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UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Survey
of
Brown County, Ohio

By

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United States Department of Agriculture, in Charge

and

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Ohio Agricultural Experiment Station

Bureau of Chemistry and Soils
In cooperation with the Ohio Agricultural Experiment Station

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SOIL SURVEY OF BROWN COUNTY, OHIO

By EARL D. FOWLER, United States Department of Agriculture, in Charge, and
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COUNTY SURVEYED

Brown County is in southwestern Ohio, bordering Ohio River, and is the third county east of the Indiana State line (fig. 1). Georgetown, the county seat, is about 40 miles southeast of Cincinnati. In outline, the county roughly resembles a boot with the toe pointing to the southeast, and the narrow extension to the north is commonly known as the "boot leg." The extreme length north and south is approximately 43 miles, and the width across the central part of the county is approximately 19 miles. The total area is 495 square miles, or 316,800 acres.

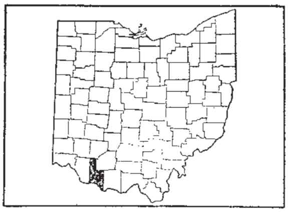

FIGURE 1.—Sketch map showing location of Brown County, Ohio.

The surface relief of the upland part of the county is that of a broad plain which maintains a comparatively uniform elevation, except in a belt bordering Ohio River and near the mouths of Whiteoak, Straight, and Eagle Creeks, where dissection has been so great that only comparatively narrow ridges and sloping hills mark the former level. In the extreme southeastern corner, dissection has been greatest, and, for a distance of 10 miles north of Ohio River, deep steep-sided valleys have been cut into all parts of the former plain. The divides are sharp, narrow ridges, most of them much less than one-fourth mile wide. Farther from the larger streams, in the central and northern parts of the county, the divides are broad and comparatively level, the largest extending northward from Hamersville to East Fork Little Miami River near Fayetteville, and thence eastward. Another broad divide extends northward from the vicinity of Georgetown to Brownstown, thence eastward to the county line. Very shallow depressions are scattered over these broad divides, and, in places, small low-lying rounded knolls are striking features. A few of these knolls, about 2 miles north of Georgetown, rise from 20 to 30 feet above the surrounding land, but in most places they are less than 15 feet high and many of them are only 2 or 3 feet high.

The canyonlike valleys of the principal streams emptying into Ohio River are one-fourth mile or less wide and from 300 to 400 feet deep. During floods, water from Ohio River backs up these larger valleys for a distance ranging from 1½ to 3 miles. Within 10 or 12 miles from the mouths of even the larger tributary streams, the valleys are less than 100 feet deep, and the streams are much more sluggish as the valley heads are approached.

Benches which differ considerably in width have been formed at different levels along all the larger streams, those along Ohio River broadening to a width of 1 mile at the mouths of some of the larger tributaries and those in other places being mere remnants of the former stream bottom. The low benches are subject to annual overflow, but above these, in places, are two or three higher benches which are above normal overflow. Comparatively narrow remnants of benches, lying at two or more different levels, extend far up toward the heads of some of the larger creeks.

Ohio River receives all the drainage water from the county, most of it directly from four tributaries. Although the smaller drainageways do not reach all parts of the broader divides, nearly all farms are within 1 or 2 miles of natural drainage outlets. Under natural conditions, surface run-off and internal drainage are very slow over the greater part of the broad comparatively flat uplands, but in the rougher sections drainage is very rapid and is sometimes destructive to crops and soils on the steep slopes.

The highest part of the county is the eastern, where a maximum elevation of a little more than 1,100 [1] feet above sea level is reached at a point 1 mile north of Ash Ridge. At Macon the elevation is 1,073 feet. The elevation of the rest of the uplands is comparatively uniform, ranging from 900 feet at Saint Martin in the northern part to 968 feet at Hamersville in the western part and 935 feet at Georgetown in the south-central part.

The 500-foot contour level passes through all the Ohio River towns. The high-water mark of Ohio River, recorded in 1913 at Aberdeen, was 519.5 feet above sea level; at Higginsport it was 513.5 feet. The lowest point in the county, approximately 450 feet above sea level, is in the southwestern corner at low-water mark of Ohio River.[2]

The county was originally forested with an excellent stand of hardwood trees, but most of the virgin forest has been cut, only small scattered patches remaining as evidence of its character. The uplands, valley slopes, and bottom lands each have their characteristic vegetation.[3]

The principal trees on the gray upland flats are pin oak, white oak, sweetgum, sour gum, red maple, swamp white oak, shellbark hickory, beech, and some white elm and white ash. Either pin oak, white oak, sweetgum, sour gum, hickory, or beech may dominate locally, but where beech or white oak dominate the areas are either better drained or the trees stand on low knobs, and in such places large beech tree roots lie on the surface. The purer stands of white oak are, for the most part, more or less open and grassy. The undergrowth on these gray flats consists of saplings, briers, weeds, bulrushes, large blue lobelia, and various other herbaceous plants. In areas which are reforesting, the tree growth consists of white elm, pin oak, red maple, sweetgum, sassafras, and swamp white oak, with a rather dense undergrowth of saplings, briers, hazel, poison-ivy, sedges, and coarse grasses. Locally on these flats are small areas of dark-gray soils occurring in shallow depressions, and these support a growth of red maple, pin oak, white elm, shellbark hickory, and water beech, and, in most places, a thick undergrowth of saplings, briers, ironweed, wild grapevines, and herbaceous plants. The meadow vegetation on the gray flats consists of broomsedge, needle

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[1] Elevations from topographic sheets, U. S. Geological Survey.

[2] Records of the U. S. Army engineers, of Ohio River, from Pittsburgh, Pa., to its mouth.

[3] BRAUN, E. L. THE PHYSIOGRAPHIC ECOLOGY OF THE CINCINNATI REGION. Ohio Biol. Survey Bull. 7, v. 2, no. 3, pp. [113]–[212], illus. 1916.

or poverty grass, redtop, goldenrod, blackberry, Spanish-needles, and other weed pests, and around the intermittent shallow ponds are buttonbush, sedges, rushes, and coarse grasses. In the drier meadows, trumpetcreeper is common in places and becomes a serious weed pest if allowed to spread.

The better drained uplands support a forest consisting chiefly of beech, white oak, red oak, black oak, sugar maple, and hickory, with numerous wild cherry, sassafras, blue ash, tuliptree, basswood, and black walnut.

The tree associations on the valley slopes differ considerably with the steepness, dryness, rockiness, and direction of the slopes. The principal species are sugar maple, white oak, red oak, tuliptree, black locust, beech, red elm, and less commonly red cedar, wild cherry, basswood, honeylocust, and dogwood. Ferns, lichens, mosses, and briers comprise the undergrowth around springs or where seepage occurs on the slopes. A second growth of black locust is common on the slopes, and reproduction of this tree progresses rapidly. The greater part of the bottom lands has been cleared, but scattered trees of sugar maple, beech, black walnut, tuliptree, blue ash, red elm, and sweet buckeye give evidence of the original tree growth on the second bottoms, or benches. The flood plains and stream margins support a growth of sycamore, willow, silver maple, cottonwood, and some elm, ash, walnut, boxelder, and buckeye.

Settlement began in this part of the country in the latter part of the eighteenth century, the early settlers coming chiefly from Kentucky, Tennessee, Virginia, Pennsylvania, New Jersey, and Maryland. They established themselves along Ohio River near the mouths of its tributaries, and by 1805 most of the choice tracts were taken in this part of the county, but as late as 1828 large tracts of the flatter lands to the north remained unsurveyed and unoccupied.[4] Brown County was organized in 1818 from parts of Adams and Clermont Counties. It is now divided into 16 townships. The county was without a railroad until 1877, when the Cincinnati & Eastern Railway reached Mount Orab along the present route of the Norfolk & Western.

The inhabitants are chiefly descendants of the early settlers, although many families from Kentucky have settled in the southern part in recent years. The total population has decreased since 1880, when the census reported 32,911 inhabitants. The population in 1930 was 20,148, all classed as rural, with 12,857 classed as rural farm and 7,291 as rural nonfarm. The density was 42 persons a square mile. The population is more sparse on the flatter parts of the uplands. Georgetown, the county seat, near the central part of the county, has about 1,600 inhabitants. This town and Mount Orab and Sardinia to the north are the principal railway shipping points. Hamersville, Russellville, Fayetteville, and a number of other small towns are local trading and shipping points, and Ripley is the most important town along the Ohio River.

Transportation facilities are fair. The Norfolk & Western Railway and the Cincinnati, Georgetown & Portsmouth Railroad serve the central and northern parts. Each of the river towns has a land-

[4] MORROW, J. THE HISTORY OF BROWN COUNTY, OHIO. . . . pt. 3, illus. Chicago. 1883.

ing for river boats and public ferries to the Kentucky side, where a line of the Chesapeake & Ohio Railway connects with Cincinnati. A new bridge over Ohio River between Aberdeen, Ohio, and Maysville, Ky., is under construction (1930). This is particularly advantageous to residents of the southern part and also to the entire county because a large part of the tobacco crop is sold at Maysville. River transportation has been greatly benefited by the recent completion of a series of dams and locks, which assures a minimum 9-foot water stage throughout the year. There are a number of bus and truck lines operating on regular schedules and serving almost every community.

The main public highways are well improved and maintained. Many are surfaced with crushed stone, gravel, and tar-bound macadam. Four United States highways, No. 52 along Ohio River, No. 50 across the northern part of the county, No. 68 extending north and south through Fayetteville and Mount Orab, and No. 62 extending north and south through Russellville, together with a number of State highways, form the main system of intersecting and improved roads. The secondary road system is well laid out, and these roads are, for the most part, improved. Provision has been made for the gradual extension of improvements to all the unimproved districts, and within a few years all sections should be readily accessible throughout the year.

Many farm homes have telephones and radios, practically all families receive free delivery of mail, a large number have electricity, and high-tension power lines are being extended to many communities. The school system ranks high, and several good consolidated schools are located in different townships, although in a number of districts grade schools are still in use. A school for boys is located at Fayetteville and one for girls at Saint Martin. Denominational churches are well distributed.

A marble-works factory and a shoe factory at Georgetown, two loose-leaf tobacco markets and warehouses at Ripley, and a sawmill at Sardinia are the most important business enterprises.

CLIMATE

The climate of Brown County is favorable to agriculture, although it is marked by extremes of temperature. High temperatures are not uncommon in late summer, and periods of zero and subzero temperatures occur during most winters, but these extremes are of short duration.

The annual snowfall is low, and the rainfall is normally sufficient and well distributed during the growing season, although periods of drought in July and August and excessively wet periods in the spring and early summer occur in some years. Complete crop failures are unknown, but in some years heavy losses are sustained locally, owing to droughts, to floods in the bottom lands, to heavy rains on the unprotected hill land and valley slopes at planting time, and to long-continued wet periods which sometimes delay planting, cultivation, or harvesting.[5]

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[5] According to data of the U. S. Weather Bureau station at Cincinnati, a total of 14 excessively wet springs and 10 abnormally dry periods in late summer occurred between 1835 and 1923.

The length of the frost-free season varies considerably in southwestern Ohio, as evidenced by the records of the United States Weather Bureau at different stations. The variations seem to be due chiefly to differences in relief which affect the soil and the air drainage. At an elevation of 645 feet at Peebles, in Adams County, 14.5 miles east of the Brown County line, an average frost-free season of 155 days is recorded; at the Batavia station, at an elevation of 850 feet, 7 miles west of the Brown County line, an average of 178 days is recorded; the Camp Dennison station, in the valley of Little Miami River in eastern Hamilton County, has an average of 173 days; and the Mount Healthy station, on the uplands north of Cincinnati, 179 days. In the valleys of Ohio River and its larger tributaries, heavy fogs sometimes exert a moderating influence on frosty nights, and deep valleys create excellent air drainage outlets for the surrounding hill land, so that early or late frosts are prevented or moderated in their effects.

As a rule, moderate westerly winds prevail, although occasionally, during the spring, summer, or early fall strong winds accompany local thunderstorms and some storms reach destructive velocities. Hail sometimes accompanies the storms, damaging corn, tobacco, or other crops in small areas.

Tables 1 and 2, compiled from the records of the Weather Bureau stations at Peebles, in Adams County, and at Batavia, in Clermont County, respectively, give the more important data which may be considered representative of climatic conditions in Brown County.

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

[Elevation, 645 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1930)	Total amount for the wettest year (1921)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	34.0	76	−31	3.74	1.43	5.59	4.7
January	31.8	73	−26	4.10	4.28	3.35	7.7
February	34.0	76	−13	2.88	3.23	2.83	4.6
Winter	33.3	76	−31	10.72	8.94	11.77	17.0
March	42.1	82	−8	3.88	3.20	5.61	4.0
April	52.0	91	12	4.10	1.53	4.10	1.1
May	61.5	97	24	3.72	1.20	1.77	
Spring	51.9	97	−8	11.70	5.93	11.48	5.1
June	69.9	100	33	3.94	.57	4.75	
July	73.5	102	41	4.40	3.46	8.80	
August	72.3	103	34	4.41	3.73	7.87	
Summer	71.9	103	33	12.75	7.76	21.42	
September	65.8	100	27	3.10	2.92	8.03	
October	55.2	95	17	3.02	.86	1.91	.3
November	42.7	78	6	2.91	1.71	6.90	1.2
Fall	54.6	100	6	9.03	5.49	16.84	1.5
Year	52.9	103	−31	44.20	28.12	61.51	23.6

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation at Batavia,*[1] *Clermont County, Ohio*

[Elevation, 850 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1930)	Total amount for the wettest year (1929)
	°*F.*	°*F.*	°*F.*	*Inches*	*Inches*	*Inches*
December	33.9	64	−19	3.19	1.32	2.57
January	30.9	69	−19	3.26	3.87	3.40
February	34.4	74	−10	1.94	2.72	1.58
Winter	33.1	74	−19	8.39	7.91	7.55
March	43.2	78	3	3.02	1.68	2.01
April	53.3	84	18	3.46	1.98	4.16
May	62.1	91	33	3.78	1.27	9.08
Spring	52.9	91	3	10.26	4.93	15.25
June	70.8	93	41	4.08	.80	5.17
July	75.0	100	48	3.24	1.29	7.60
August	73.2	102	48	4.56	1.68	1.81
Summer	73.0	102	41	11.88	3.77	14.58
September	67.9	97	32	2.70	2.60	6.17
October	56.4	91	25	3.19	.73	2.94
November	44.0	76	10	2.86	1.44	4.85
Fall	56.1	97	10	8.75	4.77	13.96
Year	53.8	102	−19	39.28	21.38	51.34

[1] Station located on the Clermont County experiment farm which is surrounded by rolling country and is 4 or 5 miles north of the town of Batavia.

AGRICULTURE

Agriculture has remained the dominant industry in Brown County since the first settlements were made. The very earliest agriculture was governed by the necessity of the pioneers to provide for their living. As markets were distant and prices low, few products were sold. During this early period, corn, wheat, hay, and flax were the principal crops, and corn has continued to be the most important crop, both in acreage and in value.

The largest acreage of corn was reported for 1899, when 58,929 acres were devoted to this crop and the average acre yield was about 29 bushels. The 1930 census reports 45,417 acres of corn harvested for grain in 1929, yielding 1,022,831 bushels. In addition, corn from 530 acres was cut for silage, yielding 3,444 tons; from 2,894 acres was cut for fodder; and from 371 acres was hogged off. Yellow Clarage is the predominant variety of corn grown both on the flats and on the rolling lands. Rotten Clarage, Leaming, Woodburn Yellow Dent, and Reid Yellow Dent are other varieties grown. Boone County White is grown on some of the bottom lands in the southern part of the county.

At the time of the very earliest settlement, wheat was the second crop in importance. Although production has continued, the acreage devoted to this crop has differed greatly from year to year. The annual average acre yields range from 10 to 13 bushels. Wheat grown on 7,284 acres in 1929 yielded 74,029 bushels. The popular varieties of wheat are Trumbull. Fulhio, Nigger, and other soft red winter varieties.

Tobacco early became an important crop, and previous to 1850 it had gained a place second only to corn in value. In 1865, a total of 4,156,921 [6] pounds was produced, placing Brown County in second place in the State in tobacco production. About this time white burley tobacco is said [7] to have been originated in the county, and it has gradually become the dominant tobacco grown. A definite change to still lighter colored and lighter weight tobacco came about the time of the World War, and an effort is being made to obtain the finest quality light-colored leaf and still maintain as heavy yields as possible. Formerly acre yields ranging from 1,000 to 1,800 pounds were common, but now the range is from 500 to 1,200 pounds. However, with the increased price obtained, the value of the crop has increased, even though the total weight has decreased since 1909. In 1929, a total of 5,855 acres produced 5,029,021 pounds, placing the county third in tobacco production in the State. Hallie is one of the popular varieties because of its high grade and comparatively high average acre yield. Other varieties commonly grown are Kelley, Twist Bud, and Judy Pride. Pepper is a high-grade tobacco, but it does not, as a rule, produce so heavy an acre yield as Hallie.

The 1930 census reported a total of 18,180 acres devoted to hay crops in 1929, and the yield was 18,748 tons. Timothy and timothy and clover mixed represented about 72.1 percent of the crop. Much of the hay was formerly sold on the Cincinnati market where the demand was great at one time. In recent years the acreage in clovers and other legume crops has increased considerably. The 1930 census reported 13,115 acres in timothy and timothy and clover mixed in 1929, 1,535 acres in clover alone, and 506 acres in alfalfa. The clovers are chiefly red and mammoth red, but some alsike, sweetclover, crimson clover, and Japan clover (lespedeza) are also grown.

Since their introduction, soybeans have increased steadily in acreage, and the 1930 census reports 3,403 acres devoted to this crop in 1929. Rye has been an important cover and nurse crop for a number of years, the 1930 census reporting 25,502 bushels produced on 3,075 acres in 1929. Rosen is one of the principal varieties, although no attempt is made, as a rule, to plant pure strains. Other crops, acreages, and total yields in 1929 were: Oats on 2,511 acres, yielding 25,546 bushels; barley on 52 acres, yielding 460 bushels; buckwheat on 271 acres, yielding 3,277 bushels; potatoes on 551 acres, producing 51,117 bushels; and sweetpotatoes on 34 acres, producing 2,218 bushels.

Among the orchard fruits, apples have been predominant from the first, with peaches next in importance. The 1930 census reported for 1929 a total of 36,350 bearing apple trees, yielding 4,969 bushels; 14,948 bearing peach trees, yielding 3,061 bushels; 2,681 bearing pear trees, yielding 2,542 bushels; 2,996 plum trees; 2,397 cherry trees; and 4,699 grapevines. Some strawberries and blackberries are grown under cultivation, and many wild blackberries, dewberries, and raspberries grow throughout the county. Cabbage, lettuce,

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[6] MANSFIELD, E. D. NINTH ANNUAL REPORT OF THE COMMISSIONER OF STATISTICS TO THE GOVERNOR OF THE STATE OF OHIO FOR THE YEAR 1865. 75 pp. 1866.

[7] MORROW, J. See footnote 4, p. 3.

onions, tomatoes, sweet corn, cantaloups, and watermelons are grown, but they are important commercial crops on only a very few farms. A significant change, which the census reports since 1880 reveal, is the gradual decline in value of forests and forest products. The census reports the value of forest products in 1929, cut for home use and sale, at $82,112. Only a few attempts are being made to reforest the land.

