Series 1932, No. 40 Issued July 1940

Soil Survey

Jennings County
Indiana

By
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United States Department of Agriculture

This number is the last Soil Survey Report for the Year 1932

UNITED STATES DEPARTMENT OF AGRICULTURE
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In cooperation with the
Purdue University Agricultural Experiment Station

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Area inspected by Mark Baldwin, Inspector, District 1

United States Department of Agriculture in cooperation with the Purdue University Agricultural Experiment Station

COUNTY SURVEYED

Jennings County is in the southeastern part of Indiana (fig. 1). It comprises an area of 383 square miles, or 245,120 acres. Vernon, the county seat, is about 60 miles southeast of Indianapolis, a little more than 50 miles north of Louisville, Ky., and about 70 miles west of Cincinnati, Ohio.

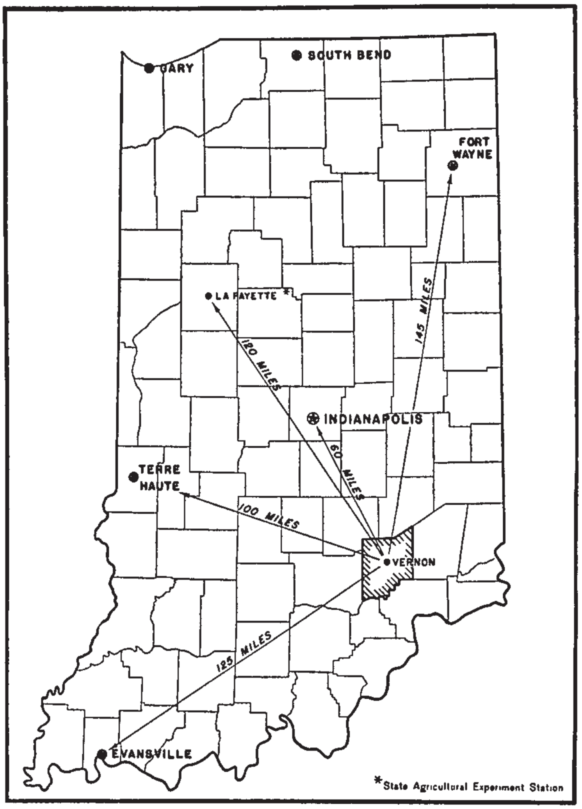

FIGURE 1.—Sketch map showing location of Jennings County, Ind.

In general, the physiography of this county is that of the Till Plains section of the Central Lowland province of the United States.[2] Locally, it is part of the Muscatatuck regional slope, a structural upland plain developed on Silurian and Devonian formations. The general slope of the land is west and southwest at a rate of about 18 feet to the mile, or slightly less than the dip of the bedrock strata, which consist of limestones that are overlain by dark oil shale in the western part of the county. A thin covering of Illinoian glacial drift has helped to smooth the preglacial relief. On divides

[1] The Soil Survey Division was transferred to the Bureau of Plant Industry July 1, 1939.
[2] MALOTT, CLYDE A. THE PHYSIOGRAPHY OF INDIANA. Ind. Dept. Conserv. Pub. 21: 59–256, illus. 1922.

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this old drift surface is almost featureless, in contrast with the younger early Wisconsin drift with its characteristic depressions and knolls in the northwestern corner of the county.

On the broad smooth interstream areas this general regional slope grades imperceptibly into the more level Scottsburg lowland in the southwestern part. The direction of slope is revealed in the form of the valleys. The map shows that the courses of the larger streams, as well as the courses of their main tributaries, are roughly parallel and southwesterly, following the regional slope. The minor tributaries flowing from northwest to southeast are short and drop rapidly from upland levels to the main streams.

Most of the large streams follow comparatively straight troughlike valleys which have been cut through the softer overlying formations, such as glacial drift and black oil shale, down into the more resistant limestones. The covering of glacial drift on the limestone benches, with their irregular sinkhole relief, indicates that these are preglacial valleys. The streams are deeply entrenched in the limestone valley floors, with narrow but widely meandering channels and flood plains. The valley walls are steep and in many places are perpendicular limestone bluffs. This is well illustrated along the north side of Graham Creek in the vicinity of San Jacinto, where the upland level is reached from one-fourth to one-half mile from the main channel.

These streams, which are swift-flowing and entrenched to a depth of more than 100 feet in many places as they traverse the regional slope, become more sluggish and meander through broader flood plains after entering the Scottsburg lowland near the Jackson County line. This is best illustrated in Jennings County by the broad shallow valley of the Muscatatuck River.

