainic ridges these gravel deposits form one of the chief sources of surfacing material for roads.

The type is fairly uniform throughout the county, but owing to differences in position, natural drainage, and local treatment, it has certain variations in color, texture, and depth of soil. The texture is naturally heaviest where the depth of the soil is least, as in the larger, shallower basins, while the color is darkest in the deeper basins, or in the situations where conditions have been most favorable for the accumulation of organic matter deposited largely by surface waters carrying in suspension decomposed vegetation from the uplands. Small mucklike areas are not infrequently developed in the lower situations. Cultivation tends to alter both the color and the texture of the soil. From the dark color of the soil the term "black land" is applied to the type in contrast to the associated lighter colored "clay lands."

The Clyde silty clay loam occupies irregularly outlined depressions in the uplands. It occurs as the most extensive and widely distributed soil in the county, but its main development is in the southern and southwestern parts, particularly in Franklin, Liberty, and Sims Townships, about half the total area of which is occupied by this type. It is also extensively developed in Fairmount and Green Townships. In the remaining townships of the county the rolling topography and unfavorable natural drainage features have largely prevented the development of this type.

The surface of the Clyde silty clay loam is flat or low lying, with little or no natural drainage. The type was originally in a semiswampy condition throughout the wet season, but in summer usually dry, except possibly for the small "buttonwood" ponds, which were permanently swampy. This type was generally too wet for cultivation under natural drainage conditions, a fact which accounted for its slow development. Its farming possibilities were not understood until in the early eighties, when adequate drainage outlets were constructed, giving the individual farmer an opportunity to drain his land. The building of good roads through the type permitted the farmers to handle their crops to better advantage. Artificial drainage was first effected by open ditches, but as these interfered with the cultivation of the type in large tracts they have largely been replaced in recent years by underground tile drains. The drainage outlets, which

have followed the general course of creeks and branches, have been made more effective by the deepening and straightening of the stream channels. The larger streams are left open and carry off more readily the flood waters and accumulated discharge from the tiled ditches. The drainage of the type in the western part of the county is largely through Pipe and Deer Creeks, while in the eastern part, Black and Walnut Creeks dispose of the drainage waters. The clearing away of the forest growth and subsequent tillage have contributed to the improved drainage of the type.

The Clyde silty clay loam is not only the most extensive but also one of the most productive types in the county, and since practically all of it is under cultivation, ranks first in agricultural importance in the county. The particular adaptation of this soil to corn has increased its value. The ordinary yield of corn, the most profitable grain crop grown in the county, is from 10 to 30 bushels more than that generally obtained from the lighter colored soils. Tomatoes in favorable seasons produce their largest yields upon this type, though their firmness and keeping quality may not be so good as in the case of tomatoes grown upon certain other soils. Similarly increased yields are obtained with such crops as oats, cowpeas, soy beans, clover, and sugar beets. The type, however, is not so well adapted to wheat. The larger yields of forage crops and grasses, and of corn for ensilage, insure better returns from dairying and stock feeding than in the case of "clay lands."

Crops grown upon the Clyde silty clay loam usually mature later than upon the lighter colored soils, chiefly because of the ranker growth of vegetation due to the higher content of nitrogen or organic matter in the soil. Lateness in maturity is particularly true of tomatoes, which never mature a full crop. Frequently, not more than half the fruit is ripened before the vines are nipped by frost. Wet seasons still farther retard the development of the fruit, so that much of it specks or rots in the field.

Aside from the first bottoms lands, the Clyde silty clay loam is generally recognized as the best corn soil in central Indiana, if not in the State, and its use, so far as practicable, is restricted to this crop—often to the detriment of the soil. The increasing demand for corn for stock feeding and other purposes has led to the extensive planting of this grain, not infrequently to the exclusion of other crops, so that there is not sufficient crop rotation to maintain the productiveness of the soil. The practice of the one-

crop system is naturally more general with the tenants than with the farmers who operate their own land. The tenant system is being extended as capitalists from the towns and cities invest in farm holdings, the "black lands" or "corn lands" being among the most attractive investments because of their suitability to the production of corn and hogs, the leading income products of the farms.