The 1930 census reports the value of all domestic animals, chickens, and bees on farms on April 1 of that year as $2,317,654. The same authority reports 6,787 horses; 838 mules; 19,364 cattle, of which 10,510 were cows and heifers more than 2 years old, kept for milk production; 26,116 swine; 20,444 sheep; 225,469 chickens; and 1,124 hives of bees. There were 376,264 chickens, 3,514 turkeys, 3,118 ducks, and 2,917 geese raised in 1929 and 1,892,867 dozens of chicken eggs produced in that year.

The amount expended for fertilizer has been an important item in the farm expenses for a number of years. Since 1910 the census reports show that the average yearly expenditure for the farms reporting is more than $55 a farm. The 1930 census reports an expenditure of $122,455 for commercial fertilizer, manure, and lime, on 2,066 farms in 1929. Complete commercial fertilizers are almost exclusively used in all parts of the county. The fertilizer mixtures differ greatly in the percentages of nitrogen, phosphoric acid, and potash they contain, but a 2–12–12 [8] mixture is most commonly used on corn and wheat and to less extent on tobacco. The principal tobacco fertilizers are 3–8–6 or 4–10–10 mixtures. Other mixtures used in different localities and on different crops are 2–12–6, 2–14–4, 4–24–4, 0–16–4, 2–8–6, 2–8–2, 0–10–10, and many others. The quantity of fertilizer applied on the various crops differs widely, but generally corn receives an acre application of 125 pounds in the row at planting time, and wheat from 125 to 250 pounds applied in the drill row at planting time. The range in the acre application, from 100 pounds to 1,000 pounds, is greater for tobacco than for other crops, though, as a rule, tobacco receives a heavier application than any other crop, commonly from 250 to 350 pounds. An earnest effort is being made by the State extension service and experiment station to standardize and reduce the number of fertilizer mixtures placed on the market.

The value of liming is well demonstrated, particularly on the gray soils, and an increasing number of farmers are applying lime each year, in order to neutralize the acid condition of the soil and thus stimulate the growth of sweetclover and other legumes on such soils. According to the report of the county farm adviser, about 1,500 tons of lime were used in 1929, the average acre application being about 2 tons. Of the total quantity used, about one-third was obtained by grinding the local limestone rock. This product gives promise of offering lower costs for agricultural lime to many communities. The price at railroad points in carload lots ranges from $3 to $3.70 a ton, but locally produced limestone is quoted at about half this price.

Most of the laborers are native whites, and a few colored men are employed on some farms. The average daily wage for farm laborers

[8] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

is $2 and the monthly wage about $40, in addition to subsistence. The labor demand, which arises during planting, harvesting, or at other times when additional help is needed, is met on most farms by an exchange of labor among neighbors. According to the 1930 census, 1,004 farms reported a total expenditure of $148,679 for labor in 1929.

Farms range in size from 3 acres to 1,000 acres, but most of them are between 50 and 174 acres, the average size for the county being 86.1 acres. The 1930 census reports 3,302 farms in the county with a total area of 284,188 acres, of which 226,256 acres, or 79.6 percent, is classed as improved land, including crop land and plowable pasture. Of the total value of all farm property ($5,174 a farm), 50.5 percent represented the value of the land alone, or an average of $30.35 an acre. Many of the well-located and better improved farms are valued at $100 or more an acre. Although the average size of farms has not changed greatly for a number of years, a considerable increase in the total value of farm property has taken place, but only a small part of the increase is represented by a rise in land values.

A large proportion of the farms have always been operated by the owners, the census of 1880 recording 82.5 percent. Tenancy reached its maximum about 1910, when 32.9 percent of the farms were operated by tenants. Of the 3,302 farms reported by the 1930 census, 2,283 were operated by owners and part owners; 1,010 by tenants, only 29 of whom were renting for cash; and 9 by managers. Under the share system of rental, the owner furnishes the land, fertilizer, and seed, and the tenant supplies the labor, work animals, and implements.

Most of the farm homes are well-built painted frame buildings without modern conveniences, and a number of modern well-equipped homes are scattered throughout the county. Many very old but substantially built brick houses are still standing in the southern part, where settlement first began. As a rule, the number of barns and sheds is sufficient to properly house the livestock, implements, and stored crops. In the tobacco-producing section, it is not uncommon to see 2 or 3 large barns on a farm, to supply the additional shed room necessary for curing the tobacco crop. Only a few farms are equipped with silos. Most of the corn fodder is shredded and stored in barns for feed. Light farm machinery of the more modern type is in general use. In 1930 there were 291 tractors, 2,710 automobiles, 228 motor trucks, 22 electric motors for farm work, and 230 stationary gas engines used on the farms. Electric light was used in 323 farm dwellings, 89 were provided with bathrooms, 326 had water piped to the house, and 1,572 had telephones.

The early agricultural pursuits were similar to those now engaged in, with the exception that at one time pork packing was important and tanneries and gristmills were in operation in various parts of the county. In 1846, Ripley had the second largest pork-packing house in the State, but this industry has been abandoned. Only a few small feed mills are now in operation.

The dominant agricultural activities at present are the raising of dairy cattle, hogs, sheep, and poultry; growing tobacco; and marketing the farm products. Dairying ranks first, both in the amount of

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capital invested and in the value of the products. Its value is based chiefly on the many small herds of grade cattle which are distributed over the county and not on dairying as a specialized industry. Jersey dairy cattle are decidedly predominant, although Holstein-Friesians, Guernseys, and Ayrshires are raised. The grade of the cattle in many of these herds is kept rather high by the introduction of purebred bulls. A number of herds of registered Jersey cattle are in the general vicinity of Russellville and Georgetown, and a few purebred Holstein-Friesian herds are in various sections. The number of milk cows in a herd is small, ranging from 5 to 10, although a few herds, ranging from 20 to 40 head, are kept in the central part of the county.

Dairying has prospered because of the excellent markets, not only for whole milk, butterfat, and cream, but also for dairy cattle. The prices for good milk cows in recent years have ranged from $90 to $150 each and for veal calves from $9.50 to $17.50 a hundred pounds. Cincinnati receives a large part of the dairy products.

A milk condensery, recently established at Maysville, Ky., has furnished a steady market for whole milk in its vicinity, and a truck milk route has been established in the southeastern corner of the county to help supply this market. Another whole-milk route covers the section around Mount Orab, Sardinia, and Macon. Dairy truck routes cover the central part of the county, and from this section butterfat and cream are sold. This practice is significant because it is in this section of well-drained soils that general farming reaches its maximum development. Most of the corn is produced and most of the hogs are fattened here, and the practice of selling butterfat and cream leaves the skim milk on the farm for calves, hogs, and poultry and at the same time affords a steady income to the farmer. A number of cream stations are operated in this section, offering to a large number of farmers a reliable market for dairy products. This rolling section of better drained soils is more naturally adapted to dairying than the flatter section, as creeks and springs furnish an excellent water supply, and bluegrass, clovers, and alfalfa grow luxuriantly in many places, supplying the necessary pasture. Farmers in parts of the flatter sections of poorly drained gray soils are overcoming the handicap of poor pastures by draining, liming, and successfully growing sweetclover or other legumes.

A comparatively small total acreage of corn is cut for silage. Probably 5 percent or more of the corn crop is cut and shocked, and later the fodder is shredded and stored for feed. During fall and winter the farm supply of dairy feeds is supplemented by ground grains or commercial dairy feeds. These differ considerably in composition, depending on the price of the various concentrates used. A common practice is to purchase a 32-percent concentrate and mix this with corn. Soybean hay, together with the beans, is a valuable dairy feed.

The raising of beef cattle is of minor importance, and no large cattle feeders are located in the county, but a few breeders of small herds of grade Shorthorns, Herefords, and Aberdeen-Angus have located in various parts.

Poultry farming ranks second in value. As a specialty, poultry raising is more or less localized in the vicinities of Mount Orab and

Sardinia, where a number of comparatively large flocks of White Leghorns are raised. Eggs from this section are shipped by truck to Cincinnati and other nearby markets. Only a comparatively small part of the poultry production is represented by the special poultry farms, as the many farm flocks distributed over the county provide a large proportion of the total value. The farm flocks range in number from 50 to more than 200 fowls. One of the heavy poultry-producing sections is in the vicinity of Fayetteville, extending north of this place to the county line. The popular farm breeds are Barred Plymouth Rock, Rhode Island Red, White Plymouth Rock, and White Leghorn, although chickens of many other breeds and mixtures of these breeds are raised. Many farm flocks consist of purebred high-producing strains. A ready market is provided for poultry and eggs at local trading points and in the larger markets at Cincinnati and other nearby cities. Most of the poultry products are sold to local buyers.

Hogs are raised on the farms in all parts of the county, although there are no large breeders or feeders. During the year 1929 a total of 17,000 hogs was reported by the county agricultural agent. During the growing period, the pigs are allowed to run in the meadows, preferably clover meadows, with a supplemental grain feed, and are then finished on corn. Practically all the corn grown is fed on the farms, and a large part is fed to hogs. Many spring pigs are raised in the northern section of the county, but a comparatively small number are fattened, 75- to 100-pound hogs being commonly sold to feeders in other sections. In the central and southwestern parts, the farmers are both breeders and feeders, and a number of farmers in these sections purchase additional hogs to fatten when their supply of corn warrants. According to the county agricultural agent, as a rule more fattened hogs are sold from Lewis Township than from any other one section. Duroc-Jersey is the most popular breed, and many Poland China and Chester White hogs are raised. In order to obtain the highest market price, an effort is made to complete the finishing period at a weight ranging from 175 to 225 pounds.

Tobacco is grown chiefly as a cash crop, along with the general-farm crops. As considerable labor is necessary in growing, harvesting, and marketing tobacco, the acreage devoted to this crop by one grower, as a rule, is not large. Most growers start their own plants in specially prepared seed beds. More than 50 percent of the crop is fertilized. Specialized knowledge and skill are required to produce a crop and successfully place it on the market. The curing process is important, and, unless properly done, low grades of tobacco result. The sorting of the leaves in established grades is also an important procedure, as, in order to obtain the highest price, the grower must conform to the standard grades.

Practically all the tobacco produced is marketed either at Ripley or at Maysville, Ky. Maysville, one of the largest loose-leaf tobacco markets in the United States, receives the great bulk of the crop from this section. It has 12 loose-leaf warehouses in operation, and Ripley has 2. The grower hauls his crop to one of these markets, where it is labeled with the owner's name, the weight, and a lot number. Usually each lot is then examined and sold to the highest bidder. Prices differ greatly from year to year, depending on many factors, among which are the quality of the tobacco, grading of the leaves, the total production in the burley tobacco section, and demand for the finished product. A 5-year average of 25 cents a pound was paid by the Burley Tobacco Growers Association while it operated. The average price in 1928 was about 30 cents, and in 1929 about 21 cents.

Sheep raising on a large scale is not practiced, although it is an important source of income on many farms. The income is obtained principally from the sale of wool and fat lambs. Nearly all the large flocks, some of which number 200 or more, are raised in the hilly southeastern part of the county, principally in Huntington and Byrd Townships. Here the range consists chiefly of bluegrass and is excellent during normal seasons. Little additional feed is required, this being readily supplied by alfalfa, clover, and other legumes, which grow well in this section. The Merino sheep is the favorite breed. The flocks are in general of good strains, but as a rule no special effort is made to keep purebred or registered flocks. Shelter is provided on most farms. Precaution and sometimes treatment is necessary to retard or prevent certain parasitic diseases, as stomach worms, and abnormal conditions, as foot rot. Frequent changing to new grazing lands is a common practice.

SOILS AND CROPS

On the basis of their color, drainage condition, and other common characteristics, the soils of Brown County fall naturally into two major distinctive groups. Included in the first group, covering approximately 60 percent of the county, are the better drained brown soils. The second group, covering the remaining 40 percent, includes the gray more poorly drained soils. Although members of the first group border all the valleys, they are decidedly predominant in the southern half of the county; and though soils of the second group occupy most of the flats and depressions in all sections, they predominate in the northern half.

The soils of the two groups differ not only in color, natural drainage conditions, and geographic distribution, but in chemical and physical characteristics. The brown soils are naturally more open than the gray soils, thereby allowing freer movement of both air and water; they are, for the most part, more easily kept in good tilth, being less subject to baking after rains. They are more susceptible to erosion because of their more sloping surfaces; as most of them occupy more favorable topographic situations with respect to air drainage, the effects of early and late frosts are moderated; in general their need for lime is less; and they are, as a rule, richer in available plant nutrients.

The more poorly drained gray soils resemble one another in having gray or light-gray surface layers which are extremely low in organic matter, with the exception of some soils of very small extent, which have dark-gray surface soils; the surface soils of most of them are inclined to run together when wet, and on drying to form a hard surface crust; nearly all of them are acid; their natural fertility is comparatively low; and they are all naturally poorly drained, the surface run-off being so slow in many places that the soils remain in a saturated condition, and water stands on them for long periods.

Largely because of these inherent differences in the soils of the two groups, the differences in their natural adaptation to the principal crops of the region is marked, and these differences have largely determined the agricultural practices on them. The principal crops grown on the better drained soils are white burley tobacco, grown as a special cash crop, hay, wheat, and corn. On the more poorly drained soils an inferior grade of tobacco is produced, on only a very small acreage. Unless special efforts are made to correct poor drainage, high acidity, and plant nutrient deficiencies, the average acre yields and the quality of the hay, wheat, and corn crops are much poorer than are commonly obtained on the better drained soils.

Although only about 4 percent of the average yearly acreage devoted to crops is planted to tobacco, 99 percent or more of the crop is harvested from soils of the better drained group, approximately 75 percent being produced on the soils occupying the valley and ravine slopes, 24 percent on the bottoms or on the rolling uplands, and only 1 percent or less on the gray soils. Fair yields are sometimes obtained from some of the gray soils by making heavy applications of manure or commercial fertilizers and by special efforts to correct poor drainage, but the grade is inferior, commonly a dark-colored or red leaf of heavy weight, whereas the market demand is for a light-weight bright-leaf tobacco. Hence, because of their well-drained condition, adequate supply of lime, potash, and other necessary plant-nutrient elements, the soils on the less eroded valley and ravine slopes are particularly adapted to the production of a high-quality bright-leaf tobacco which is in demand by cigarette manufacturers.

The characteristics of the soils in each group are important factors in the distribution of the various hay crops and pasture grasses. Only about one-fifth of the total crop land is devoted to the production of hay, and of this land timothy is grown on about 45 percent, legumes on approximately 10 percent, and mixed timothy and clover on the remaining 45 percent. The same general characteristics which make the brown soils better adapted to the production of tobacco also account for their natural capacity to yield larger crops of hay and to produce the more luxuriant and nutritious pasture grasses. Nearly all the red clover, alfalfa, and bluegrass is grown on these better drained soils; they produce most of the mixed timothy and clover hay; they are equally well adapted to the production of timothy, sweetclover, mammoth red (sapling) clover, Japan clover, and white clover; and soybeans do well on them, although soybeans are grown to less extent on the more sloping lands because they do not provide such effective protection against erosion as the clovers, alfalfa, and grasses. Most of the timothy hay is produced on the gray soils, because this crop will tolerate the deficiencies of these soils to a considerable extent. The increasing difficulty of growing this crop on the gray soils without special effort, however, is more evident each year. It is significant that the gray soils produce a large proportion of the total crops of mammoth, or sapling, clover, alsike clover, little-white clover, sweetclover, and soybeans. The large proportion of soybeans, sweetclover, and sapling clover grown on these soils is due chiefly to the increased practice of liming, inoculating for legumes, and improving drainage conditions, as without these special efforts yields are low. Sweetclover cannot be grown satisfactorily unless the land is limed.

During normal years about 45 percent of the farm land is in pasture, and most of this is land that could be plowed and cultivated without clearing, drainage, or any other special effort. The acreage in pasture land is about equally distributed on the two major groups of soils, although almost all the bluegrass grows on the brown soils, principally in the more rolling sections or on the bottom lands where the soils are sweet and are inherently more fertile than the gray soils. Bluegrass spreads very rapidly on these soils if shrubs, briers, and weeds are kept down and erosion held in check. On the other hand, the greater part of the gray soils is lacking in natural pasture grass of high nutrient qualities. Some farmers owning tracts of the upland gray soils have overcome this handicap by liming, draining, and fertilizing.

Other factors, which serve to indicate the relative importance of the gray and the brown soils, are the comparative proportions of fallow land in the two groups, and the relative acre yields, quality, and total production of fruits, garden truck, and grains. Although only 10 or 15 percent of the total crop land normally lies fallow, 75 percent of this is on the gray soils. Furthermore three-fourths or more of all the orchard fruits, garden truck, and potatoes are produced on the better drained soils because of their more favorable air and water drainage, their better tilth, their more favorable topographic situation, and their ready response to fertilizers. Even in the flatter parts of the county most homesteads and the orchard and garden tracts surrounding them are located on knolls or are adjacent to drainageways, where one or more members of the group of brown soils dominate the homestead site.

Owing to the poorly drained condition of the gray soils, their low natural fertility, and also to the fact that rye commonly follows tobacco in the rotation, very little rye is grown on these soils. Oats are a very minor crop grown on the soils of both groups, commonly following corn in the rotation or sometimes following wheat in the spring when winter injury has been serious. Greater acre yields are obtained in most seasons from the brown soils. As a rule, approximately one-tenth of the crop land is utilized for the production of wheat, and commonly the gray soils have the larger acreage and produce a larger total yield, but the average acre yield from the brown soils is greater. Without the use of fertilizers on the soils of both groups this difference would be much greater than it is.

Annually about 50 percent of all the crop land is planted to corn, the most important crop grown. It is commonly fertilized on the soils of both groups with about equal applications, so that fertilizer is not a contributing factor in the relative yields obtained. More than 50 percent of the corn harvested from the section dominated by the gray soils is grown on those soils in the group having the best drainage, chiefly Avonburg silt loam, and on the less extensive Blanchester silt loam, Eel silty clay loam, and Lindside silty clay loam, and on the darker colored phases of Clermont silt loam, all of which are naturally better adapted to corn than the more predominant gray soils. More than 75 percent of all the corn produced is harvested from the brown soils, and the quality, as a whole, is better than of the corn produced on the gray soils.[9]

Differences in the kinds of materials from which the soils have developed naturally divide the brown soil group into three distinct subgroups, consisting of brown soils from glacial till, brown soils from hard rock material, and brown bottom soils. Differences in parent materials also naturally divide the gray soil group into two distinct subgroups, namely, gray soils from glacial till and poorly drained bottom soils.

The division between the soils developed from glacial till and those developed from material residual from hard rock is based on a natural boundary line extending from Ohio River at Ripley northeastward to the point south of Decatur where East Fork Eagle Creek enters the county. The upland soils northwest of this line have a substratum consisting of a weakly cemented limy glacial deposit of mixed sand, clay, silt, gravel, and scattered boulders including rocks foreign to this region. This deposit in most places ranges from 10 to more than 30 feet in thickness. It is locally known as hardpan but generally known as boulder clay or glacial till. Southeast of this boundary line the so-called hardpan layer does not occur, but the soils have been formed from the accumulation of weathered material from the underlying bedrock of limestone and shale. The bottom soils are so named because they consist of rather recently deposited material along the stream bottoms or are formed from assorted deposits of sand, gravel, and in places silt and clay, which have been deposited by stream action. They are commonly known as first or second bottoms, according to the elevation of the surface of the bench above the stream.