The main interstream divides cross the county in strips ranging from very narrow to several miles in width. Their continuity is interrupted by a few saddles where tributaries have cut back from adjacent creeks until their heads almost meet. Arms of the upland flats follow the small divides between the branches of the streams.

The land along the streams is dissected by small tributaries into belts ranging from narrow to 2 or 3 miles wide. In many places, as in the vicinity of Vernon, the relief is rough and broken. On steep slopes, especially where the timber has been cut, erosion has removed much of the surface soil, and in many places gullying is severe. The underlying limestone and shale rocks are exposed in many places in the dissected belts, although the small gullies near heads of drainageways in few places cut through the glacial deposits, most of which are less than 25 feet thick. Dissection is least evident in the section northwest of Scipio, where the glacial drift is thicker and more recently deposited, and bedrock is not exposed.

The highest elevations are in the eastern part of the county, the maximum being 885 feet above sea level. The altitude of Butlerville on the Baltimore & Ohio Railroad is 767 feet. The minimum elevation, 535 feet, is in the western part, and the average is 710 feet. Near the town of Vernon, Vernon Fork Muscatatuck River is entrenched from 140 to 165 feet below the general level, giving the maximum range in local relief.

The original native vegetation consisted dominantly of such trees as oak, maple, tuliptree, gum, hickory, ash, elm, walnut, and beech.

The first white settlers came from Ohio, Pennsylvania, Kentucky, Virginia, and the Carolinas.[3] The county was organized in 1817. Clearing the land of timber preceded agricultural development. Lumber and crops in the early days were hauled to distant markets, among others Cincinnati. By 1850 the population was 12,096, or larger than it is today, and it was greatest in 1880 with 16,453 people. The 1930 census reports 11,800 inhabitants. Ever since the organization of the county, more than two-thirds of the people have lived in the rural sections.

Vernon, with a population of 410 in 1930, is the county seat. The only city is North Vernon with a population of 2,989. Other towns are Butlerville, Zenas, Brewersville, Scipio, Hayden, Lovett, Commiskey, and Paris Crossing.

Three railroads enter Jennings County: The Baltimore & Ohio Railroad, the Cleveland, Cincinnati, Chicago & St. Louis Railway (New York Central system), and the Pennsylvania Railroad. The Pennsylvania line across this county is part of the first railroad built in Indiana.

United States Highway No. 50 and State highways connect Vernon with surrounding towns, and good limestone-surfaced roads reach nearly all sections. The earth roads usually are passable to automobiles in the summer, but they are traveled with difficulty in the winter and spring.

Churches are numerous, and consolidated schools have been established in most of the towns. Telephone connections reach all towns as well as parts of the rural districts.

The county is largely agricultural, and no important industries are carried on within its borders.

CLIMATE

The climate is continental, with hot summers and moderately cold winters. Extreme cold spells generally last only a few days. Rainfall is distributed fairly well throughout the year, but occasional dry weather in late summer or fall is detrimental to crops.

The average frost-free season extends from April 26 to October 14, a period of 171 days. Frost has occurred, however, as late as May 26 and as early as September 16. Injury from frost is somewhat greater in the lowlands than on the higher ground.

Table 1, compiled from the records of the United States Weather Bureau station at Butlerville, gives detailed climatic data that are fairly representative for the county.

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[3] ROBERTSON, LYNN, and POTTS, FLOYD W. AGRICULTURAL IN JENNINGS COUNTY. Purdue Ext. Bull. 122, 32 pp., illus. 1924.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Butlerville, Jennings County, Ind.*

[Elevation, 767 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1934)	Total amount for the wettest year (1921)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	33.7	67	−18	3.76	2.27	6.11	4.6
January	31.9	73	−25	4.60	1.75	3.59	8.6
February	32.6	71	−26	2.94	.81	3.84	6.4
Winter	32.7	73	−26	11.30	4.83	13.54	19.6
March	43.6	85	2	4.80	3.05	7.02	3.9
April	53.2	90	14	4.23	1.19	6.49	.8
May	62.9	98	29	4.65	.89	2.18	.1
Spring	53.2	98	2	13.68	5.13	15.69	4.8
June	71.6	102	35	4.29	7.49	7.17	.0
July	76.2	109	44	3.72	1.15	1.78	.0
August	74.6	104	40	4.17	3.04	4.43	.0
Summer	74.1	109	35	12.18	11.68	13.38	.0
September	69.2	103	25	3.50	4.65	6.14	.0
October	57.4	93	18	3.56	.09	3.23	.1
November	44.7	80	1	3.25	1.37	9.38	1.0
Fall	57.1	103	1	10.31	6.11	18.75	1.1
Year	54.3	109	−26	47.47	27.75	61.36	25.5