The yields of corn upon the Clyde silty clay loam has varied from 40 to 80 or more bushels per acre, with an average of about 55 bushels. The ordinary yields of wheat seldom exceed 18 to 20 bushels and this crop is more subject to heaving and is more likely to be injured by ice and standing water than upon the better drained "clay lands." The heads also do not fill as well, although a heavier straw is produced. Oats yield from 30 to 50 bushels per acre, and the straw is heavier than upon the lighter colored soils. In wet seasons, however, the crop lodges badly, and there is considerable loss unless the growth can be utilized for hay or pasture. Alfalfa can be successfully grown on this type if proper attention is given to draining and turning the soil. Although the quality of the hay may not be as good, heavier yields will apparently be obtained from this type than from the lighter colored soils. More careful curing of the crop, however, will be required.

The Clyde silty clay loam, if properly handled, is capable of being reduced to a fine, mellow tilth, but if deep plowing is done while the subsoil is more or less saturated, clods are formed which cannot always be broken down by subsequent cultivation. Late springs, with excess of rainfall, too often tempt the farmers to work this soil before it becomes dry enough to turn and pulverize properly, and in this way the physical condition of the soil is frequently impaired for even more than one season.

Where commercial fertilizer is applied to this type, it is generally in the form of muriate of potash and at the rate of 100 to 200 pounds to the acre. Its use, however, is more general upon the "mucky" phases of the type, locally called "chaffy land," where the corn tends to burn or turn yellow and the crop does not properly mature.

The rapid increase in land values in this and adjoining counties has been due largely to the wide distribution of the productive Clyde silty clay loam throughout this part of the State. The value of individual farms is not infrequently determined by the included area of this "black land", which is valued at \$150 to

\$200 or more an acre, according to the proximity of the land to town or city and the character of the farm improvements.

### FOX LOAM.

The surface soil of the Fox loam to a depth of 12 or 15 inches is a brown loam or light silty loam, underlaid by a somewhat lighter brown, heavy silty clay loam or clay loam which becomes more friable or sandy below 20 to 24 inches. At about 30 inches the change to lighter material becomes more rapid, a loose, friable, sandy to fine gravelly loam being encountered here. This in turn passes into stratified layers of sand and gravel below 3 to 4 feet. In color and character of material, the Fox loam is very similar to the Bellefontaine loam, the main differences being in their topography and respective positions upon the river terraces and the uplands.

The Fox loam is known locally as second-bottom land, although it occurs upon both the second and third terraces above the river. Before the type was cleared of its native forest growth it was commonly called "sugartree flats" and included some of the first land to be cleared, it being, a strong, well-drained soil. The type is confined almost exclusively to the terraces of the Mississinewa River and Jocinah and Walnut Creeks. It is most extensively and typically developed along Jocinah Creek and the Mississinewa River in Pleasant Township, although small areas are scattered along the entire course of the river in this county. The city of Marion is in part located upon this type.

The surface of the Fox loam is generally level, or slightly undulating if the terrace has been eroded, but it is never rolling. It has sufficient relief to insure ample surface drainage and the open, porous nature of the substratum admits of the ready downward movement of any excess of moisture.

The fox loam, though not as extensive as some of the lighter colored upland types, is more productive and is well adapted to a wide range of agriculture. It is especially well suited to the growing of alfalfa. If its adaptation to this legume is understood, however, it is not practiced, since no fields of alfalfa were observed upon this type during the course of the soil survey. Corn is the main crop, although wheat and oats are also grown extensively. Crops are not as likely to be injured by excessive rainfall or drought as upon the heavier upland soils, and full maturity of the crop is generally assured.

The use of the type is largely restricted to general farming, although it is equally well adapted to the growing of truck, including potatoes, tomatoes, peas, and beans, and to fruit growing.

Commercial fertilizers containing from 8 to 10 per cent phosphoric acid, 1 to 2 per cent nitrogen, and about the same percentage of potash are sometimes applied to wheat, but for the most part the productiveness is maintained by the usual crop rotation, with an occasional application of barnyard manure.

The crop yields are fairly uniform from year to year, the ordinary yields of corn being about 40 to 45 bushels per acre, of wheat 20 to 25 bushels, and of oats 30 to 40 bushels.

The Fox loam is more sandy and friable than the silt loams and silty clay loams of the uplands and is easier to cultivate; a good tilth is readily produced.

Land of this type, along with the first-bottom lands or adjacent uplands, is valued at \$125 to \$250 an acre, according to the improvements and the proximity to Marion. Within the city limits of Marion the prices are naturally much higher.