Although the soils in any one of these five subgroups have many features in common, they differ sufficiently to justify further separation into a number of individual soil types, because variations in drainage conditions, vegetation, and in the lay of the land have caused the individual differences, even among soils having the same kind of substrata or parent materials. Some of these differences in the characteristics of the individual soils are not so apparent on the surface, but, nevertheless, they reflect their importance by the kinds of crops grown on a particular soil, or by the average acre yields obtained from it.

In the following pages the different soils are described in detail and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 3.

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[9] Based on Federal farm-census data, on county records, on statements of the county agricultural agent, and on observations made and data collected in the field during the progress of the survey.

TABLE 3.—*Acreage and proportionate extent of soils mapped in Brown County, Ohio*

Type of soil	Acres	Percent	Type of soil	Acres	Percent
Rossmoyne silt loam	68, 032	21. 5	Clermont silt loam	56, 704	17. 9
Loudon silt loam	384	. 1	Clermont silt loam, dark-colored phase	1, 408	. 4
Cincinnati silt loam	19, 840	6. 2	Clermont silt loam, dark-colored subsoil phase	1, 408	. 4
Cincinnati silt loam, shallow phase	1, 216	. 4	Avonburg silt loam	52, 608	16. 6
Jessup silt loam	3, 456	1. 1	Avonburg silt loam, dark-colored phase	576	. 2
Edenton silt loam	33, 856	10. 7	Blanchester silt loam	4, 800	1. 5
Fairmount silty clay loam	11, 264	3. 5	Sciotoville silt loam	320	. 1
Heitt silty clay loam	22, 080	6. 9	Sciotoville silt loam, dark-colored phase	128	. 1
Maddox silt loam	5, 440	1. 7	Ginat silt loam	192	. 1
Eden silt loam	2, 944	. 9	Williamsburg silt loam, mottled-subsoil phase	576	. 2
Ellsberry silty clay loam	1, 280	. 4	Williamsburg silt loam, dark-colored phase	64	. 1
Wheeling silt loam	2, 432	. 8	Lindside silty clay loam	64	. 1
Wheeling very fine sandy loam	64	. 1	Eel silty clay loam	384	. 1
Huntington silt loam	2, 176	. 7	Algiers silt loam	128	. 1
Huntington fine sandy loam	320	. 1	Alluvial soils, undifferentiated	5, 888	1. 8
Williamsburg silt loam	3, 904	1. 2	Total	316, 800	
Williamsburg very fine sandy loam	1, 856	. 6			
Genesee silt loam	7, 808	2. 4			
Genesee silt loam, dark-colored phase	256	. 1			
Genesee very fine sandy loam	2, 880	. 8			
Genesee very fine sandy loam, high-bottom phase	64	. 1			

BROWN SOILS FROM GLACIAL TILL

The group of brown soils derived from glacial till includes Rossmoyne silt loam; Loudon silt loam; Cincinnati silt loam; Cincinnati silt loam, shallow phase; Jessup silt loam; and Edenton silt loam. These soils cover 40 percent of the county. The members of the Cincinnati, Rossmoyne, Loudon, and Jessup series have undulating or rolling surface relief. They occur mainly in the southwestern and central parts, occupying the better drained upland divides and the long comparatively narrow points formed by the numerous streams and ravines that reach back into the uplands. The Edenton soils occur on the rather steeply sloping sides and at the heads of practically all the valleys and larger ravines throughout the central and northern parts.

Rossmoyne silt loam.—Rossmoyne silt loam is the dominant soil of the county and includes 21.5 percent of the total area. This soil occurs on knolls and bordering valleys in the central and northern parts, but the most extensive areas lie along the eastern side, south to Rattlesnake Creek, and thence west to the western county line. This soil is commonly known as "beech and sugar-tree land" and is generally considered a desirable soil for general farming.

Under cultivation, the surface soil of grayish-brown smooth mellow slightly acid silt loam extends to a depth of about 14 inches. It is underlain by a yellowish-brown silty clay loam subsoil which is more acid than the surface soil. The subsoil is firmer than the surface soil, but under normal moisture conditions it is friable, becoming moderately sticky and plastic when wet. Below a depth of 18 or 20 inches the subsoil is mottled with light gray and yellowish brown and contains some small dark-brown pellets of iron oxide, indicating that water movement at times is slow in the lower part of the subsoil. The substratum becomes more friable below a depth of 60 inches, and, at a depth of 8 or 9 feet, the weakly cemented glacial till, or so-called " deep hardpan layer ", is reached. To this depth much of the lime and other readily soluble materials have been leached from the soil, but below this there is a much higher percentage of these elements. Where this limy substratum is exposed on the ravine slopes, or where the material thrown out from wells or other deep excavations has been deposited, a luxuriant growth of clover or grass occurs. This deep material is the original glacial deposit with but little alteration since glacial times.

In addition to being dominant in total area, Rossmoyne silt loam is an agriculturally important soil as regards the value and yield of crops produced on it, because of the mellow and friable character of the surface soil; because of the rapidity with which excess water moves from it, owing to its rolling surface relief and comparatively open structure; and because it is not extremely acid or extremely low in available plant nutrients, although it responds well to both lime and fertilizers.

Mapped areas of Rossmoyne silt loam include minor variations in places, particularly as regards drainage conditions. This has resulted in a more gray color where the Rossmoyne soil grades into the closely associated and more poorly drained Avonburg silt loam, and, on the other extreme, near the better drained Cincinnati or Edenton soils, the color is more nearly or uniformly brown.

Approximately 95 percent of this soil has been cleared and utilized for crops or pasture. It produces about 45 percent of the corn, 10 percent of the tobacco, and about 40 percent of the hay grown, and a large part of the wealth of the county results from the corn, hay, and wheat produced on it.

Loudon silt loam.—Loudon silt loam is similar to Rossmoyne silt loam in color, texture, mellowness, and well-drained condition of its surface soil, but it differs in having a much heavier and tougher subsoil of heavy silty clay or clay and a heavier more plastic substratum which in many places rests on bedrock at a depth ranging from 70 to 80 inches. The substratum resembles the slick, plastic, and tough olive-brown and gray clays which occur in the residual materials of the southeastern part of the county, but, unlike their substratum, it has slabs of limestone and some hard foreign rock embedded in it. Because of these heavier materials, leaching has been less thorough, and lime and other soluble materials are apparently more plentiful at a depth within reach of plant roots.

Practically all this land has been cleared and cultivated. The same crops are grown as are grown on Rossmoyne silt loam, but the average yields are somewhat higher, although fertilizing practices are about the same. Clover and bluegrass make more certain stands, and they grow more luxuriantly.

Only a few small areas of this soil occur, most of them in the immediate vicinity of Decatur and 3 miles southwest of that place. This soil is much more extensive to the east, in Adams County.

Cincinnati silt loam.—Cincinnati silt loam, locally termed " sugar- and walnut-tree land ", is the best drained upland soil developed from glacial till. Most of it lies within a belt, ranging from 4 to 6 miles in width, bordering Ohio River from Ripley to the western county line, where it occupies the numerous rolling divides and the

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long narrow points of upland. Small areas are on the higher knolls or rounded knobs scattered over the county, and others occur in some of the better drained situations adjacent to the larger creek valleys.

Cincinnati silt loam differs from Rossmoyne silt loam, with which it is closely associated, mainly in being more thoroughly drained. The better drainage has resulted in a browner surface soil, a red cast to the yellow-brown subsoil, and the absence of gray streaks and spots to a depth of 30 inches or deeper.

This soil is generally considered a stronger soil than Rossmoyne silt loam and equally responsive to fertilizers. Although it covers only about 6 percent of the county, it holds an important place in the agriculture. Acre yields of corn and clover average higher than on the Rossmoyne soil, and a larger proportion of the land is planted to tobacco. It is better suited to tobacco on the outer margins of the divides and on rounded points where the supplies of lime and potash seem to be more plentiful. Rye is grown more extensively than wheat, and it commonly follows corn or tobacco. Rye is a good nurse crop for grasses and is particularly valuable in checking erosion, as the surface relief of this soil favors rapid washing by the excess water that quickly passes off the land. Peaches, apples, pears, and other orchard fruits do well, not only because of a fair degree of fertility and a favorable-textured and well-drained subsoil readily penetrated by roots, but also because air drainage is good and tends to lessen winter injury to trees and fruit injury caused by late frosts.

Cincinnati silt loam, shallow phase.—Cincinnati silt loam, shallow phase, is distinguished by the comparative thinness of the brown mellow surface soil which everywhere is less than 10 inches thick. In many places plowing has mixed the shallow surface soil with the heavier subsoil, and in such places it is difficult to maintain good tilth. Therefore, the absorptive capacity of the surface soil is so lessened that surface run-off becomes more pronounced, and the surface soil is more likely to bake. The subsoil and substratum layers are similar to the corresponding layers in the typical soil, except that they are not so thick. In some places bedrock lies within a depth of 6 feet from the surface, and the readily soluble lime has been leached from the soil. The areas north of Georgetown have a more gravelly substratum than is typical of soil of this phase. All the more prominent mounds are used chiefly for pasture and hay land, as bluegrass and clovers grow well and afford protective coverings for the slopes.

The shallow phase of Cincinnati silt loam occurs on the long sloping points or on the rounded narrow parts of divides in the section occupied by the typical soil. More than 95 percent of the land is cleared and used for crops or pasture land. Corn, wheat, and rye are grown, but average yields are less than on the typical soil, particularly during dry seasons. Tobacco is more commonly grown on this shallow soil than on the typical soil, and the quality and yield are better. Clover and alfalfa do well. When this land is cultivated, erosion may become a serious factor, and efforts are made to check it by contour plowing and by a rotation that includes from 1 to 3 or more years of grass, but for the most part results are far from satisfactory.

Jessup silt loam.—Jessup silt loam is a desirable soil of small extent. It resembles Loudon silt loam in having a brown mellow silt loam surface soil about 12 inches thick, a heavy clayey subsoil, and a similar substratum of limy, stony, heavy silty clay of glacial origin. The upper part of the subsoil is a brown heavy silty clay loam layer about 18 inches thick. Broken clods of this material have a reddish-brown cast on their surfaces. The lower part of the subsoil has in general the appearance of being olive brown, but actually it is a combination of yellow, olive, and brown clay containing scattered specks and small spots of dark-brown iron stains. The surface soil and upper part of the subsoil are moderately acid, but the lower part of the subsoil is limy, and the substratum has a high lime content. The subsoil is very plastic and sticky when wet, but it dries to a very hard mass and cracks during extremely dry seasons. The stony character of the substratum provides good underdrainage at all times to the heavy material above. A few scattered rounded fragments of granite, diorite, and other hard rocks foreign to the region occur in many places on the surface and in the soil.

Most areas of this soil are rolling, as they occur on rounded knobs, such as those 2 miles southeast of Russellville, but the soil is more extensively developed on the rolling ridges in the vicinity of Decatur and southwestward toward Ripley where it borders the southern boundary of glaciation.

Corn, mixed clover and timothy, wheat, rye, and tobacco are the principal crops. The grain crops normally receive from 125 to 200 pounds of a 2–12–2 or 3–8–6 fertilizer, and hay meadows receive most of the barnyard manure. Tobacco receives from 150 to 200 pounds of a high-grade fertilizer, such as 3–8–6, and it is commonly planted on only the shallower and heavier spots where the limy clay is near the surface. Corn yields range from 30 to 50 bushels an acre in normal seasons and wheat from 15 to 25 bushels. As on all the heavier textured soils of the southeastern part of the county, crop yields differ greatly with the season, the quantity of fertilizer applied, and the general care and treatment which the soil has received over a period of years. The differences are especially noticeable where sheet erosion has reduced the thickness of the mellow surface layer to such an extent that bald spots occur, on which crops do not thrive.

Edenton silt loam.—Edenton silt loam occupies the heads of valley slopes of creeks and ravines in the central and northern parts of the county. Because of the differences in the degree of slope, the depth to the underlying bedrock, and the kind of material along these valley slopes, the characteristics of the soil included in mapped areas vary greatly within short distances. In the upstream parts of the valleys, the surface soil and subsoil are very similar in color and texture to the corresponding layers of Cincinnati silt loam, but the thickness of the layers is much less and the limy substratum is present at a depth ranging from 24 to 60 inches. More gravel, boulders, and rock fragments occur on these slopes, and leaching of lime and mineral elements is not so thorough. For this reason, the land is naturally better for tobacco, legumes, and bluegrass than the adjoining uplands. Clover sod is difficult to maintain in places where a heavy layer of soil occurs, because of heaving during freezing and thawing. In the downstream parts of the larger valleys, small unmappable areas of Fairmount silt loam occur, where the depth to bedrock is slight, and in many places heavy plastic calcareous clay is reached just above the rock. Narrow bands of this included soil occupy the upper parts of the steeper valley slopes in the southern and southwestern parts of the county. In the northeastern corner and in a few other places ravines have been cut into a heavy dark-gray waxy clay layer containing scattered boulders and pebbles.

This soil covers 10.7 percent of the area of the county, but only a comparatively small part is cultivated during any one year, although about 40 percent of the land is cleared, and much of it is plowable. Permanent pastures and wood lots occupy most of this soil. About 75 percent of the tobacco grown in the central and northern parts of the county is grown on it (pl. 1, *A*). From unprotected parts of these slopes, small gullies may cut their way into the smoother uplands and impair them. Straw, brush, cornstalks, and weeds are thrown in to catch sediments and check the advance of such gullies.

BROWN SOILS FROM HARD ROCK MATERIAL

The group of brown soils from hard rock material have a total extent of 67.2 square miles, or 13.4 percent of the area of the county. Those occupying the ridge tops or divides cover 10.5 square miles and include Maddox silt loam and Ellsberry silty clay loam; and those on the valley slopes covering the remaining 56.7 square miles include Fairmount silty clay loam, Heitt silty clay loam, and Eden silt loam.

Although the combined area of these soils is comparatively small and the land they occupy is rough, the agriculture may be sufficiently diversified to support the population, even though settlement is more dense than in most other sections. Agriculture on these soils centers around the tobacco crop as a cash crop, and this is supplemented by corn, rye, wheat, hay, particularly clover and alfalfa, as feed crops for cattle, hogs, work animals, and sheep. Bluegrass thrives luxuriantly on these heavy limy soils, affording excellent pasture during seasons of well-distributed rainfall. The springs and small streams, supplemented by cisterns, afford an adequate water supply, except during extremely dry periods, such as that during the summer of 1930. Orchard fruits, berries, and garden vegetables do well. Yields of tobacco on the more desirable land on the valley slopes are higher than the average, and, as a rule, the grade is the best produced in this section.

All these soils have brown surface soils and heavy clay subsoils. They are for the most part stronger than most of the upland soils. They are subject, however, to rapid drainage and to washing and gullying where unprotected, and for this reason the steeper slopes are planted to small patches of tobacco and then resodded and allowed to stand for a period of 6 years or longer. Were it not for their heavy plastic clay subsoils they could not be farmed, even intermittently, as the angle of slope in many places is more than 40°, and run-off is extremely rapid.

Creeping or slipping of large patches of the surface soil occur at times in the spring, resulting in barren spots above and benchlike deposits below. These benches act as natural terraces in places. In places cornstalks (pl. 1, *B*), brush, or rocks are thrown in the gullies, or an effort is made to establish grass or shrubs as a protective covering. Reforesting is not generally practiced, although black locust reproduces very rapidly as a second growth, and its thick spreading root system not only protects against erosion but also loosens the heavy clay and rocky substratum and adds nitrogen through the root nodules. The early agriculture of the county was established on these and the adjoining bottom soils.

Fairmount silty clay loam.—Fairmount silty clay loam is known as "dark-colored limestone land." It occupies the valley slopes of the larger streams in the southern part of the county, and, though of small extent, is important because it produces approximately one-fifth of the tobacco crop grown. The surface soil is very dark grayish-brown silty clay loam which is friable when dry and fairly retentive of moisture but becomes very sticky and plastic when wet. This material extends to a depth of 6 or 8 inches and is underlain by yellowish-brown heavy tenacious clay which grades, at a depth of about 24 inches, into tough and plastic olive-gray clay. On drying the olive-gray clay becomes very hard and, when exposed, cracks into angular-shaped lumps. At a depth ranging from 30 to 40 inches, interbedded limestone and shale rocks are present. Limestone slabs are scattered over the surface and through the soil mass, increasing in number as bedrock is approached.

Because of its natural fertility, good surface and internal drainage, fair moisture-holding capacity, and abundance of lime within reach of plant roots, tobacco (pl. 2, *A*), corn, rye, bluegrass, and alfalfa and other legumes produce more than average yields. Rye is commonly sown following cultivated crops, to act as a nurse crop for grasses and to check washing of the steep slopes. In some places slopes of more than 45° are planted to tobacco for 1 year, then sodded for a period of 4 years or longer, and this practice has been continued over a period of years without erosion greatly damaging the soil.

In many places the dark-gray mellow surface material has been removed, the yellowish-brown clay exposed, and the bedrock brought so near the surface that crops fire during long-continued dry periods. On the steeper parts, rock outcrops are common, and in places stream cutting has caused precipitous rock cliffs and ledges. During periods of freezing and thawing small landslides occur in places on the steeper slopes, causing damage to crops, forests, meadows, fences, and roads.

Most of this soil has been cultivated at some time, but normally not more than 5 percent of it is cultivated during any one year.

Fertilizer is not generally used, except for starting the young tobacco plants. Some farmers state that tobacco is "burned up" by it, and others claim good returns from fertilizer, but it is generally agreed that the better areas require little fertilizer for tobacco or for any other crop.

Heitt silty clay loam.—Heitt silty clay loam is most extensive in the southeastern part of the county and, like Fairmount silty clay loam, occupies the valley slopes. It is a naturally fertile soil but is subject to serious damage by erosion where unprotected. Less fertilizer is used on this than on any other soil, with the exception of the first-bottom soils. More than 75 percent of Huntington Township and a large part of Byrd and Union Townships are occupied by this soil.

Heitt silty clay loam differs from Fairmount silty clay loam principally in color. The surface soil and subsoil are dark brown or brown and have a decided red cast which is more pronounced when the soil is wet. The substratum is very tough plastic sticky clay when wet and is very hard when dry. Puddling and baking are common on the areas of thinner soil, from which most of the original surface soil has been washed. Many areas are very stony, and limestone and shale ledges are exposed in places. More than 80 percent of the land has been cleared and cultivated at some time, but large areas are now in bluegrass pasture and second-growth timber, chiefly locust and oak, with an undergrowth of briers and bushes.

On the bases of acre yields and quality of the crop, this soil ranks with Fairmount silty clay loam as one of the most fertile and desirable tobacco soils in the county. Rye and corn are the principal grain crops. Alfalfa (pl. 2, *B*), clover, and other legumes thrive. Soybeans are not popular, because their root system does not give sufficient protection from washing.