AGRICULTURAL HISTORY AND STATISTICS

In the early settlement of Jennings County the removal of timber and the clearing of land were the first important tasks. Lumbering was still of considerable importance until a few years ago. Agriculture developed rapidly, and for many years the production of the major crops—corn, wheat, and oats—was fairly uniform. From 1879 to 1919, the peak of agricultural production in the county, the acreage devoted to these crops gradually increased. Since then the acreage has been reduced sharply, and in 1934 the decrease in the acreage of corn from that reported in 1919 was almost one-third, wheat more than one-half, and oats about eight-ninths. The acreage in soybeans and vegetables has expanded markedly, but this increase is small compared with the reduction in the acreage of cereal crops.

The acreages of the principal crops in stated years are given in table 2.

TABLE 2.—*Acreages of the principal crops in Jennings County, Ind., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn	28, 698	20, 865	31, 236	32, 669	35, 931	17, 093	25, 011
Wheat	15, 515	18, 290	20, 356	17, 142	21, 563	7, 175	8, 555
Oats	5, 808	6, 949	2, 673	4, 433	5, 828	1, 468	669
Rye	198	98	66	364	823	187	443
Buckwheat	126	38	83	217	383	973	(1)
Soybeans						3, 033	4, 702
Tomatoes						445	1, 098
Tobacco	21	7	10	104	321	410	89
All hay	17, 233	30, 444	25, 853	21, 836	20, 228	17, 209	16, 085
Alfalfa				55	36	156	424
Timothy and clover, alone or mixed				20, 711	17, 292	12, 016	8, 178
Small grains for hay				94	955	837	943
Legumes for hay					129	3, 132	4, 602
Other tame hay				966	1, 744	1, 058	1, 938
Wild hay				10	72	10	(2)
	Trees	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*
Apples		85, 496	119, 947	84, 056	42, 776	22, 698	24, 674

[1] Not reported.
[2] Included in other tame hay.

A large proportion of the crops grown are consumed locally. Some wheat is sold in nearby markets, also some of the special crops, such as tobacco and tomatoes. Tobacco usually is sold in Madison, Jefferson County, and in Louisville and Carrollton, Ky. Tomatoes are canned at Hayden; and canneries at Dupont and Deputy in Jefferson County, at Westport in Decatur County, and at Seymour in Jackson County afford a market for this crop, as well as for other special crops.

The value of field and orchard crops, vegetables, and farm-garden produce in 1929 was $916,782, of which cereals with a value of $492,574 and hay and forage with a value of $207,775 were the principal items.

The chief sources of income from livestock are the sale of dairy products, poultry products, and hogs.[4] Dairy cattle are raised on practically every farm. The total value of butter, cream, and whole milk sold in 1929 was $260,715. In that year 2,180,635 gallons of milk was produced. The production dropped to 1,576,072 gallons in 1934. Poultry raised in 1929, including 204,416 chickens, of which 104,391 were sold alive or dressed, 733 turkeys, 2,815 ducks, and 1,485 geese, was valued at $188,674. The number of chickens raised in 1934 decreased to 155,250. The value of chicken eggs produced in 1929 was $242,189 for 807,297 dozen, of which 661,673 dozen were sold. The production of eggs decreased to 600,009 dozen in 1934. The number of hogs is limited by the production of corn. The census reports 10,965 swine on farms on April 1, 1930, and 9,199 on January 1, 1935.

About one-half of the cattle raised are for beef purposes. The total number of beef and dairy cattle on farms in 1935 was 11,138. Other livestock included 2,679 horses, 971 mules, and 3,699 sheep.

[4] ROBERTSON, LYNN, and POTTS, FLOYD. See footnote 3, p. 3.

The purchase of fertilizers was reported on 876 farms in 1929 at a cost of $68,825, or an average of $79 per farm reporting. Most of the fertilizer used is a ready-mixed complete fertilizer, such as 2–12–6.[5] The use of lime to correct the acidity of sour soils is coming into common use where legumes, such as clover and alfalfa, are to be grown.