#### GENESEE LOAM.

The surface soil of the Genesee loam to a depth ranging from 10 to 15 inches, and averaging about 12 inches, is a medium to dark-brown fine sandy loam to loam or silty loam. The upper subsoil is very similar to the surface soil in texture, but is usually lighter brown in color. Below 18 to 20 inches the substratum is frequently made up of horizontal beds of clay and sand.

Since the Genesee loam is an alluvial soil, both the surface soil and subsoil are quite variable over short distances, owing to differences in the movement of depositing stream currents at various flood stages. In the immediate vicinity of the streams and across the sharper bends where the currents are swift, coarser particles have been deposited, the soil in many places consisting of a medium to fine sand. Along the larger bends or in settling basing where the waters are less turbulent the deposition of the finer sediments gives rise to the heavier or silty phases of the type, which are usually somewhat darker in color. It is from the intermixture of the sand and silt that the Genesee loam is derived.

The type includes all of the overflow bottoms of the Mississinewa River and part of the first-bottom lands along some of its tributaries. The bottom lands are generally flat or level, cut

across by numerous creeks and branches tributary to the main stream. The drainage is fair to good throughout the greater part of the year, and for the most part admits of cultivation. In the lowlying situations, ditches have been constructed to carry off the excess water.

The Genesee loam is not so extensively developed as most of the upland types, but its high yield determines its importance. It is used largely for grain crops, particularly corn. Where it occurs in the vicinity of Marion and some of the larger towns it is used to some extent for trucking, the largest truck farm on the type being located in the northwestern corner of section 19, Washington Township. That part of the type not cultivated is utilized for pasture.

The lighter, sandy phases of the type are more often selected for trucking. Melons, cucumbers, potatoes, and tomatoes are among the most profitable truck crops. Only those crops are grown which can be matured between the flood periods, but overflows seldom come at such a season of the year as to interfere with the use of the soil for trucking. Corn is quite a profitable crop, since some of the largest yields in the county are not infrequently obtained from the bottom lands. Yields of 60 to 70 bushels are usual. The yields vary considerably with the character of the season and the cultivation which the crop received, the latter being somewhat dependent upon the lateness of the spring floods.

Some commercial fertilizers are used upon the truck crops where it is desired to force them to an early maturity. The annual depositions of alluvium, however, is the main source of the productiveness of this soil, and in consequence the crop yields have shown a decline since the land was first cleared and drained, largely owing to the tendency to cultivate corn to the exclusion of other crops.

The farms are in no case so constituted as to include exclusively first-bottom land, so that accurate selling values for the type cannot be given, but in association with adjacent soils it sells at \$100 to \$200 an acre, according to the location and the proportion of the type under cultivation.

With proper farm methods it is possible to bring practically all of the type under cultivation. It is claimed that the clearing of the bottom lands and the adjacent slopes is responsible in large measure for the destructive effects of floods in recent years. Surveys of the bottom lands and a study of the effect of clearing them



of the native forest growth have been made by the State in recent years. Some of the larger cities also have sent out engineering corps to study the effect of straightening and deepening the channels of the river, and improvements of this nature will affect the future development of this soil.

#### GENESEE SILT LOAM.

The soil of the Genesee silt loam to an average depth of 8 to 10 inches is a brown to dark-brown, heavy silt loam or, in places, silty clay loam. This grades into a very dark brown to almost black silty clay loam and this in turn into a drab to slate-blue, stiff, plastic clay, mottled with shades of brown or iron stains. The color of the substratum becomes lighter with depth. The brown stains are due in part to the decay of roots, which have penetrated the subsoil to various depths. The dark color of the soil is due to the accumulation of organic matter from decayed vegetation, these bottom lands having been originally low and semi-swampy in many places.

Where this type merges into the Clyde silty clay loam the boundary drawn is frequently an arbitrary one, to the similarity of these two soils in color and the very gradual change in texture. Where the type occupies old, partially filled-in valleys, its origin is not unlike that of the Clyde silty clay loam where the latter type occupies elongated or ponded areas. Adjacent to the stream channels and in the narrow necks of the valleys the surface soil is usually lighter textured than is typical. Where the currents during periods of overflow are swifter and can carry the heavier materials in suspension the soil is similar to the Genesee loam, though the material is heavier in the lower depths, where deposit was made by more sluggish currents.