Maddox silt loam.—Maddox silt loam has a dark-brown mellow silt loam surface layer from 8 to 12 inches thick, overlying a rather uniformly brown or yellowish-brown silty clay loam subsoil which is much heavier than the surface soil and very plastic when moist. This layer extends to a depth of more than 22 inches in places and gradually merges through mottled gray-brown and yellow-brown silty clay into yellow or olive-colored clay which rests on the underlying limestone and shale rock at a depth ranging from 36 to 60 inches. As a rule, the material just above the bedrock contains a high percentage of lime and is rather friable under normal moisture conditions. The upper part of the surface soil has a fair organic-matter content, is only slightly acid, and is easily worked into good tilth. The upper part of the subsoil, though rather heavy and compact, allows water to pass through rapidly enough to give fair aeration, and it gives up its moisture supply well, except in places where the divides are narrowest. The subsoil material is acid, but the underlying lime is within reach of many of the deeper rooted plants.

Mapped areas of Maddox silt loam include small "bald" spots, or clay knolls, from which the surface soil has been washed away.

Corn, clover, hay, rye, and wheat are the predominant crops, and fair yields are obtained during normal seasons. Tobacco is grown to less extent, and this crop is invariably well fertilized with manure or commercial fertilizer, from 150 to 300 pounds or more of a 3–8–6 mixture being used. More than 80 percent of the land has been cleared, and approximately one-fourth of it is cultivated each year, the remainder being devoted to clover, meadow, building sites and lots, and to bluegrass pasture. Apples, pears, plums, and other orchard fruits thrive in the small home orchards.

Eden silt loam.—Eden silt loam occurs on the narrower divides, or hog-backed ridges, and on sloping areas. This soil is similar to Aberdeen silt loam, but the silty surface layer is 8 inches or less thick and in spots is entirely removed. The subsoil layer is also thin, and, in most places, bedrock is reached at a depth ranging from 20 to 30 inches. Impairment of these areas has seriously affected the growth of crops, and many fields have been abandoned or attempts have been made to establish grass for permanent pastures. Gullies and rivulets are cutting to the bedrock in many places, leaving scarcely enough soil material even for grasses to establish themselves.

Ellsberry silty clay loam.—Ellsberry silty clay loam occurs as small isolated bodies, in association with Maddox silt loam, on the narrow ridges, and in many places it occupies a slightly higher position than the Maddox soil. The striking difference between the two soils is the presence of specks of red in the subsurface and subsoil layers of the Ellsberry soil. Both the surface soil and subsoil are moderately acid, as a rule. The substratum overlying the limestone rock consists of yellow or olive-colored clay containing much lime and streaked with red seams. The surface soil is rather plastic and difficult to work into good tilth, and it is inclined to bake after heavy rains. The bedrock is reached at a depth ranging from 18 to 40 inches.

Practically all this soil is cleared and has been cultivated in the past, but many areas are now in bluegrass pasture, and cultivation is confined to the more favorably located areas, where fair yields of tobacco, corn, and alfalfa are obtained. In most places the soil is so shallow that, during periods of drought, sufficient moisture for crop needs is not retained. Like on Maddox silt loam, farming is necessarily patchy, owing to the irregular occurrence of this soil.

Included with Ellsberry silty clay loam as mapped are a few small areas locally termed " red clay land ", because of the decidedly red cast of the subsoil and substratum. This included soil is developed principally on prominent knobs or ridges, chiefly in two localities—one 2 miles northeast of Ash Ridge and the other along the county line east of Macon. It is characterized by a brown silt loam surface soil about 10 inches thick, a lighter brown and heavier subsoil layer extending to a depth of about 22 inches, and a mottled brown and purplish-red rather tough highly plastic silty clay layer which is streaked with gray below a depth of 4 feet and rests on bedrock at a depth of 8 feet. The upper part of the subsoil is slightly acid, as a rule, but the rest of the material ranges from neutral to alkaline in most places. In its natural adaptation to legumes and in its capacity for producing corn, hay, bluegrass, and tobacco, this soil ranks with Maddox silt loam and the typical Ellsberry soil. All the land is cleared and is cultivated with the associated soils.

BROWN BOTTOM SOILS

The many differences in the kind and character of the material, in the thickness of the deposits, and in the drainage conditions existing along the second bottoms, or stream terraces, and the first bottoms have resulted in many different soil characteristics. Although the combined area of the better drained terrace and bottom soils is less than 10 percent of the total area of the county, their proportionate contribution to the wealth of the county is much greater.

The brown bottom soils include Wheeling silt loam, Wheeling very fine sandy loam, Huntington silt loam, Huntington fine sandy loam, Williamsburg silt loam, Williamsburg very fine sandy loam, Genesee silt loam; Genesee silt loam, dark-colored phase; Genesee very fine sandy loam, and Genesee very fine sandy loam, high-bottom phase.

The soils of the terraces and first bottoms of Ohio River differ from those along the other streams, chiefly because of the difference in the character of the stream deposits from which they were formed. Those along the Ohio have been brought down from widely scattered parts of the Ohio River watershed, whereas those along the local streams are composed of materials from the surrounding uplands.

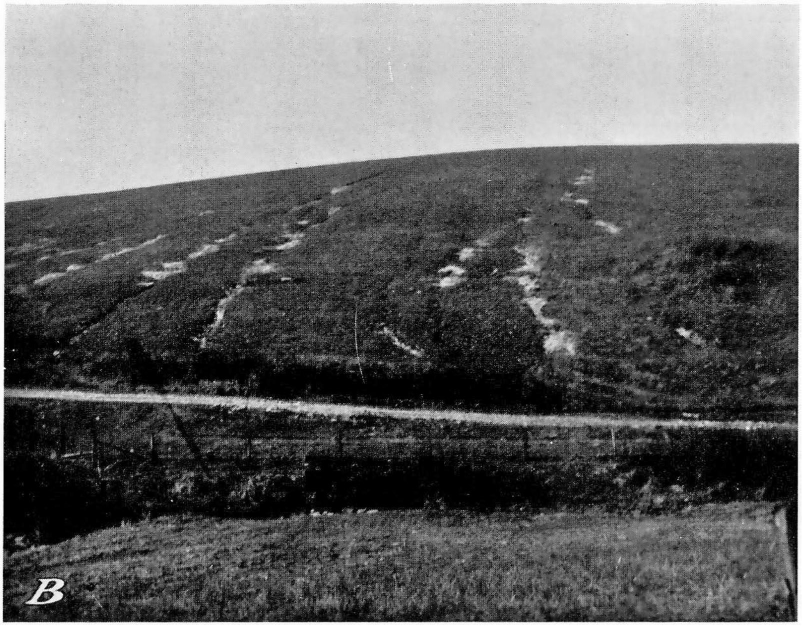
With the exception of narrow marginal areas along the first bottoms, all the soils of the Ohio River bottoms have been cleared and cultivated for many years, some of them for more than 100 years. Fertilizer is generally used on corn and tobacco on the higher levels, but it is rarely used on the first bottoms. Very little lime is used, although it has proved beneficial on the Wheeling soils.

Parts of the Wheeling soils were flooded during the extremely high waters of 1870 and 1913, even though they occupy the higher benches. The brown soils on these benches, or terraces, are Wheeling silt loam and Wheeling very fine sandy loam. The brown or better drained soils are represented on the flood plains of Ohio River by two members of the Huntington series—Huntington silt loam and Huntington very fine sandy loam. They differ from one another mainly in the texture and thickness of their surface layers.

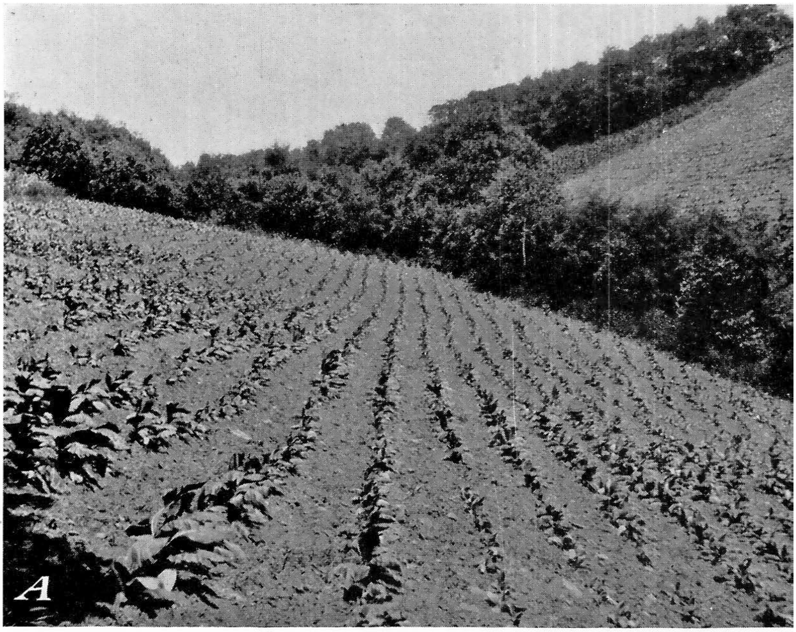
Wheeling silt loam.—Wheeling silt loam is the dominant soil on the Ohio River terraces, occupying the higher gently undulating parts of these benches. The surface soil is dark-brown rather floury silt loam which is easily worked and kept in good tilth. A little heavier and more compact silt loam, essentially brown but with a faint yellow cast when crumbled, occurs at a depth of about 13 inches. The brown color predominates throughout the soil, but in most places, below a depth ranging from 40 to 48 inches, small gray seams extend downward through the material. The percentage of fine sand and the friableness increase with increased depth, and small flakes of mica are conspicuous in the substratum. At a depth ranging from 10 to 15 feet, stratified layers of sand or sand and gravel are present in most places.

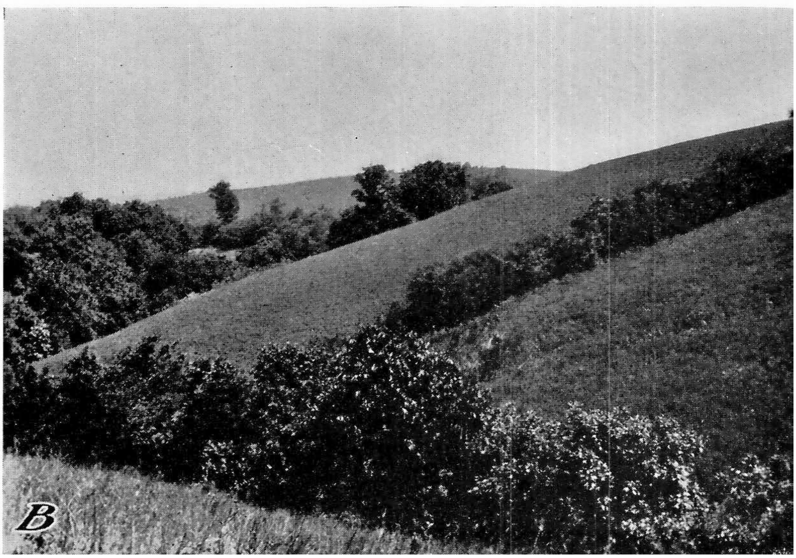
Leaching has resulted in comparatively acid materials down to the gravel layers, and for this reason white clover, alsike clover, and Japan clover (lespedeza) thrive better than red clover, although all are grown. Corn and tobacco are the principal crops, and the acre yields compare very favorably with those obtained on Cincinnati silt loam, but the grade of tobacco averages lower than that obtained on the Fairmount and Heitt soils. Wheat, rye, soybeans, and timothy are other crops successfully grown. Good homes, gardens, and orchards are common on land of this kind.

Sloping areas of Wheeling silt loam occur along the valley slopes formed by streams cutting through the terraces. Such areas are not



A, Harvest of bright-leaf burley tobacco grown on Edenton silt loam near Georgetown. *B*, Fairmount silty clay loam in Union Township showing eroded condition which commonly develops under cultivation. The light-colored patches are cornstalk barriers used in an attempt to check erosion.





A, Tobacco growing on steep slopes of Fairmount silty clay loam in Pleasant Township. *B*, Alfalfa growing on steep slopes of Heitt silty clay loam in Huntington Township.

generally farmed, but some tobacco is grown on them. For the most part the slopes are sodded with bluegrass or have grown up with bushes, briers, and saplings. In places steep-sided cliffs occur, which, by gradually caving in, work their way back into the adjoining fields.

Wheeling very fine sandy loam.—Wheeling very fine sandy loam differs from Wheeling silt loam in having a very fine sandy loam surface soil and subsoil and a rather loose fine sand substratum. The surface soil is dark brown, and the subsoil and loose sandy substratum are brownish yellow. Because of its small total area, this is an agriculturally unimportant soil, and it is farmed with the adjoining Wheeling silt loam. Crop yields average somewhat less than on Wheeling silt loam, owing to more thorough leaching and excessive internal drainage. A few small prominent sandy knolls are included with mapped areas of this soil. Such areas are more droughty, and average yields on them are smaller.

Huntington silt loam.—Huntington silt loam has a friable silt loam topsoil which is 3 or more feet thick in places. It has a fine sandy substratum containing conspicuous lenses of silt, gravel, or coarse sand in some places. Many fine flakes of mica give even the sandier materials a slick or greasy feel. The soil throughout is alkaline in reaction.

Corn and tobacco are the main crops, and large yields are obtained during favorable seasons. Tobacco of choice quality is produced. The fact that the land is subject to flooding from 1 to 3 or more times yearly causes occasional losses, but because the surface is sloping and the soil has good natural internal drainage, crops are not always lost even when the land is flooded, as rapid draining of the soil results as soon as the water recedes. Most of the floods occur in late fall, winter, or early spring—rarely during the growing season.

The areas of Huntington silt loam mapped along the small streams, like those of Huntington silt loam of the Ohio River bottoms, are very fertile, and the kinds of crops grown on them and crop yields are practically the same. Like the soil on the Ohio River bottoms, this soil is alkaline (sweet) throughout. It differs from the soil on the Ohio River bottoms in that it is more reddish brown, the soil material having been washed from the surrounding limestone and shale soils of the unglaciated uplands. Unlike the soil of the Ohio River bottoms it does not contain mica and other material foreign to this part of the county. It occupies the narrow first bottoms in the southeastern part. About one-half of this land is farmed, and the rest is in forest and pasture. The tree growth consists chiefly of willow, locust, elm, and ash, with some walnut and wild cherry.

Huntington fine sandy loam.—Huntington fine sandy loam is brown very fine sandy loam to a depth of 2 feet or deeper. It is particularly adapted to early garden vegetables, truck crops, tomatoes, and melons, because of its fertility, good aeration, and because it warms up early in the spring. Corn and tobacco are the principal crops, and yields are good.

This soil occurs in close association with Huntington silt loam and like that soil is subject to overflow, but the land drains quickly after the flood waters subside. The surface relief is sloping, and both surface and internal drainage are good.

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The crops grown, yields, and natural vegetation are similar to those on Huntington silt loam.

Williamsburg silt loam.—Williamsburg silt loam is the dominant soil on the terraces of the streams tributary to Ohio River. The brown floury silt loam surface soil extends to an average depth of 14 inches and is underlain by a heavier subsoil of rather friable yellowish-brown silty clay loam which changes, at a depth of about 30 inches, to intricately mottled yellowish-brown and gray plastic silty clay loam. The gray color becomes more pronounced with increased depth, and, at a depth of about 54 inches, light-gray sandy clay occurs. Below this depth, the substratum becomes sandier and changes to yellow and gray rather loose gravelly sand at a depth of approximately 90 inches, and it continues with alternating deposits of sand, gravel, and slack-water silt and clay to the depth of the original stream deposits.

Normally this soil is very acid to a depth of 7 feet or deeper. It occupies the broader and smoother parts of the terraces and is rarely flooded. A gradual change from Williamsburg silt loam to Wheeling silt loam takes place near the mouths of the larger streams entering Ohio River. In places mica flakes, which are common in the Ohio River deposits, occur for a distance of a mile or more up these tributary streams.

The agricultural utilization and value of Willamsburg silt loam are practically the same as those of Wheeling silt loam of the river terraces. Applications of complete fertilizers and lime, in addition to tile drainage, are recognized as beneficial and profitable. The desirability of these soils was early recognized, and more than 90 percent of their total area has been cleared and placed under cultivation. In association with the adjoining bottom lands and uplands, they comprise some of the most desirable farm lands.

Minor variations, which influence crop yields, occur locally. In the valley of East Fork Whiteoak Creek near Sardinia, small bodies of this soil occur at such low elevations above the stream that flooding has resulted and a thin deposit of alkaline material from 2 to 6 inches thick has been left on top of the normally acid soil. Owing to the alkaline surface deposit, these areas are naturally adapted to the growth of legumes, and yields of both hay and corn are higher than on the typical soil. In places where the substratum is more gravelly or stonier, internal drainage is more rapid, and such areas are better suited for growing tobacco.

Sloping areas of Williamsburg silt loam occupy the terrace escarpments and the slopes of ravines crossing the benches. The narrower, steeper parts of these slopes are kept in sod or timber, as a rule, but the more gentle slopes are farmed with the adjoining soils. Corn and small grains suffer from lack of moisture during most years on these slopes. Clovers and bluegrass do well, except during extremely dry seasons or where washing or gullying hinders their growth. Tobacco is grown successfully on some slopes, as more lime is available than in the flatter areas.

Williamsburg very fine sandy loam.—Williamsburg very fine sandy loam has a brown or dark-brown rather loose fine sandy loam surface soil, 12 or 14 inches thick, overlying a brown somewhat sticky sandy clay subsoil. The substratum is loose fine sand, clayey gravelly sand, or in places consists of a layer of large limestone slabs with gravel and sand intermixed. In some places these slabs occur within a depth of a few feet. Where the porous substratum is near the surface, as it is in small bodies along lower Whiteoak, Straight, and Eagle Creeks, crops suffer from lack of moisture at times, but during normal seasons or when excessive rains occur, crop yields, particularly of corn and tobacco, are higher than on Williamsburg silt loam. Like Williamsburg silt loam, the very fine sandy loam is very acid to considerable depth, and therefore, stands of mammoth clover, white clover, or alsike clover are more certain than those of red clover. The substratum is limy at a depth ranging from 5 to 7 feet. The surface relief of this soil is more rolling or undulating than that of the silt loam, and most of the areas are on a different bench level.

A few small areas included with Williamsburg very fine sandy loam very closely resemble it in color, occurrence, and utilization but, unlike typical areas of the Williamsburg soil, are subject to overflow, although a period of a few years lapses between floods. The very fine sandy loam surface soil and the substratum of gravel or sandy gravel are alkaline in most places, but the subsoil is moderately acid. The largest area of this kind lies 2½ miles northwest of Decatur along West Fork Eagle Creek.

Genesee silt loam.—Genesee silt loam is the most extensive first-bottom soil in the county. With the exception of the extreme southeastern part, it occurs along all the Ohio River tributary streams and their larger branches. Most areas of this soil are comparatively long, narrow, and flat surfaced.

The surface soil is brown mellow silt loam to a depth of about 10 inches, and this material gradually changes to somewhat heavier silt loam that is slightly plastic when moist but friable when dry. Normally, at a depth of approximately 36 inches, the material changes abruptly to predominantly brown fine sandy loam representing a different stream deposit from the layer above. Some gray streaks and spots are present below this layer, and the sand content increases to a depth of about 66 inches, where rather loose, incoherent, gray fine sand occurs.

As in most first-bottom soils, minor variations occur, particularly in the thickness and proportion of fine sand in the silty surface layer and in the character of the underlying deposit. On the north side of East Fork Little Miami River, 1½ miles west of Chasetown, and 1 mile northeast of Sardinia on the west side of Bells Run at the county line, are bodies of this soil, which are underlain, at a depth of more than 20 inches, by a dark-colored deposit representing a former dark bottom soil which was subsequently covered by fresh deposits.

Genesee silt loam is one of the most fertile soils in the county, not only in the supply of lime and other mineral elements, but also in its supply of organic matter, which is much above the average. The variety of crops grown depends mainly on the possible damage by overflows which normally occur during winter or early spring. For this reason corn is the principal tilled crop, and acre yields ranging from 50 to 75 or more bushels are not uncommon. Alfalfa, soybeans, and clover produce high yields. Wheat and rye are sometimes grown, and pumpkins and tobacco do well. The lower lying areas are timbered or in grass. Bluegrass grows luxuriantly and usually remains green throughout the summer and fall. Fertilizer is rarely used. Artificial drainage is unnecessary, except to clear outlets along the margins, as the open sandy substratum and friable character of the material throughout allow rapid return of excess water to the streams even after floods. At times losses from floods may be expected on this soil, but ordinarily crop returns are high, owing to the high average yield. Most of the land is under cultivation, and many fields have been cultivated for a long time. The value of all farms including areas of this soil and other bottom soils is high.

Genesee silt loam, dark-colored phase.—A dark-colored phase of Genesee silt loam occurs in very small areas. It differs from the typical silt loam in having a very dark grayish-brown silt loam surface layer about 12 inches thick, which, though mellow and easily cultivated, is somewhat stickier than the typical soil when wet. The subsoil, to an average depth of 36 inches, consists of very dark brownish-gray heavy loam, with fine sand pockets occurring in places. It becomes more gritty in the lower part and normally rests on very dark grayish-brown or dark-brown calcareous clayey gravel, and this, in turn, rests on the glacial drift deposit or the underlying bedrock. Subsoil drainage is not quite so free as in the typical soil.

Like the browner soils, this soil occupies comparatively flat narrow bottoms, but, owing to a wetter condition, it has retained a larger supply of organic matter and is darker colored. Owing to poorer drainage and to somewhat less favorable natural tilth, more of this dark-colored soil is utilized for pasture, although corn, soybeans, and clovers are grown on the better areas, with yields averaging higher than on the surrounding uplands and only a little less than on the typical soil. Fertilizers are not commonly used.

Genesee very fine sandy loam.—Genesee very fine sandy loam is similar in almost all respects to Genesee silt loam, except that it has a fine sandy loam surface soil and a loamy fine sand subsoil. The sandy substratum is reached at a depth of about 40 inches in most places. Both the silt loam and fine sandy loam members of the Genesee series occur in some of the larger bottoms, and invariably the fine sandy loam soil occupies a situation nearer the stream, in some places occurring as a low-lying natural levee bordering the stream bank. Owing to better drainage, tobacco, melons, garden truck, and early and late sweet corn are more commonly grown on this soil than on the silt loam. Most of the land is cleared and under cultivation or is used for pasture. Like on other bottom soils, the tree growth consists chiefly of sycamore and willow, and less common trees are elm, boxelder, ash, buckeye, and walnut.

Genesee very fine sandy loam, high-bottom phase.—Genesee very fine sandy loam, high-bottom phase, is a first-bottom soil of very small extent. It occurs in the vicinity of Newhope along Whiteoak Creek, and a small area is mapped 2 miles north of Fayetteville.

The surface layer of this soil is dark grayish-brown very fine sandy loam, normally about 30 inches thick, showing slight variations in the quantity of silt present. This layer rests on a sandy layer which is somewhat loamy in the upper part but is invariably loose and incoherent at an average depth of 4 feet. Part of the area of this soil lies above ordinary overflow. Farming practices and yields are about the same as those on the typical soil.

GRAY SOILS

Members of the gray, or more poorly drained soils group, cover about 40 percent of the county. This group is dominated by the Clermont and Avonburg soils, which together cover 35.5 percent of the total area. Soils of these two series are very closely associated and are about equally divided in extent, hence a discussion of the members of these two dominant series gives the important facts regarding most of the area covered by the entire gray soils group. The range in value and in the natural features of the soils in this group, however, is wide; particularly of those upland soils having dark-gray surface soils or dark-gray subsoils, because, although these soils are poorly drained, they, nevertheless, have considerable potential agricultural value. The first-bottom soils of the poorly drained group are more fertile than the average for this group of soils.

Clermont silt loam.—Clermont silt loam, locally known as "pin-oak land" or "buckshot land", is readily distinguished by its occurrence on upland flats and its light-gray color. Characteristically it occupies the broader flats having fan-shaped points around the outer margins pointing into the heads of invading drainageways. Even when the soil is wet, the gray shade is pronounced, although it is somewhat darker gray than the dry soil color.

Clermont silt loam, to a depth of 16 or 18 inches, is floury silt loam which tends to run together and bake rather firmly on the surface after being wet. The tight or compact silty clay subsoil in most places is water-logged for long periods. This layer is predominantly light gray, but it contains many yellow and brown stains and splotches. It extends to an average depth of 48 inches and is underlain by a dark-gray layer splotched with brown and yellow. The material in this layer averages about 3 feet thick, and it is dense, plastic, and almost impervious to water in places. Below this layer lighter gray colors predominate, with yellow and brown mottles conspicuous. Pebbles and gritty particles, although not numerous, are scattered throughout the soil, increasing in number with depth. At a depth ranging from 110 to 116 inches, heavy brownish-gray gritty clay loam occurs, which is normally calcareous is rather firmly cemented in the upper part, and is commonly known as hardpan where reached in digging wells and cisterns. This material continues to bedrock in most places or to the depth of the glacial deposits from which it has formed. The lower part as a rule is bluish gray.

This soil is strongly acid to a depth of 80 or more inches, and it is naturally low in organic matter and available nutritive elements. Artificial drainage by open ditches is generally practiced, and a few tracts have been successfully tile drained. The silty, floury character of the soil and its flat surface make thorough artificial drainage difficult to establish and maintain.

The principal crops are corn, wheat, and timothy and alsike or mammoth clover. Complete fertilizer is used on corn and wheat. Corn is the principal intertilled crop, and yields of 35 or more bushels to the acre are obtained during seasons when the rainfall is well distributed; but during wet seasons, such as those of 1928 and 1929, crop failures or very low yields are common unless drainage and improvement of the soil fertility have been previously made. Because this is a cold, wet soil, early autumn and late spring frosts frequently damage the corn crop.

The acreage devoted to corn is larger than that devoted to any other crop. Wheat is the second crop in importance. The soil is more naturally adapted to the production of wheat than of corn, though during open winters the wheat crop is sometimes a failure. From 150 to 300 or more pounds of a complete standard fertilizer are required for best results with wheat. Timothy was formerly the most important crop and is still the most important hay crop. Fair crops of mammoth clover, alsike clover, or timothy and clover mixed are obtained in the better areas. Soybeans are rapidly gaining in favor as a hay crop and green-manure crop. Sweetclover is grown after heavy applications of lime. At times, buckwheat is sown as a catch crop after failure of wheat, corn, or oats. Oats are comparatively unimportant.

Clermont silt loam, dark-colored phase.—Clermont silt loam, dark-colored phase, differs from typical Clermont silt loam mainly in the darker color of the surface soil, as a result of its more poorly drained condition, heavy cover of grass vegetation, and less leaching and oxidation, which have allowed more organic matter to accumulate. The dark-colored surface layer is about 10 inches thick, but it is looser and more free from surface crusting than the typical soil because of the higher content of organic matter, and it is somewhat less acid. In places this layer is underlain by a very light gray upper subsoil layer, such as occurs in some of the bodies lying 1 mile west of Brownstown.

This soil occurs in widely scattered and comparatively small areas in the northern part of the county, chiefly 2 miles west of Mount Orab, 2 miles northwest of Fivemile, 2 miles southwest of Chasetown, and west and east of Brownstown.

Yields of all crops are slightly higher than on the typical soil.

Clermont silt loam, dark-colored subsoil phase.—The striking difference between the dark-colored subsoil phase of Clermont silt loam and the typical soil is that the phase has a darker subsoil and is less acid in reaction. The higher lime content has resulted in increased crop yields, particularly of legumes, and a better growth of pasture grasses. Most areas of this darker soil slope very gently toward a center of low ground, where a narrow strip of alkaline Blanchester soil occupies the lowest part, whereas the surface relief of the typical soil is more uniformly level.

The surface soil of the dark-colored subsoil phase is smooth light-gray silt loam 12 inches thick, and the upper subsoil layer is predominantly gray silty clay loam containing scattered yellowish-brown iron stains, the brown and yellow colors becoming more pronounced larger splotches as depth increases. From a depth of 66 inches to a depth of about 110 inches, the material is yellow-brown and dark bluish-gray clay which increases in grittiness and in lime content in the lower part of the layer. Below this is the deep hardpan layer which in most places continues to bedrock.

Fertilizers are commonly used on this soil, and some liming has been done, with decidedly beneficial results. Corn, the principal crop, yields from 35 to 50 bushels to the acre during normal seasons. This crop receives from 75 to 125 pounds of 2-12-2, 2-12-6, or 0-16-4 commercial fertilizer to the acre, applied in the row at planting time. Wheat yields from 18 to 20 bushels and receives 150 or more pounds of 2-12-2 or other complete fertilizer. Mixed timothy and clover hay normally yields from 1 to 2 tons and clover from 1 to 1½ tons to the acre. Mammoth red (sapling) is the principal variety of clover grown.

Avonburg silt loam.[10]—Avonburg silt loam represents an intermediate stage of soil development between Rossmoyne silt loam and Clermont silt loam, and it occupies a topographic position between these two soils. It occurs throughout the central and northern parts of the county, on the smoother uplands, and on almost imperceptible swells or knolls on the broader flats. These areas are, in general, from 1 to 3 feet higher than the surrounding Clermont soils, hence are slightly better drained, but they have much poorer drainage than Rossmoyne silt loam.

The surface layer of Avonburg silt loam is mellow silt loam about 15 inches thick. The color of the topmost 4 to 8 inches of soil is a combination of light yellow, brown, and yellowish gray, and when the material is moist, is pronounced yellowish brown, but when the soil is dry the gray tints are pronounced. Below a depth of 8 inches the surface soil consists of finely mottled light-gray and light yellowish-gray smooth friable silt loam. The subsoil is light silty clay loam, predominantly light gray in color and containing many yellow and brown stains and specks. This material continues to a depth of 48 inches with a gradual increase downward in the size of the color splotches, in the lightness of the gray color, and in the heaviness of the material. The material in this layer is compact and friable when dry but plastic when wet. Pebbles are more numerous than in the layer above. From an average depth of 48 inches to a depth of about 72 inches the material is comparatively friable silty clay loam, changing in the lower part to gritty silty clay loam. The color is predominantly brownish yellow, with many gray or light-gray streaks, seams, and splotches. The material in the lower part of this layer is less acid, and it changes rather abruptly to the gritty and somewhat stony calcareous glacial deposit, or so-called deep hardpan layer. In places the ground-water level is within 3 feet of the surface of the ground.

The principal crops are corn, wheat, and hay, the hay consisting of mammoth red clover, alsike clover, white clover, timothy, redtop, and soybeans. Some sweetclover also is produced but only after heavy applications of lime. The crops are similar to those grown on the closely associated soils, and the average acre yields are greater than those commonly produced on Clermont silt loam but less than those on Rossmoyne silt loam. This difference is owing chiefly to the difference in drainage conditions, as even the slight difference

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[10] In a number of places along the Clermont-Brown County line the soil mapped as Avonburg silt loam in Brown County joins areas of Clermont silt loam in Clermont County. This discrepancy is due to recognition of the Avonburg series as intermediate between the Clermont and Rossmoyne series subsequent to the completion of the soil map of Clermont County.

in elevation of the flatter lands results in a marked advantage to the higher lying soil, particularly during wet seasons. Intertilled crops may be planted earlier and cultivated more frequently. The common practice of opening shallow furrows for drainage is also more effective.

More than 90 percent of the land has been cleared and placed under cultivation or is utilized for hay meadows or pastures. In the flat sections many homesteads and garden tracts are located on this soil, in order to obtain the slightly better drainage conditions it has over the surrounding Clermont soils.

Avonburg silt loam, dark-colored phase.—Avonburg silt loam, dark-colored phase, differs from the typical soil mainly in the color of the surface soil and in its wetter condition. Grass vegetation and less leaching and oxidation have no doubt brought about the higher organic-matter content. Drainage conditions of the dark-colored phase and its relative elevation with respect to associated soils are practically the same as of the typical soil, although, as a rule, the darker soil is looser and freer from surface crusting than the lighter colored typical soil, because of the higher content of organic matter. Yields of corn, wheat, and clover and other hay crops are also somewhat greater.

The surface layer of this dark soil is about 10 inches thick, and it is generally less acid than the lighter colored typical surface soil material. The subsoil and substratum are identical in all respects with the typical soil.

Small bodies of the dark-colored phase of Avonburg silt loam are associated with areas of Clermont silt loam, dark-colored phase, and several areas are near the western county line west of Hamersville. Approximately 80 percent of the land is cultivated at some period in the crop rotation, and the rest, which is woodland or cut-over land, is used for pasture. Farm values are, in general, a little greater where areas of this soil are included in the farm.

Blanchester silt loam.—Blanchester silt loam is locally known as "black loam." It is distinguished from the dark-colored phase and the dark-colored subsoil phase of Clermont silt loam, in having both a dark-colored surface soil and subsoil. It occupies the wetter situations—the shallow depressions and swales—in the uplands, which have little or no surface drainage outlets.

The 6-inch surface soil is very dark gray or almost black silt loam. In places the material is loose, mellow, and almost chaffy. Below the lighter textured surface layer the soil material is predominately dark gray, and it gradually increases in heaviness to a depth of about 4 feet, where a very dark gray sticky plastic clay layer occurs. Numerous dark-brown iron stains and splotches occur throughout the soil profile. A lighter texture and a lighter gray color are common below a depth of 78 inches, and the material changes from gray and yellow-brown heavy silty clay, through dark-brown and increasingly gritty clay loam, to the hard calcareous glacial till layer which lies at an average depth of about 110 inches.

Blanchester silt loam is less acid than typical areas of Clermont silt loam with which it is closely associated. In a few bodies the material is neutral or alkaline in reaction at a very slight depth. The texture of the surface soil differs in heaviness from place to place, ranging from typical silt loam to silty clay loam. Approximately 60 percent of the land is cleared and farmed. Because it is poorly drained and holds moisture well, crops are better during moderately dry seasons. During favorable seasons this soil produces higher yields of corn than do other members of the poorly drained upland soils, because of its greater content of organic matter, but crops on it are subject to damage by early and late frosts which occur occasionally. Wheat is inclined to lodge on the better areas of this soil, although acre yields range from 20 to 25 or more bushels in some places. Clover also grows well, particularly on the less acid areas.

POORLY DRAINED BOTTOM SOILS

The poorly drained bottom soils include the Sciotoville and Ginat soils and phases of the Williamsburg soils on the second bottoms, or terraces; and the Lindside, Eel, Algiers, and undifferentiated alluvial soils on the first bottoms. The Sciotoville and Ginat silt loams are closely associated with Wheeling silt loam, and they are derived from the same gravelly and sandy stream deposits as the Wheeling soils which they resemble in character, except in the surface soil and subsoil layers.

Sciotoville silt loam.—Sciotoville silt loam occupies an intermediate position with respect to drainage between the Wheeling soils and the poorly drained Ginat silt loam. The surface soil is grayish-brown silt loam, and the heavier subsoil is mottled light gray, brown, and yellowish brown, because of its water-logged condition during part of the year.

Sciotoville silt loam, dark-colored phase.—Sciotoville silt loam, dark-colored phase, differs from typical Sciotoville silt loam chiefly in having a very dark brownish-gray silt loam surface layer 8 inches thick, and a very dark brown silty clay subsoil which changes to mottled brown, yellow, and gray at a depth of about 24 inches and continues to a depth of more than 100 inches, where it passes into the gravelly sand substratum commonly occurring beneath all the Ohio River terraces at a depth ranging from 12 to 14 feet. This soil lies high above the river and along the outer border where it joins the upland slopes and receives surface wash and seepage from them. It is acid, as a rule, to a depth of several feet.

Better yields of corn and clover are normally obtained than from typical Sciotoville silt loam and Ginat silt loam. This soil is very inextensive in Brown County, but all of it is cleared or utilized for pasture. A few small areas are in the extreme southwestern part.

Ginat silt loam.—Ginat silt loam occupies shallow depressions and flat areas or long narrow flat depressions on the broader terraces. It is locally termed slash land or buckshot land, because many small iron oxide pellets are scattered over the surface and through the upper part of the soil. Both surface and internal drainage are inadequate. The land is commonly partly drained by shallow open furrows, although on a few farms tile drains are operating successfully.

Tobacco is seldom grown on this soil because of the acid condition and deficiencies in mineral elements necessary for the production of a good quality leaf. Corn, wheat, and timothy hay, or timothy and clover mixed, are the principal crops. Wheat, with moderately heavy applications of complete fertilizer, produces fair yields on the better drained fields, as the rather compact and more or less impervious subsoil makes this land more favorable for wheat than for corn. Soybeans are grown to a small extent. The acre yields of all crops, as a rule, are less than on the associated Wheeling soils.

Williamsburg silt loam, mottled-subsoil phase.—Williamsburg silt loam, mottled-subsoil phase, is naturally poorly drained on the surface and through the subsoil. It is readily distinguished by its light-gray slightly gritty silt loam surface layer, as it is the only soil with a light-gray surface soil in the county occurring on the terraces of the streams tributary to Ohio River.

The surface soil extends to a depth of approximately 20 inches and in the lower 9 inches is marked by scattered specks and stains of iron oxide, ranging in color from dark brown to yellowish brown. The subsoil is mottled brownish-yellow and light-gray silty clay loam extending to a depth of about 60 inches, which, owing to a rather high content of sand, is very friable except when wet. Below a depth of 60 inches the material is variable, because of the succession of deposits of clay, silt, and sand. This material is calcareous in most places at an average depth of 100 inches, but both the surface soil and subsoil layers are acid in reaction.

This soil is of very small extent, but most of it is cleared and cultivated with the other Williamsburg soils. Crops are the same as those grown on the typical soil, but the average acre yields are less. Buckwheat is sometimes sown as a catch crop when areas of this soil remain wet too late in the spring to plant other crops. A few small bodies are along upper Whiteoak Creek and along the valley of East Fork Little Miami River.

Williamsburg silt loam, dark-colored phase.—The dark-colored phase of Williamsburg silt loam is very inextensive. It occurs in very small bodies along the middle and upper courses of Whiteoak Creek and the lower course of Eagle Creek. It is readily recognized, as no other soil having a dark-colored surface layer occurs on the terraces, or second bottoms, of these streams. The 14-inch surface soil is very dark gray slightly mealy silt loam. The subsoil is heavy fine sandy clay or silty clay, intricately mottled with shades of brown, yellow, and gray, and when moist it is rather sticky. The material becomes sandier with increased depth, and, at a depth ranging from about 4 to 5 feet, it changes to yellowish-brown gravelly sand containing small clay lenses. Considerable variation occurs in the proportions of sand and gravel in different areas of this soil, but on all of it the run-off is naturally slow and the moisture-holding capacity is high.