The Genesee silt loam is most extensively developed along Lugar, Walnut, Black, Deer, Pipe, and Back Creeks. The type occurs as first-bottom land bordering the streams. Other less extensive developments of the type are found along the smaller creeks and branches. It occurs in narrow strips, even in the larger valleys seldom exceeding one-fourth mile in width.

The low-lying position of the type necessitated the installation of artificial drainage, which has been largely effected through the deepening and straightening of the natural drainage outlets by dredging. In addition, tiled laterals have been properly placed to carry off the excess surface water, and the greater proportion of type is now under cultivation.

Corn is the chief crop grown, and some of the largest yields in the county are obtained on the Genesee silt loam. The average yields, however, is about the same as that obtained from the Clyde silty clay loam, approximately 55 bushels per acre, although returns of 70 to 80 bushels per acre are not infrequent. Oats are grown to some extent and produce heavy yields, but frequently the full crop cannot be harvested because of lodging. Owing to the low position of the Genesee silt loam, wheat is likely to be injured by overflows is seldom grown. The type is one of the best grass sown in the county, and hay yields  $1\frac{1}{2}$  to 2 tons per acre. On the better-drained areas heavy yields of tomatoes are produced.

Owing to the heavy yields of corn produced and the slow depreciation in productiveness of the soil, the tendency is to grow corn to the exclusion of all other crops. Rotation is practiced only to a very limited extent.

When the season is favorable, a good tilth can be obtained with this soil, but too often when the spring planting has been delayed by late overflows or other wet conditions the soil breaks up in large compact clods which cannot be broken down readily by subsequent cultivation. This haste to get in the crop frequently impairs the physical condition of the soil for even more than the one season.

No fertilizer is applied to this soil, the deposition of sediment being the only source of added fertility aside from the plowing under of oats and corn stubble and the native vegetation. In many cases the addition of potash would increase the corn yields.

Land of the Genesee silt loam is valued, in association with the adjacent uplands, at \$100 to \$200 an acre, according to the location and the condition of drainage, or the general possibilities of development.

#### MUCK AND PEAT.

The type mapped as Muck and Peat represents mainly Muck, with included areas of Peat. The material consists of dark-brown to black accumulations of organic matter in different stages of decomposition, mixed with varying quantities of other transported soil material including silt, clay, and sand. The soil mass, however, is built up largely from the remains of cattails, rushes, mosses, sedges, grasses, and other water-loving plants which originally occupied and filled up the shallow lakes and ponds in which Muck and Peat now occurs. Muck and Peat 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 Muck is darker in color than the peat, and finer or smoother textured. The latter is more fibrous, consisting of a less decomposed mass of vegetable matter than the Muck, and is found where the organic material is deepest, generally near the center of the depressions. The depth of Muck and Peat varies from a few inches near the margin of the area to several feet in the deeper places. The organic material is generally underlain by a bluish-black, stiff, plastic clay, which grades below into a lighter-colored or grayish, mottled clay. Occasionally impure shell mark occurs embedded with the underlying material.

The bodies of Muck and Peat mapped are relatively small and widely distributed, although their occurrence is confined to the eastern half of the county. The largest and most typical development of the type is between Fairmount and Fowlerton. There are smaller areas skirting Lake Galatia; two miles southwest of Fowlerton; south and southeast of Gas City; 2 and 3 miles southeast of Upland, and  $3\frac{1}{2}$  miles southwest; and 3 and 4 miles northwest of Van Buren, and 3 miles southeast of that place.

The type occupies old filled-in valleys and shallow lakes and ponds which had no natural drainage outlets. Artificial tile drainage and subsequent cultivation have reclaimed most of the areas for cultivation or for use as pasture. These were formerly swamps throughout the greater part of the year. The native grasses which grew in the better-drained places were used by the early settlers for hay.

Muck and Peat at present is of little agricultural importance in the county, aside from its local value, owing to its limited acreage and lack of use for other purposes than general farming. No efforts have been made to develop the type for specialized crops, such as celery, cabbage, Irish potatoes, beets, turnips, cauliflower, and other vegetables, to which it is well adapted. The greater part of the areas brought under cultivation are used for corn, oats or timothy. Oats produce a rank growth but lodge badly. Corn sometimes "burns" or turns yellow without fully maturing, a tendency which can be largely corrected by liberal applications of barnyard manure and by the use of potash salts applied at the rate of 150 to 200 pounds per acre. Lime judiciously applied is also beneficial.