Its high organic-matter content and the natural availability of mineral elements result in comparatively large acre yields of corn, wheat, and hay where the land has not been mistreated. With proper rotation and care a high state of productivity can be maintained.

Lindside silty clay loam.—Lindside silty clay loam is very closely associated with Huntington silt loam. It has a dark-brown and gray mottled surface soil, and natural drainage is not adequate. Water-logging is common during parts of each year, which has resulted in a mottling of the material with gray, rust brown, and drab in the subsurface and subsoil layers. As this soil occurs in swales or old channels at the outer border of the wider parts of the first bottoms of Ohio River where quiet water prevailed during its deposition, it is heavier than the Huntington soils and, as a rule, contains more organic matter.

This is an excellent soil for corn, and it also produces good yields of pumpkins and hay where sufficiently drained. Wheat is not grown because of the danger from floods each year during winter and early spring. The natural run-off is slower than on the Huntington soils. Only two small areas of this soil occur—one, one-half mile east of Higginsport near the mouth of Whiteoak Creek, and the other, one-half mile southeast of the Ripley water works plant.

Eel silty clay loam.—Eel silty clay loam occurs in the wetter situations along the outer borders of the broader creek bottoms or in old abandoned channels. It occurs typically in small bodies west of Sardinia at the western margin of the first-bottom land along East Fork Whiteoak Creek, and north of Fayetteville in the valley of East Fork Little Miami River.

The 8-inch surface soil is yellowish-brown silty clay loam containing gray streaks in the lower part. Below this and continuing to a depth of about 28 inches is plastic silty clay having a combination of brownish-gray and yellowish-gray colors with dark-brown soft iron specks scattered through it. The mottled colors of this heavy layer indicate its saturated condition at times. The substratum differs from place to place, ranging from dark-brown and gray silt loam to sandy clay. Below a depth of 5 feet rather loose sandy gravelly layers are common.

Most of the land is cleared and is farmed with the adjoining better drained bottom soils. Like these soils, it is well adapted to the production of corn during seasons that are not too wet. Because of its flat or depressed surface relief and consequent slow run-off and also because of its tight compact subsoil, the land remains wet for longer periods than Genesee silt loam or Genesee fine sandy loam. The soil material is alkaline, or " sweet ", throughout.

Algiers silt loam.—Algiers silt loam differs from Eel silty clay loam in having a strongly acid subsoil layer. Chiefly for this reason it is not so productive as the Eel soil. It occupies similar situations in the first bottoms, and farming practices are the same. Its total extent is much less than 1 square mile. One area lies 3 miles southeast of Mount Orab in the valley of West Fork Whiteoak Creek, and small bodies are north of Fayetteville in the valley of East Fork Little Miami River.

Alluvial soils, undifferentiated.—At the heads of small ravines and extending along their narrow wet bottoms is a mixture of silt, sand, and clay washed from the nearby glacial uplands. Because of the variable character within short distances these materials are classed as alluvial soils, undifferentiated. Their color ranges from gray to brown and yellow without definite distribution in any part of the soil profile. Most of the surface material is gray, and the underlying material is everywhere mottled. These alluvial materials are sweet, and, except during extremely dry periods, they remain saturated.

Areas of undifferentiated alluvial soils are used chiefly for pasture, as bluegrass grows luxuriantly where the land is not too wet. Very little of this undifferentiated soil is cultivated. It occurs in small stream bottoms in all except the extreme southeastern part of the county.

Included with this material in mapping is a very small total area of rocky land that borders stream channels or occupies newly cut channels between bends in the streams. This material consists of a mixture of rock slabs, boulders, sand, gravel, and driftwood. It is subject to overflow during most freshets and is considered nonagricultural land. Willow and sycamore are the common trees. Most of it is waste land, but in places it is fenced with adjoining pasture land and affords some grazing and a run for livestock.

SOILS AND THEIR INTERPRETATION

The soils of Brown County, form a part of that great group of gray-brown podzolic soils which occupy large areas of land in Ohio, southern Michigan, Indiana, and southern Illinois. Based on differences in color, in other marked physical characteristics, and in drainage conditions, these soils may be divided into two major groups: (1) The brown soils, or better drained group; and (2) the gray soils, or more poorly drained group. The color of the surface soils of soils of the brown group ranges from grayish brown or yellowish brown to reddish brown, and the subsoils are free from mottling, particularly in their upper parts. The color of the soils of the gray group ranges from light gray to very dark gray in both the surface soils and subsoils. The subsoils of soils of this group are invariably mottled with gray and various shades of brown and yellow. The deep substratum is practically identical with that beneath the corresponding soils of the brown soil group. With the exception of some soils of very small extent, which have dark or very dark surface soils, the soils of both groups are deficient in organic matter and are, for the most part, rather thoroughly leached of lime and other readily soluble mineral elements in their surface soil and subsoil layers. By far the greater proportion of the soils have silty surface soils, about 12 inches thick, and subsoils which are heavier in texture than the surface soils.

For purposes of detailed discussion and description, the two major groups may be further divided, on the basis of differences in parent material, into 5 subgroups. On this basis the brown soils fall naturally into 3 subgroups: (1) Soils derived from Illinoian glacial drift;[11] (2) soils derived from materials produced by the weathering of the underlying limestone and interbedded shales of the Cincinnati and Richmond beds of the Silurian geological formations;[12] and (3) soils derived from or composed of stream deposits of stratified sands, clays, silts, gravels, or slack-water material. On the same basis, the gray soils have two natural subgroups: (1) Soils derived from Illinoian glacial drift; and (2) soils derived from or composed of stream deposits.

The charactertistic mature profile of the soils of each of the three divisions of the brown group will be described, and the relationships which the various soils of a particular group have to the mature or

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[11] LEVERETT, F. GLACIAL FORMATIONS AND DRAINAGE FEATURES OF THE ERIE AND OHIO BASINS. U. S. Geol. Survey Monog. 41, 802 pp., illus. 1902.

[12] CHAMBERLIN, T. C. and SALISBURY, R. D. GEOLOGY. Ed. 2, v. 2, illus. New York. 1907.

normally developed soil of that group will be discussed. This will be followed by a discussion of the variations caused by poorly drained conditions which have resulted in the development of immature soil profiles such as those of the gray group.

Cincinnati silt loam is the normally developed soil of the glacial region.[13] A representative body of this soil occurs in the northeastern part of Pleasant Township, about 3 miles east of Georgetown along State Highway No. 125. The exposure of the profile examined faces eastward and is approximately one-fourth mile east of Straight Creek. The soil occupies a gentle slope near the steeper slope of a short tributary valley of Straight Creek. Here the ridge point is about 400 feet wide at the top, the surface relief is gently rounded or convex, and the elevation is approximately 880 feet.[14] Drainage is well established on the surface and through the soil to a depth of 3 or 4 feet, although water movement is slower through the heavy layer, as is evidenced by gray tints. Surface run-off is rapid, and gullies are cut rapidly in exposed places. At this point the creek bed is from 65 to 75 feet below the crest of the ridge. The soil here is apparently derived from the weathered product of Illinoian glacial till. The tree growth is predominantly sugar maple, black walnut, beech, red oak, and white oak, with some ash, linden, buckeye, hickory, and black gum. In most places tuliptree is common. Following is a description of the profile as observed at this place:

A_0. This layer, which ranges from one-fourth to 1 inch in thickness, consists of partly decomposed and disintegrated leaves, twigs, and other organic remains, forming a loose mulch on top of the mineral soil. The upper part is variegated with the many shades of color of the leaves, twigs, and bark composing it; and the lower and better decomposed part is very dark brown. The pH value[15] is 6.4.

A_1. 0 to 1 inch, loose smooth very dark grayish-brown silt loam having a single-grain structure, though fine granules cling to rootlets. The material is composed of silt, very fine sand, and very little clay. Many roots and rootlets penetrate it. A few scattered glacial pebbles occur on the surface. The pH value is 6.4.

A_2. 1 to 4 inches, yellowish-brown silt loam with siftings of organic matter from above, giving a general appearance of brown in spots. The color of the dry soil is brown. The structure is single grain, and the material breaks into small lumps which crumble readily under light pressure. The material in this layer is floury and friable when dry or moist, but when wet it adheres weakly under pressure. The percentage of silt is high. Organic matter has reached this layer through insect and worm workings and by sifting along root or other channels. The gradation to the layer below is through a 2-inch transitional layer. The pH value is 5.6.

A_3. 4 to 15 inches, light yellowish-brown silt loam containing scattered stains and spots of light reddish brown, which become more pronounced with depth. A sprinkling of light-gray or light yellowish-gray silt covers the exteriors of many lumps or naturally broken fragments and occurs on the pore-space walls. The structure is single grain, but the material, in place, contains many fine needlelike holes. When picked out it breaks irregularly, and the fragments crumble easily in the hand. When dry or slightly moist the material is friable but not so floury as that in the layers above. The change to the layer below is gradual through a transitional layer ranging from 2 to 4 inches in thickness. The pH value is 4.8.

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[13] CHAMBERLIN, T. C., and SALISBURY, R. D. See footnote 12, p. 36.

[14] Estimated from UNITED STATES GEOLOGICAL SURVEY topographic map, Higginsport Quadrangle.

[15] All reaction readings unless otherwise indicated are by E. H. Bailey, Bureau of Chemistry and Soils, U. S. Department of Agriculture. The hydrogen-electrode method was used in making the determinations.

B_1. 15 to 32 inches, brownish-yellow light silty clay loam having a coating of reddish brown on the faces of many fragments. The interiors of the particles are yellowish brown. Only a very little gray silt is sprinkled along crevices, but very dark brown specks and stains of manganese and iron oxides occur in the lower part of the layer. The natural breakage results in irregular lumps which are made up of subangular fragments ranging from one-fourth to one-half inch in diameter, which may be crumbled readily in the hand. When dry or slightly moist the material is friable, but when wet it is sticky and can be rolled out between the fingers into cylinders one-sixteenth inch in diameter and 1½ inches long, before breaking. Only the larger roots penetrate this layer. The gradation to the layer below is represented by a zone from 3 to 5 inches thick. The pH value is 5.1.

B_2. 32 to 48 inches, brownish-yellow silty clay loam, with material of a very pronounced red cast occurring as a coating on natural fracture planes. This red coloring is more uniformly distributed throughout the mass. The more open crevices have light-gray or light yellowish-gray silt particles sprinkled along their walls. The reddish-brown coatings and the very dark brown coatings and splotches of iron and manganese oxides, which are from one-half to 1 inch in diameter, are the conspicuous features of the color of this layer. Under normal field moisture conditions irregular-sized lumps may be broken out, and these crush with a little pressure in the hand. The proportion of clay, iron, and manganese, and rock fragments is greater than in the layer above. The pH value is 4.9.

B_3. 48 to 64 inches, silty clay which is predominantly brownish yellow and contains mottles of light yellowish gray. The manganese and iron oxide content is greater in this layer, and very dark brown pellets or aggregates having rather hard centers are present. Very little reddish-brown coating of the particles occurs. The structure is massive, and lumps of various sizes may be picked out, but in their natural state they are not held together firmly. The material crumbles readily except when wet, and in this condition it is sticky, plastic, and slightly tough. The gray slick and shiny material is very plastic, but the dark-brown material is friable. Resistant pebbles of glacial origin are scattered through the layer, and most of them are small, but some range from 1 to 2 inches in diameter. Through a distance of 4 or 5 inches this layer changes to the sandier and more pebbly layer below. The pH value is 5.1.

C_1. 64 to 110 inches, some parts of this layer are sandy clay and other parts, particularly the lower part, are gravelly clay. The colors are predominantly brownish yellow and yellowish brown, though thin streaks and seams of gray and light gray occur, and yellow and reddish-brown tints appear in the sandier spots. The clay content is sufficiently high and coherent to bind the material rather firmly, so that when moist it is slightly tough, plastic, and sticky. Even the sandier pockets contain sufficient clay to bind the material into a sticky mass. The sand, pebble, and boulder fragments consist entirely of resistant igneous and metamorphic rocks of glacial origin. Although the material is neutral or alkaline in reaction, it does not effervesce with cold dilute hydrochloric acid. The change to the calcareous layer below occurs abruptly, though not as a horizontal plane. The boundary is depressed in the gravelly and sandy areas and rises higher where the materials are heavier and leaching has been less rapid. The pH value is 7.3.

C_2. 110 to 118 inches +, a complex mixture of clay, silt, sand, gravel, and rounded boulders and limestone slabs, which has not been greatly altered since it was left by the Illinoian glacier. The various shades of yellow, gray, and brown indicate that changes are taking place, but very little leaching has occurred, as considerable amounts of free carbonates are present. Oxidation of some of the materials occurs to a depth of 15 feet, and below this the predominant color is bluish gray. The average thickness of the glacial deposit in Brown County is about 20 feet, and in places it is 50 or more feet thick. The upper part is rather firmly bound or cemented. Jointing seams or planes, 1 or 2 inches apart, are conspicuous in the exposed profiles. Most of the material comprising the drift is from limestone or dolomite, though many kinds of igneous and metamorphic rocks are present—granites, gneisses, schists, quartzites, and diorites being the most common. The mixed materials in this layer effervesce freely in cold dilute hydrochloric acid. The pH value is 8.2.

Other soils, which are geographically very closely associated with Cincinnati silt loam, are Cincinnati silt loam, shallow phase, Rossmoyne silt loam, Avonburg silt loam, Loudon silt loam, Jessup silt loam, and Edenton silt loam. The profile features of Rossmoyne silt loam are similar to those of the Cincinnati soil, with the exception that Rossmoyne silt loam is mottled with gray at a much slighter depth and everywhere above an average depth of 30 inches, and columns are generally evident in the heavier part of the B horizon. Although the A and B_1 horizons are uniformly oxidized, they are not so well oxidized as are the corresponding layers in Cincinnati silt loam, hence do not have the reddish-brown tint; but instead, the dominant colors are yellowish brown or brown. Seemingly, this is chiefly owing to the fact that drainage is not so well established in the Rossmoyne soil, as this soil occurs farther from the larger drainageways and has a smoother and less rounded surface configuration.

Bordering the glacial boundary on the north are two transitional soils—Jessup silt loam and Loudon silt loam. The color profile of Jessup silt loam resembles that of Cincinnati silt loam, with the exception that an olive-brown color appears in the substratum. Likewise, the color of Loudon silt loam resembles closely that of Rossmoyne silt loam, except in the substratum where the olive-brown color appears. The glacial drift is much stonier, however, and it contains a higher proportion of clay and lime and less foreign rock than is typical. For this reason these soils are not so thoroughly leached and the calcareous drift occurs at a slighter depth. Their subsoils are much heavier, and the olive-brown clays or silty clays of the substrata resemble very closely those in the soils of the unglaciated section of the county. A gradual thinning of the glacial deposit and, apparently, a weaker ice action near the limit of the ice, together with the fact that it terminated in a region where the bedrock was comparatively pure limestone with some interbedded shale, accounts for the stony heavy calcareous glacial till.

Edenton silt loam represents a soil condition existing on V-shaped valley slopes in the Illinoian glacial region. Typically, it occurs at the heads of the smaller valleys where they are invading the undulating uplands, but farther down and in the larger valleys it occurs as a narrow strip along the valley rim, in association with Cincinnati, Rossmoyne, or Jessup soils on the adjoining uplands and Fairmount silty clay loam on the lower slopes. The profile varies considerably within mapped areas, but in most places the calcareous till lies within a depth of 36 inches of the surface, and in some places it is exposed on the surface. Because this fresh calcareous drift is within reach of the deeper rooted plants, clover, alfalfa, and tobacco produce higher yields than on the average upland soils, except where erosion and freezing have interfered. The layers above the glacial till are similar to those comprising the A and B layers of the Cincinnati soils, except they are thinner and any part or all of either or both layers may be missing, depending on the stage of development in the particular location.

Poorly drained conditions existing subsequent to deposition of the glacial drift have resulted in a number of differences in the profiles of soils formed from the drift. On the broader flats, run-off has been slow and saturation common for considerable periods at times, and light-gray leached soils have developed.

These soils are best represented by Clermont silt loam which has four main horizons. The first horizon extends to a depth of about 16 inches and is floury silt loam. The material is dark gray for only a fraction of an inch even in wooded areas, and below a depth of 3 inches it is predominantly light gray, although specks and small spots of yellow and brown iron stains without definite arrangement are common. Small dark-brown shotlike pellets of iron and manganese oxide are on the surface and through this layer. The second layer is predominantly light-gray silty clay loam to a depth of 48 inches. It is splotched and stained with iron oxide of various shades of brown and yellow. This material is plastic and sticky when moist, and, though in general appearance it is massive, it has developed a rather definite prismatic structure in most places. The prisms may be pried out of the upper part of the layer, and they have a definite transverse or horizontal fracture. They reach a maximum length of 6 or 8 inches, including their light-gray silty cappings, and are from 1 to 1½ inches in diameter. Below this is the third, or transitional layer, which is about 6 feet thick. When moist the materials are very sticky and plastic. The material in the upper 3 feet of the layer consists normally of dark-gray silty clay containing splotches of brown and yellow colors, larger than in the layer above, which form around soft clayey manganese and iron oxide aggregates. From an average depth of 78 inches to a depth of 126 inches the gray color becomes less predominant and the yellow and brown more pronounced, particularly in places where the rocks are more numerous. Although the content of pebbles and gritty fragments is greater in this part of the layer, the texture is silty clay loam or heavy clay loam. The fourth layer consists of calcareous glacial drift which is somewhat sandy and gravelly, rather firmly cemented, jointed, and partly oxidized in the upper part, but below a depth of approximately 15 feet is bluish-gray till apparently little changed since deposition.

Apparently a correlation exists between the tree growth and the depth of the heavy layer in Clermont silt loam. Large areas having uniformly heavier subsoils than typical, at a depth of 10 or 12 inches, support a tree growth predominantly of red oak, white oak, and scattered beech; whereas on areas having a deeper silty surface layer beech is predominant. The tree growth is larger and denser on the areas of heavy soil and on the dark-colored subsoil phase of Clermont silt loam. This heavier subsoil phase has a certain characteristic brown tint to the light-gray color of the surface soil, which contrasts with the uniform light-gray color of the silty type of soil.

The low-lying knolls or areas having slightly sloping surface relief, which commonly occur on the broad gray flats, have somewhat better surface drainage, and this has resulted in the development of Avonburg silt loam. This soil differs from Clermont silt loam chiefly in having a somewhat browner surface soil and a greater amount of yellow and brown staining and splotching throughout the soil profile. It represents an intermediate stage of development between Clermont silt loam and Rossmoyne silt loam.

Slightly depressed and wetter lands on these broad upland flats have gradually accumulated organic matter and retained it and are characterized by very dark gray surface soils and drab or dark-gray subsoils. In these places Blanchester silt loam is developed. Other soils having dark-gray surface soils are Avonburg silt loam, dark-colored phase, and Clermont silt loam, dark-colored phase. Apparently a combination of poorly drained conditions and a former period characterized by a prairie or grass vegetation accounts for the dark surface soils. The dark-colored subsoil phase of Clermont silt loam is very similar in profile features to the typical soil, except that it is much less acid at a depth below 2 feet. The subsoil and substratum are a shade darker than the corresponding layers of the typical soil. This phase is very small in extent, but it is a stronger soil than the typical soil and is more naturally adapted to the growth of legumes. It occupies a similar stage of development between typical Clermont silt loam and the less acid type of Blanchester silt loam that the Brookston soils occupy between the Clyde soils on the one hand and the Crosby soils on the other. However, the Clermont and Blanchester are much older soils and have reached an advanced stage of development of their respective profiles.

In the southeastern part of the county, which is known as the unglaciated section, is a group of soils derived from the weathered product of limestone and interbedded shales. The sharper breaks, the steeper slopes, the absence of foreign, or so-called glacial, pebbles and boulders on the surface and through the soil profile, and the absence of glacial till in the substratum, are the more evident features used in differentiating the soils of the two groups. Unlike glacial boundaries in many places, there is an absence of morainic features to mark the general outline of this group. One of the mounds north of Georgetown is somewhat gravelly in the substratum, but it lies several miles northwest of the actual boundary. Roughly, the boundary line extends southwestward from a point on the eastern county line 2 miles south of Decatur to Ripley on Ohio River. Except for the two prominent salients extending along the valleys of Lafferty Run and Eagle Creek, the general course of the boundary is very direct, extending over ridge tops and across valleys.

Maddox silt loam is the normally developed soil of the unglaciated limestone and shale region. Its surface layer is predominantly brown, is about 10 inches thick, and consists of smooth floury silt loam. A few inconspicuous light-gray and yellowish-gray fine specks and coatings and scattered dark-brown manganese specks occur in this layer. This material changes, through an inch or two of gradational material, to silty clay loam which is predominantly brown with reddish-yellow and yellowish-gray tints well distributed throughout, also scattered specks of dark-brown iron stains. When wet the material of this second layer, which extends to a depth of about 20 inches, is plastic. Below this, and extending to a depth of about 38 inches, is intricately streaked and specked yellowish-gray and yellowish-brown clay which, under certain light reflections, has a reddish-yellow cast. The gray color is more pronounced in the lower part and manganese specks are more numerous, indicating some slowness of drainage. When wet the material is plastic, sticky, and somewhat tough. The next layer rests directly on and occurs around the limestone rock slabs of the disintegrating upper part of the bedrock. It consists of olive-yellow calcareous clay having dark-brown and reddish-brown stains and coatings in places, and it contains much light-gray friable limy material, also some scattered specks of manganese oxide. The olive-yellow clay is very plastic, sticky, and slick when moist, and it retains moisture even during dry periods. In the typical soil, bedrock is reached at a depth of about 44 inches.

Eden silt loam differs from Maddox silt loam chiefly in that it has a silty clay loam surface layer or only 2 or 3 inches of silt loam overlying the silty clay loam, and bedrock lies within 26 inches of the surface.

Fairmount silty clay loam is very similar in most characteristics to Eden silt loam. It differs from that soil in that it has a very dark grayish-brown silty clay loam surface layer from 6 to 10 inches thick, and has glacial rock fragments scattered over the surface in places. It occurs on the steep valley slopes within the glacial region. It is derived directly from the weathered product of the Richmond beds of the Cincinnati formation, which consist of thin-bedded limestones and soft calcareous shales.

Heitt silty clay loam has a reddish-brown surface layer underlain by olive-yellow calcareous clay like the Fairmount and Maddox soils. It is developed chiefly on the steep valley slopes within the unglaciated region.

Ellsberry silty clay loam differs from the Maddox soils chiefly in having an intricate specking of red below the silty surface layer and extending to the olive-yellow clay which overlies the bedrock. It is apparently derived from thicker limestone beds than the Maddox soils, and in most places bedrock is reached at a somewhat slighter depth.

The best drained brown soils on the higher parts of the stream terraces closely resemble the upland soils—Cincinnati and Rossmoyne—in that they have brownish-colored smooth silty surface layers about 14 inches thick, and brownish-colored heavier subsoils, or B horizons, with reddish-brown tints. They also have the thick transitional zone, in which leaching has been very active, but disintegration and decomposition has only partly changed the parent material. These soils differ from the upland soils chiefly in their parent materials or substratum layers.

The Wheeling soils are derived from the stratified sands and gravels, deposited by Ohio River, which consist of a great variety of comparatively well rounded fragments, chiefly of quartz, though granite, diorite, schist, quartzite, fragments of coal, and flakes of mica are numerous. These soils are strongly acid in reaction down to the gravel and sand layers, or approximately to a depth of 150 inches. Below this the reaction is neutral or alkaline, although the materials do not all effervesce when cold dilute hydrochloric acid is added.

Although derived from the same kind of materials as the Wheeling soils, Sciotoville silt loam and Ginat silt loam have developed mottled yellow, gray, and brown profiles because of less favorable drainage. Ginat silt loam has developed under very poor drainage and is predominantly light gray in the surface soil, through the subsoil, and in the upper substratum. Sciotoville silt loam has developed under drainage intermediate between that of the Wheeling and Ginat soils, and in color profile it very closely resembles Rossmoyne silt loam.

The first-bottom soils differ in character, according to the kind of deposits forming them. In general they are alkaline in reaction. Along the first bottoms of Ohio River the common materials are brown or grayish-brown micaceous silt loam and fine sandy loam, from which Huntington silt loam and Huntington fine sandy loam have developed.

Alluvial deposits along streams receiving wash from the unglaciated limestone and shale section of the southeastern part of the county are characteristically reddish brown and free of all mica and other foreign materials commonly found in the Ohio River deposits. These bottom soils are correlated with Huntington silt loam. Their surface soils are invariably silt loam in texture, and sandier layers occur below.

Lindside silty clay loam is alluvium of the Ohio River first bottom, which has lain in a poorly drained situation and has developed the characteristic gray and mottled gray and brown colors of poorly drained soils.

Of the soils in the first bottoms of the tributary streams of Ohio River, which receive wash from the glaciated uplands, the better drained and brown deposits have been correlated as Genesee silt loam and Genesee very fine sandy loam, although the Genesee soils are more typically derived from drift material of Wisconsin glacial age. A dark-colored phase of Genesee silt loam and a high-bottom phase of Genesee very fine sandy loam occur in very small areas.

Eel silty clay loam is alluvium lying in poorly drained situations along the small streams. Algiers silt loam, like Eel silty clay loam, is poorly drained alluvium differing from the Eel soil mainly in having alkaline material deposited over an acid layer which normally occurs at a depth ranging from 18 to 24 inches.

In the many small drains and at the heads of small valleys the deposits are variable in texture and color, but they are everywhere rather wet, as they receive seepage water from the surrounding uplands. They are alkaline in reaction and are classed as alluvial soils, undifferentiated. This classification also includes narrow marginal strips of nonagricultural land lying along parts of the larger creeks, which consists of a mixture of boulders, rocks, shale, gravel, sand, and driftwood. Such areas are flooded during freshets and frequently reworked or changed by stream action.

Table 4 gives the pH determinations of several soils.

TABLE 4.—*pH determinations of three soils in Brown County, Ohio* [1]

Soil type and sample no.	Depth	pH	Soil type and sample no.	Depth	pH
Clermont silt loam:	*Inches*		Clermont silt loam, dark-colored subsoil phase—Continued	*Inches*	
273517	0 - ½	5.4	273505	66 - 78	7.2
273518	½- 3	4.8	273506	78 -110	7.5
273519	3 - 16	4.5	273507	110 -118	8.1
273520	16 - 48	4.8	Avonburg silt loam:		
273521	48 - 78	5.2	273542	0 - ½	5.3
273522	78 -102	6.9	273543	½- 3	4.6
273523	102 -116	7.3	273544	3 - 8	4.6
273524	116 -126	8.0	273545	8 - 15	4.8
Clermont silt loam, dark-colored subsoil phase:			273546	15 - 24	4.4
273501	0 - 7	5.2	273547	24 - 48	4.7
273502	7 - 12	5.2	273548	48 - 72	5.2
273503	12 - 24	5.2	273549	72 - 96	6.8
273504	24 - 66	6.7	273550	96 -110	8.3

[1] Determinations made by E. H. Bailey, Bureau of Chemistry and Soils.

THE MANAGEMENT OF BROWN COUNTY SOILS [16]

On the basis of soil-management problems, the soils of Brown County may be placed in five groups, each group presenting problems peculiar to it; and although certain of these problems exist in two or more groups, the degree of importance shifts from group to group and may even be nil in some.

With rare exceptions, the weaknesses of the soils are so acute as to necessitate a well-designed scheme of management. A soil-management program of mere maintenance is not sufficient, as the objective and the effort must aim at building the soil up to a level of efficiency for production of a high quality and yield of crops, such that operations will receive a good labor income. The five soil groups are as follows: (1) Flat upland soils, (2) undulating or rolling upland soils, (3) hill soils, (4) terrace soils, and (5) flood-plain soils. The soil types comprising each group are arranged in the order of natural drainage, the poorest drained being discussed first.

FLAT UPLAND SOILS

The soils included in the flat upland group are Blanchester silt loam, Avonburg silt loam, and Clermont silt loam.

In farming the flat upland soils, several problems are outstanding, some of which are acute and others of such weight as to jeopardize the margin of agricultural profit, but all affect the long-time stability of farming in the section where these soils are extensive. All these soils are responsive to a sustained program of improvement to bring them up to a satisfactory performance. The principal measures to be adopted in their improvement are as follows: (1) Restock the soil with liberal quantities of organic matter; (2) provide some form of systematic drainage; (3) adjust tillage to tilth and moisture peculiarities of the soil; (4) grow more and a better quality of hay; (5) increase grain yields to a profitable level by combining resources in barnyard manure, green-manure crops, straw, stalks, and fertilizer; and (6) provide winter protection to the soil and the crop.

[16] This section of the report was written by J. A. Slipher, extension agronomist, Ohio State University, and J. S. Cutler and G. W. Conrey, associate agronomists, Ohio Agricultural Experiment Station.

The first and greatest need of the soils of this group is organic matter. With the exception of the Blanchester soil, these gray soils contain the least of this constituent of any of our Ohio lands, some analyses disclosing as little as 6 tons an acre of organic material in the plow layer of Clermont silt loam. Organic matter is needed, not only for its own sake, but because it improves the tilth, aids water retention, and favors normal fertilizer efficiency—three properties in which these soils are especially weak. Experience with commercial fertilizer treatments on these soils in north-central Brown County, where fields known to have received little organic matter in past rotations were treated with 350 pounds an acre of a standard complete fertilizer, resulted in only a slight increase in the wheat yield. However, farmers who make heavy applications of manure or plow down clover report normal and profitable responses to commercial fertilizer. Furthermore, the commonly observed tendency of the soils to consolidate firmly on drying may be traced to the dearth of vegetable material, because the presence of fragments of fresh or decaying vegetable matter produce lines of weakness in the soil, keeping the plow layer friable and receptive to the absorption of water.

Because they never contained enough plant matter when plowed, the task of building up the organic-matter content of these soils is doubly heavy, and large quantities plowed in frequently are needed. To build up and maintain the needed amount requires the pooling of all means available to the farmer—manure, green-manure crops, straw, cornstalks, weeds, and sods for plowing under, as one alone is insufficient.

Undecayed manure provides the most organic matter. Fresh manure carries from 500 to 600 pounds of organic matter (dry weight) in each ton, and a 10-ton application to an acre of land provides 6,000 pounds (dry weight) of vegetable material; but if the manure be left unprotected for 3 months, aging will shrink this to 2,500 pounds. Nowhere else in Ohio are efforts expended in protecting manure likely to return so wide a margin of profit as on these needy soils. The quantity of manure from all farm livestock in Brown County is sufficient to provide 4½ tons yearly to each acre of land planted to corn; but even if no loss by aging occurs that quantity is inadequate, and supplementary organic material from straw and stalks is needed. The straw grown on an acre of land here supplies bulk equal to that in 2 tons of manure. Straw and cornstalks not needed as litter at the barn are better left in the field to be disked or plowed under promptly.

Sweetclover furnishes not only large bulk but a high quality of material to be plowed under. At the bloom stage a good growth of this crop contains from 6,000 to 8,000 pounds (dry weight) of material. Its mechanical effect excels that of 10 to 15 loads of manure, owing in part to the loosening action of the roots. To realize the full benefit from sweetclover and other clovers, it is necessary to allow the crop to reach the bloom stage before plowing it under. Because the three soils in this group are acid, liming is necessary to grow sweetclover and, to a less degree, to grow other clovers.

These level lands are practically devoid of natural drainage, as the flat surface relief and the tight subsoils retard both surface and internal drainage. During the winter and until late spring, the water table stands at, or in, the plow layer, and this results in a long lag of soil temperature behind air temperature, which delays the preparation of the land for oats and barley. The delayed fitness of the soil for working and spring planting substantially shortens the growing season and necessitates the use of short- to medium-season corn varieties, such as Woodburn and Clarage, or hybrids, such as Iowa 301. Choice of other crops is of necessity confined to water-tolerant ones, such as soybeans, timothy, orchard grass, redtop, alsike and mammoth clovers, and attempts to grow such crops as alfalfa, potatoes, and tobacco will probably result in failure.

The use of tile to improve the drainage of these soils fails to give the same measure of relief commonly experienced on other soils. A survey of response from tiling on 83 farms, involving 430 fields including soils mostly of this group, in Brown and Clermont Counties, indicates that the gain in yields on completely tiled fields has been only 8 bushels of corn and 4 bushels of wheat per acre. The completely tiled fields had laterals systematically spaced from 3 to 4 rods apart. Delivery of water through the closely packed and impervious subsoil is unusually sluggish, and this handicap is so great that offsetting it with closer spacing becomes impractical, as the added cost mounts faster than the gain in efficiency. It is necessary, therefore, to balance a reasonable spacing (and cost) with a partial crop betterment. Assuming grain and tile prices at parity, the farmer may expect more than interest return on money invested in tile lines spaced from 4 to 5 rods apart in these soils.

In practice, these lands may be drained by one or by combinations of three methods. Which should be adopted on a given farm will be determined by the finances available and by the outlook for parity prices of the more responsive crops to be grown. (1) Plowing in narrow lands from 25 to 35 feet wide and leaving open furrows to discharge into permanent outlet ditches proves fairly satisfactory in all except the wettest seasons. (2) The most promising method consists of tile lines spaced from 6 to 8 rods apart and oriented from 30° to 60° with the direction of the plow-furrow pattern. (3) A simpler method consists of a few irregular tile lines so placed as to intercept water from the plow furrows. To facilitate access of water from the furrow to the tile at the cross-over point, a filled-in core of gravel or stone is of aid in either method. For the purposes of this drainage method, 5- or 6-inch tile are preferable. The physical characteristics of these soils necessitate that the tile lines be spaced from 3 to 5 rods apart and laid at a depth ranging from 22 to 26 inches.

Crops on the flat lands closely reflect tilth conditions, and proper tillage results in marked effectiveness. What may be regarded as standard practice in plowing and cultivating most soils requires careful adjustment to meet the unusual physical characteristics of these soils. Lacking the two essentials of natural granulation—organic matter and lime—these soils fail to develop a high state of tilth, and tools alone must be depended on to provide proper granulation. But tool-made tilth set up in the absence of organic matter or lime is short-lived, the lack of stability readily giving way to the destructive action of winter and of rainfall at all seasons. Fall or winter plowing of these soils is not practical, because nature undoes rather than supplements the work of the plow. On being saturated by winter and spring rains, the plow slice sloughs off and slumps into a shapeless mass, having about the same compactness as the unplowed land. Satisfactory spring plowing is confined within a short period, as these soils possess a narrow moisture range for effective action of the plow. In favorable dry weather their moisture content quickly passes out of the optimum range, resulting in the formation of lumps and subsequent trouble and extra expense in preparing the seed bed.

Overtillage is a common fault on these soils, as well-plowed and properly shattered furrow slices need little subsequent working. Farmers are apt to forget that the weak structure of the soil cannot stand vigorous stirring, and it is better to use the drag little, if at all, and the cultipacker sparingly, so that a fair lot of small clods will take up the wear from cultivation and rainfall during the growing season. As these soils have a tendency to lose their looseness and tilth, they require frequent and thorough cultivation incident to growing corn and soybeans. The use of a shovel cultivator working 3 inches deep on weed-free Avonburg and Clermont silt loams at the Clermont experiment farm increased the corn yield. The need for vigorous stirring favors the use of standard shovels in preference to sweeps or duck-foot cultivators. Consolidation and packing of the soil by rains or prolonged damp weather necessitates recultivation.

A permanent agriculture, in respect to livestock and crop enterprises and a productive soil, rests very definitely on more acres and higher yields of legume and other hay crops in this county. At present (1929) the ratio of the hay to the cereal-crop acreage is too wide, being 1:4. Of the hay, only 25 percent consists of legumes, which means 1 acre of legumes to every 16 acres of cereals. Corn exhausts the soil of organic matter and nitrogen, whereas legumes and hay grasses are restoratives. But with 50,000 acres devoted to corn, in contrast to 4,700 acres devoted to legumes and 13,500 acres to other hay grasses, it is apparent that exhaustion is outrunning restoration. To rebuild and hold the soil on a profitable level of productiveness requires that the corn acreage be offset with at least an equal acreage of legumes and other hay crops in the rotation. This means shifting some of the corn acreage to hay production or to legume crops to be plowed under.

More legumes and a better type of hay are required to economically carry the livestock enterprise of the county. Fully 40,000 acres in good protein hay are needed by the livestock units (exclusive of work animals) in the county, and this means doubling the frequency or acreage of hay in the rotation. A more significant feature is that it allows eight times the present acreage of legumes, and, incidentally, would allow leaving the cornstalks in the field as material to be plowed under where they would give greater returns than in the feed rack.

Four-year crop rotations for soils of the flat-upland group adjusted to meet the needs of this situation are as follows: (1) Wheat, timothy (for soil amendment or hay), timothy, corn; (2) wheat, timothy, corn, soybeans; (3) wheat, clover and timothy, corn, soybeans; (4) wheat, alsike or mammoth clover and timothy, corn, soybeans; (5) wheat, sweetclover and timothy, corn, soybeans; and (6) wheat, sweetclover and timothy, timothy, corn. Rotation 6 offers most in behalf of soil betterment, and rotation 3 provides the best protein forage. The first two rotations provide a reasonably good type of hay with a minimum of hazard and of expense in soil treatment. Soybeans tolerate the wet and acid character of this flat land and are about as dependable as timothy. To enrich the protein content of the timothy and double the yield, an acre application ranging from 150 to 300 pounds of a nitrogen carrier should be made early in the spring, and for those farmers who prefer it, clover may be grown by liming the land.

One of every two attempts at obtaining clover stands on these gray soils fails; therefore, instead of gambling with failure, the farmer might better divert the money so wasted to investment in liming material. An acre-seeding of clover seed will buy from 1,000 to 1,500 pounds of ground limestone or its equivalent in agricultural hydrated lime. This quantity of lime on an acre is only a fractional application, but if applied as a top dressing after wheat seeding or simultaneously with the clover seeding in the spring, good results are obtained where drainage conditions are reasonably fair. By seeding with the grain drill and delivering the lime from the fertilizer hopper to the groove cut by the disk, the clover seed and lime are placed in intimate contact, and, in these soils especially, the action of lime is confined to the soil immediately in contact with it. Thus, the streak of soil along the drill furrow is brought into condition for the clover plants growing there. This plan is best employed in connection with rotation 3. Rotation 4 will necessitate heavier liming—at least 2 tons an acre of agricultural ground limestone, or its equivalent, as an initial treatment, plus 1,000 pounds in each successive rotation. Growing sweetclover, as in rotations 5 and 6, requires enough lime to raise the reaction to about pH 6.6, as shown in table 5.