The Muck and Peat lands are never sold separately, but farms upon which they occur are held at \$125 to \$175 an acre.

## SUMMARY.

Grant County is situated a little northeast of the geographical center of Indiana. It has an area of 418 square miles, or 267,520 acres.

The surface varies from a level to undulating till plain broken only along stream courses, particularly those of the Mississinewa River and its larger tributaries, where the valleys are generally deep and narrow.

The Mississinewa River is the chief drainage outlet of the county. Artificial drainage has been installed extensively in the more poorly drained sections of the county.

The population of the county is reported by the 1910 census as 51,436, of which 26,337 is rural. Marion, the county seat and largest town, is situated on the Mississinewa River near the center of the county. It has a population of 19,359 and is an agricultural and industrial center. Gas City, Fairmount, Jonesboro, Van Buren, and Upland are other important towns.

An excellent system of sectionized, gravelled public roads extends over the entire county. Four steam railroads and two electric interurban lines provide adequate transportation facilities. The county is highly developed.

The climate is not subject to frequent very marked extremes of heat or cold. The annual mean temperature is 50.9 degrees Fahrenheit. The mean temperature for the winter is 28 degrees Fahrenheit, and for the summer, 72.2 degrees Fahrenheit. The average annual rainfall is about 36 inches, and is well distributed throughout the year. Five months is usually the duration of the growing season.

The agriculture of Grant County is in a highly developed state. Corn, oats, wheat, and hay are the main crops. The 1910 census reports a production of 3,299,221 bushel of corn, 985,806 bushels of oats, and 285,447 bushels of wheat, the area in each being 67,391, 30,646, and 16,840 acres, respectively. The area in hay and forage was 28,617 acres, which produced 41,037 tons. Barley, buckwheat, and flax have practically been abandoned.

The greater part of the corn and hay production is fed to stock upon the farm or sold locally, while oats and wheat are more often sold in the open market. The special crops include potatoes, tomatoes, and sugar beets. Live stock, particularly hogs, is the main source of farm income, so that the operations generally center upon the animal industries.

The value of livestock and livestock products for 1909 totalled

\$2,352,619, or \$66,637 more than the value of all cereals produced. The cultivation and harvesting of crops are done largely with the most improved labor-saving machinery. Rotation in some form is practiced by most farmers, the one usually followed including corn, wheat or oats, and clover. Commercial fertilizers are sometimes applied to the wheat lands.

The total number of farms in the county in 1910 was 2,886, of an average size of 85.5 acres each.

The ordinary farm wages vary from \$25 to \$30 a month or \$1.50 to \$2 a day for harvest hands, the total expenditure for the county amounting to \$264,670 in 1909.

The average rental for improved farms is \$6 to \$8 an acre, but only 34.4 per cent. of the farms are rented.

The average land value is given by the 1910 census as \$92.32 an acre, but well-improved farms sell for \$125 to \$200 or more an acre.

Six series of soils are recognized and mapped in Grant County. The Miami, Crosby, Bellefontaine, and Clyde soils occur upon the uplands, the Fox upon the terraces, and the Genesee in the first, or overflow bottoms.

The upland soils are derived directly from glacial till of the late Wisconsin stage, while those of the bottom lands and terraces are derived from reworked and redeposited material which represents wash from the uplands.

Of the Miami series, two types are mapped, the silt loam and silty clay loam. These are best adapted to wheat and oats.

The Crosby series include the lighter-colored, poorer-drained upland soils of which two types are mapped, the silt loam, and silty clay loam. These soils are decidedly acid.

The Bellefontaine loam is somewhat rolling and well-drained. It is adapted to a wide range of crops, but is especially well suited to fruit.

The Clyde silty clay loam is extensively developed. It is especially well adapted to corn. Good yields of oats and hay are also obtained.

The Fox loam occupies the higher terraces. It is well drained and is adapted to a wide range of crops, being particularly well suited to alfalfa.

Of the Genesee series, two types are mapped, the loam and silt loam, the latter in places being really a silty clay loam. These soils are best suited to corn, although oats and hay produce good yields. They are subject to annual or more frequent overflow.

The type of muck and peat is limited in extent and unimportant.