TABLE 5.—*Rate schedule for liming soils of the flat-uplands group*

Soil type	pH	Acre application of lime [1] to give pH 6.6 (tons)
Blanchester silt loam	5.6	2½
Avonburg silt loam	5.4	2¾
Clermont silt loam	5.2	3

[1] In terms of agricultural ground limestone.

Grain crops on the gray land respond to a liberal supply of plant nutrients—nitrogen, phosphoric acid, and potash. No one of these is sufficient. Long leaching has reduced the available potash, and long cropping, the nitrogen and phosphorus. Owing in part to their marked deficiency in nutrients, yields of small grains on these soils are unprofitable in many years, and an adequate supply of nutrients must be provided for satisfactory yields on them. Fertilizer recommendations for crops on these soils are as follows: For corn, (1) manure reinforced with 20 percent superphosphate at a rate of 30 pounds of fertilizer to a ton of manure, plus 200 pounds in row of 0–14–6, or, if checked, 150 pounds in hill; (2) a full legume crop plowed down plus 200 pounds in row of 0–12–12, or, if checked, 150 pounds in hill; (3) the aftermath of timothy or clover plowed down plus 250 pounds in row of 2–12–6, or, if checked, 175 pounds in hill. The absence of material to be plowed down narrows the return on purchased fertilizer and makes the planting of corn inadvisable. For wheat, (1) from 4 to 6 tons of manure plus 300 pounds of 0–20–0, or (2) 350 pounds of 0–14–6. Because of their strong feeding power, soybeans can gather their quota of potash and phosphorus from the less available stores in the soil, and for this reason commercial fertilizer applied directly on this crop pays little or no return even on these soils.

The need for and benefit from mechanical protection of crops—clovers and wheat—over the winter is nowhere so acute as here. The frequent shallow freezing and thawing during the open winters, together with the wetness of these soils, result in heaving, with consequent breaking of the plant roots. A surface dressing of straw or coarse manure in late fall or early winter materially lessens the temperature fluctuations in the upper part of the soil. Clovers also derive substantial winter protection on these soils from the presence of timothy or orchard grass in the stand. By including a grass in the clover seeding and adding coarse manure in early winter, the hazards prevailing in growing clover can be substantially lessened.

UNDULATING OR ROLLING UPLAND SOILS

The soils included in the group of undulating or rolling upland soils are Loudon silt loam, Rossmoyne silt loam, Jessup silt loam, Cincinnati silt loam, Maddox silt loam, and Ellsberry silty clay loam.

The surface relief of these soils ranges from very slightly sloping to rolling, and, in general, the management problems are less acute than on the flat lands. One outstanding difference is that sheet and gully washing replace the problem of drainage. Measures required in handling these soils are set forth approximately in the order of their value to permanent farming.

The need of these soils for organic matter is hardly less acute than that of the soils of the flat uplands, but by reason of the fair drainage conditions and the effectiveness of moderate liming rates, satisfactory yields of legumes, including sweetclover, can be obtained on the soils of this group, and better aeration affords normal response to all forms of organic material applied.

Surface run-off of water from these soils is rapid. Sheet washing is everywhere active, and gullying is destructive on the steeper slopes where the soil is not properly managed. The soils of this group are exposed to the double danger of the surface soil washing off as well as wearing out. At the root of the trouble are the lack of binding clay, shortage of lime, and the scant supply of organic matter. To stabilize the surface soil against its tendency to erode, regular liming and the incorporation of a large quantity of organic matter, supplied by plowing under a developed crop of clover, clover and timothy, or soybeans, are practical measures. Resistance to the wearing action of water is built up, and the capacity of the plow layer to absorb and retain water is so enlarged that a smaller volume of water escapes over the surface.

It is not sufficient that resistance to erosion be strengthened, but retarding the rush of water down the slopes must also be considered. A heavy sod acts as the best barrier, and for this reason, a goodly proportion of the rotation should be given over to grass or hay. Winter grain crops, if seeded in time to develop a heavy growth before freezing weather, are effective in reducing water velocity and holding the soil material, as bare ground allows wasteful washing. All tillage operations should be made parallel with the contour of the land, as miniature terraces are thus set up by the action of tillage tools. Experience has shown the impracticability of building large soil terraces, as the instability of these soils is so pronounced that even the rain water falling on the terrace itself is sufficient to riddle the structure. For the areas of the steeper soils of the group, such as Cincinnati silt loam, strip-crop farming is advisable.

The higher ratio and yield of hay crops, which has been set forth and emphasized for the soils of the flat-upland group, applies with equal force to the soils of this group. The more favorable conditions for clover, however, should enable the farmer to start with rotation 2 as given for the soils of the flat-upland group. The rate of liming necessary on the soils of this group will be found less burdensome, as shown in table 6.

TABLE 6.—*Rate schedule for liming the undulating or rolling upland soils*

Soil type	pH	Acre application of lime [1] to give pH 6.6 (tons)	Soil type	pH	Acre application of lime [1] to give pH 6.6 (tons)
Loudon silt loam	5.5	2½	Jessup silt loam	5.8	1¾
Rossmoyne silt loam	5.6	2¼	Maddox silt loam	5.8	1½
Cincinnati silt loam	5.7	2	Ellsberry silty clay loam	6.0	1¼

[1] In terms of agricultural ground limestone.

Owing to their better moisture relations, the soils of this group are safely tilled at a slightly wider moisture range and at longer intervals than the soils of the flat uplands. Winter crops on them profit from surface protection, and the fertilizer applications are similar to those outlined for the flat uplands.

HILL SOILS

The soils included in the hill group are Edenton silt loam, Eden silt loam, Fairmount silty clay loam, and Heitt silty clay loam.

The soils of this group occupy the steeply inclined sides of ravines and valley walls. Having resulted from the rotting of native limestone and associated shale, most of these soils are rich in clay and lime, and they are very granular.

The steep slopes occupied by these soils favor the development of a regular pattern of rivulets when the surface is exposed by intertillage or close pasturing, and were it not for the high proportion of clay in the soils and the proximity of the underlying rock, cropping would lead to almost total destruction. As it is, 1 year of a cultivated crop is as much as can be risked, and safety requires that this occupy a narrow strip contourwise and be flanked below and above with grass, meadow, or small grain. Strip cropping is indispensable on these slopes, and a winter cover crop of rye or wheat is equally necessary.

Of the soils so far discussed, the members of this group are the most productive. They are well suited to tobacco, alfalfa, and bluegrass, the Heitt and Fairmount soils especially producing excellent alfalfa without liming. By growing and plowing down alfalfa or sweetclover, the soils come into favorable tilth and nitrogen content for growing tobacco of superior quality. On the Edenton soil, tobacco does nearly as well, but liming at a light rate proves helpful to the clovers.

These soils require phosphorus, but they need less potash than do the upland, terrace, or first-bottom soils. To meet the nutrient needs of crops on the hill group of soils the following recommendations are made: For tobacco—(1) alfalfa sod plowed down, with from 300 to 500 pounds of 2–12–6 fertilizer in the row; (2) grass sod, with from 300 to 600 pounds of 2–14–4 fertilizer in the row and 125 pounds of a nitrogen carrier as a side dressing; and (3) clover sod, with from 400 to 600 pounds of 2–14–4 fertilizer in the row. If preceded by tobacco, small-grain crops, such as wheat or rye, derive ample nutrients from the residue left by that crop. When grown in a tobacco rotation additional nutrients beyond the residue from the tobacco treatment are unnecessary for alfalfa. Row placement of fertilizer for tobacco results in greater efficiency. The application may be made with a corn planter with a fertilizer attachment, or by hand, setting the tobacco plants on the line of the fertilizer strip in the soil.

TERRACE SOILS

The soils included in the terrace group are Ginat silt loam, Sciotoville silt loam, Williamsburg silt loam, Williamsburg very fine sandy loam, Wheeling silt loam, and Wheeling very fine sandy loam.

Unlike the soils of the foregoing groups, the more extensive soils of the terrace group are coarse, friable, early, and, with the exception of the silt loams, leachy. Mild tillage suffices on all except the Ginat and Sciotoville silt loams whose tilth is impaired by poor natural drainage.

The Wheeling soils have friable, well-aerated, and well-drained subsoils that ideally fit them for alfalfa. Being mildly acid, a small application of lime serves to bring their reaction into condition for this crop. Likewise, supplying potash in connection with permanent alfalfa stands will prove profitable. Normally, four cuttings of alfalfa each year should be taken from thrifty, well-nourished stands on either of the Wheeling soils.

Red clover and sweetclover are well adapted to Williamsburg silt loam and Williamsburg very fine sandy loam, provided liming becomes a regular practice. After cropping and inoculating with sweetclover, the very fine sandy loam should produce alfalfa successfully. High acidity and poor drainage limit the forage possibilities on Ginat silt loam and Sciotoville silt loam to timothy and alsike clover, but by correcting the drainage and acid conditions both soils can be used to grow sweetclover or mammoth clover. The rate of liming necessary on the terrace soils is given in table 7.

TABLE 7.—*Rate schedule for liming soils of the terrace group*

Soil type	pH	Acre application of lime [1] to give pH 6.5 (tons)	Soil type	pH	Acre application of lime [1] to give pH 6.5 (tons)
Wheeling soils	5.8	1½	Sciotoville silt loam	5.8	1½
Williamsburg soils	5.7	1¾	Ginat silt loam	5.4	2¼

[1] In terms of agricultural ground limestone.

To bring the Ginat and Sciotoville soils into satisfactory production requires tiling. The drainage needs of the Sciotoville soil would be best met by a fairly regular lay-out of tile lines placed diagonally with the general direction of the contour and spaced about 6 rods apart. Drainage of the Ginat soil, however, is not so easily accomplished. Where surface water is impounded by a closed outlet, it may prove effective to attempt vertical drainage into the porous substratum which lies at a depth of about 14 feet. For complete drainage of the subsoil, 2 or 3 lines (depending on the width of the depression) of 6-inch tile laid parallel to the length of the depression should be sufficient in most places. A 6-rod spacing is recommended for Williamsburg silt loam.

Marked shortage of potash characterizes all the terrace soils, and manure produces excellent responses on legume and row crops. To avoid leaching during winter, manure intended for the very fine sandy loam soils is more effective if applied to sod land in summer or early fall and to bare ground in the spring. Recommendations for fertilizing crops on the terrace soils are as follows: For tobacco—(1) full legume crop plowed down, with from 400 to 500 pounds of 0–12–12 fertilizer in the row; (2) alfalfa or clover sod, with from 400 to 600 pounds of 2–10–8 fertilizer in the row; for corn—(1) alfalfa or clover sod plowed down, with 200 pounds of 0–14–6 fertilizer in the drill row; (2) timothy and clover sod, with manure and 100 pounds of 0–14–6 fertilizer in the drill row; for wheat—after corn, 250 pounds of 0–14–6 fertilizer; after tobacco, none; for alfalfa—in corn rotation, 350 pounds of 0–12–12 fertilizer; in tobacco rotation, none.

The earliness of the terrace soils makes possible the use of longer season varieties and hybrids of corn, with substantial advantage in yield. Johnson County White and Boone County White are corn varieties that require most of the growing season to mature. Equally late maturing hybrids are available, but their suitability should first be tested before attempting their general use on terrace farms.

FLOOD-PLAIN SOILS

The soils included in the flood-plain group are Lindside silty clay loam, Eel silty clay loam, Genesee silt loam, Algiers silt loam, Huntington silt loam, Genesee very fine sandy loam, and Huntington fine sandy loam.

The soils of the flood plains (first bottoms) resemble the coarser members of soils in the terrace group. They are friable, early, and, in spots, leachy. They respond to light tillage, require tiling only in isolated depressions, are well supplied with active organic matter, and contain much nitrogen, even in the subsoils.

For alfalfa production, these soils are of prime suitability. The naturally good tilth of the surface soils favors germination of alfalfa seed and insures a good stand; permeability of the subsoils to roots and air promotes deep rooting; and the abundance of lime in both the surface soils and subsoils assures vigorous growth. All the soils of this group are alkaline—that is, they contain an excess of lime. By laying tile in the few scattered depressions and oxbows and accompanying the alfalfa seeding with a moderate quantity of fertilizer, alfalfa can be brought into the corn or tobacco rotation on all these soils. Because alfalfa completely utilizes the plant nutrients in these soils, it makes an excellent growth on them.

All these soils are lacking in potash but are fairly rich in phosphorus, and they require a high ratio of potash in the fertilizer used on them. Tobacco, alfalfa, and, to less extent, corn, are liberal consumers of available potash; and potash applied to these soils promotes vigorous growth and permanency to alfalfa, quality to tobacco, and disease resistance and increased yield to corn. To adjust the plant-nutrient supply recommended for the terrace soils to meet conditions on the flood-plain soils, it is necessary to provide a higher proportion of potash to phosphoric acid. Accordingly, a fertilizer mixture such as 3–9–18 is recommended for tobacco and 0–12–12 for corn; and the quantities applied to all crops may be lessened by one-third.

Otherwise early bottom land is rendered tardy in the spring by wet depressions and spots, kept wet by underground seepage from the adjacent upland, but as percolation of water is free in these soils, tile drainage of such spots is very effective, and in most places a single line of tile provides adequate drainage.

The high heat-absorbing power of these brown soils, together with their excellent drainage, adds length to the growing season. Long-season hybrids and strains of corn, such as those suggested for the terrace soils, are suited to the flood-plain soils.

SUMMARY

Brown County is in southwestern Ohio, bordering Ohio River. It is the third county east of the Indiana State line. The total area is 495 square miles, or 316,800 acres.

The surface relief is essentially that of a broad undulating plain, dissected by Ohio River and its tributaries. Near the larger streams, and particularly bordering Ohio River, are many long narrow ridges and deep steep-sided valleys. In the central and northern parts the land surface is smoother and even flat on many of the broader divides.

The elevation ranges from about 450 to 1,100 feet above sea level, the minimum figure being the low-water level of Ohio River at the southwestern corner of the county. All drainage is directly or indirectly into Ohio River. Surface run-off is slow on the broad flat areas but rapid in the southern part, where destructive soil erosion is active on the sloping lands which have been used for purposes or in ways to which they are naturally unfitted.

The county was originally forested with hardwoods, chiefly birch, oak, hickory, walnut, sugar maple, tuliptree, ash, and elm, and less commonly, linden, wild cherry, ironwood, sassafras, and dogwood. Black locust is a common second-growth tree, particularly on the slopes in the southern part.

Settlement began in the southern part of the county in the latter part of the eighteenth century, but the county was not organized until 1818. The population is well distributed but is most dense in the rolling or rougher central and southern parts.

Georgetown, the county seat, has a population of 1,531 and, according to the 1930 census, is the largest town. Ripley is the principal river town. Four United States highways and a number of State highways cross the county, and these, together with the improved county roads, make most sections easily accessible the year round. There are several consolidated schools, to which the children are brought in busses. Practically every community is provided with a church.

The Norfolk & Western Railway crosses the county, and the Cincinnati, Georgetown & Portsmouth Railroad extends to Russellville from Cincinnati.

In general the climate is favorable to agriculture. The frost-free season averages about 170 days.

Agriculture has remained the dominant industry since the earliest times. The principal crops are corn, tobacco, wheat, rye, oats, and hay. The hay crop consists of clover (red, mammoth red, alsike, Japan, and sweetclover), timothy, redtop, alfalfa, and soybeans. Most of the cattle are of the dairy breeds, chiefly Jerseys. Tobacco is the principal cash crop, and in value it ranks second to corn.

The county is favorably situated with respect to markets, a great deal of produce being shipped by autotrucks, as well as by railways, to the nearby markets at Maysville, Ky., and Cincinnati, Ohio. The important problems of land use include the correction of poor drainage on the extensive flat lands; neutralizing the acid condition which is common on most of the upland soils, particularly those in the central and northern parts; the proper fertilization and choice of crops for the different soils; and the checking of erosion on the rolling lands and valley slopes.

The soils are a part of that great group of gray and brown forested soils which occupy large areas of land in Ohio, southern Michigan, Indiana, and southern Illinois. Except in very small areas in the rougher parts or in the bottoms, the surface soils of both subgroups are silt loams and the subsoils are composed of much heavier material—silty clay loam, silty clay, or clay. The soils of the brown group have predominantly brown surface soils and subsoils, whereas the soils of the gray group for the most part have light-gray surface soils and mottled light-gray and yellowish-brown subsoils. On the bases of differences in color, drainage conditions, and other marked physical characteristics, the soils fall naturally into two major groups as follows: (1) The brown soils, or better drained group; and (2) the gray soils, or the more poorly drained group.

The soils of the brown group comprise about 60 percent of the total area of the county. They are the dominant soils in the southern and lower central parts. Considerably more than half the corn and more than 80 percent of the tobacco are produced on soils of this group. It is on these soils that nearly all the red clover and alfalfa are grown, also a large proportion of the mixed timothy and clover hay. Nearly all the rye and more than 50 percent of the wheat are produced on them.

The soils of the gray group comprise the remaining 40 percent of the county. Naturally these soils are more poorly drained and most of them are lower in lime and other mineral elements than the soils of the brown group. Corn, wheat, timothy, mammoth clover, white clover, alsike clover, soybeans, and a little sweetclover are the principal crops grown, and, except where liming, drainage, and proper fertilizing are done, the acre yields are much lower than on the soils of the brown group.

Cincinnati silt loam, Rossmoyne silt loam, and phases of these two soils are the principal soils of the brown group. They are derived from the weathered product of glacial drift. These soils are not developed southeast of a general line from Decatur to Ripley. In this part of the county the soils are formed from materials weathered from the underlying limestone and shale. Here the upland soils consist of the Maddox and Ellsberry soils on the ridge tops and Fairmount silty clay loam, Heitt silty clay loam, and Eden silt loam on the slopes. On these slope soils a high grade of tobacco, representing about 80 percent of the total crop, is grown.

Clermont silt loam, with its two phases, Blanchester silt loam, and Avonburg silt loam, with a dark-colored phase, comprise the group of gray upland soils. The brown bottom lands along Ohio River include Wheeling silt loam and Wheeling very fine sandy loam, occupying the terraces or higher benches which are normally above overflow. Soils of the gray group on these benches are Ginat silt loam, Sciotoville silt loam, and the dark-colored phase of the latter.

The first bottoms of Ohio River consist of the Huntington soils in the brown group and Lindside silty clay loam in the gray group.

Along the tributary streams, the brown group is represented by the Williamsburg soils on the higher benches and the Genesee soils on the first bottoms; and the gray group includes two poorly drained phases of Williamsburg silt loam on the higher benches, and Algiers silt loam, Eel silty clay loam, and a mixed alluvial material on the first bottoms.

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Areas surveyed in Ohio shown by shading. Detailed surveys shown by northeast-southwest hatching; reconnaissance surveys shown by northwest-southeast hatching; cross hatching indicates areas covered in both ways.

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