Labor was hired on 418 farms in 1929, for which $75,935 was paid in wages, or an average of $182 per farm reporting. Feed was purchased on 1,093 farms in the same year at a cost of $223,911, or an average of $205 per farm reporting.

Farms range in size from less than 3 to more than 1,000 acres. The average size was 110.9 acres in 1935, 117 acres in 1880, and 105.9 acres in 1900—the smallest recorded. The number of farms decreased from 2,034 in 1880 to 1,765 in 1935.

No great change has taken place in tenure of farms. According to the census of 1935, 71.7 percent are operated by owners, 27.4 percent by tenants, and 0.9 percent by managers. The proportion of tenancy in 1880 was 17.4 percent.

Many comfortable farm homes have been built in recent years. Improvements for convenience and efficiency exist on some farms, whereas improvements are few or lacking on others. The quality of livestock and farm machinery, likewise, ranges from very fine to decidedly poor.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil[6] and its content of lime and salts are determined by simple tests. Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from a particular type of parent material. Thus, the series includes soils having essentially the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly

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

[6] The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus, Clermont, Avonburg, and Genesee are names of soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Genesee loam and Genesee silt loam are soil types within the Genesee series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within a type, which differs from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion frequently are shown as phases. For example, within the normal range of relief for a soil type, there may be areas that are adapted to the use of machinery and the growth of cultivated crops and others that are not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such instances the more sloping parts of the soil type may be segregated on the map as sloping or hilly phases. Similarly, soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

The soil survey of Jennings County was made on single-lens vertical aerial photographs of the scale of about 4 inches to the mile. This is the first county survey in the United States in which aerial photographs were used as a base for mapping soils.

This method was adopted after preliminary experimentation by various workers in much more restricted areas. The field work was begun in November 1929 and was essentially completed in 1930. For various reasons it was not feasible to publish the report until several years later, so that the soil surveys of many other counties have been mapped on aerial photographs and published in the meantime. The fact that practically all soil surveys and conservation surveys are now being made on aerial photographs makes the pioneer work in this field in Jennings County of consinderable interest. It is now generally recognized that good aerial photographs offer the most satisfactory base for detailed work of this kind.

SOILS AND CROPS

Jennings County lies in the so-called southern general farming area, which includes several counties in southeastern Indiana having a similar type of agriculture.[7]

The assessors' reports for the period 1926–33 classify 25 percent of the area as "not in farms." Nearly 30 percent is called rough pasture, timber, and waste land, and 10 percent is idle cropland. In other words, over 65 percent of Jennings County has little agricultural use except as pasture of limited value; 10 percent is in plowable pasture; and only 25 percent is actually in harvested crops.

The United States census of 1935 reports 195,798 acres in farms, or 79.9 percent of the area of the county. This represents an increase over the area in farms reported in the 1930 census, which was 74.7 percent of the total area. In 1935, crops were harvested from 55,619 acres, or 22.7 percent of the total area; crops were a failure on 2,703 acres, and 25,580 acres lay idle. The rest of the land in farms was represented by plowable pasture, 31,591 acres; woodland pasture, 22,430 acres; other pasture, 15,810 acres; woodland not pastured, 17,380 acres; and all other land, 24,685 acres.

The proportion of nonagricultural land differs greatly from year to year, possibly due to the difficulty in determining whether or not marginal land is included in farms. Probably considerable land may be cultivated or thrown out of agricultural use, according to conditions. Under the stimulus of high prices during the World War the area of cultivated land was double that at present, and it could again be doubled in time of need.

The use of the land differs very little throughout the county. In nearby counties where soils are developed largely on Wisconsin drift, as in the northwestern corner of Jennings County, about two-thirds of the land is in crops. This is more than twice the relative area of cropland on the soils developed on Illinoian drift in Jennings County.

The averages of the assessors' reports for 1926–33 show 43 percent of the cropland in corn, 23 percent in hay, 13 percent in wheat, 8 percent in oats, 4 percent in soybeans, and 9 percent in other crops. Little change took place in the proportion of land devoted to these crops during this period, although the total land in farms was about 20,000 acres less after 1929 than it was in the preceding 3-year period.

According to the census of 1935, about 16 percent of the county is woodland, which is fairly evenly distributed. Nearly all of the merchantable timber, which originally was abundant, has been cut, but most farms still have sufficient timber for home use. A few of the wooded areas are classified as forests by the State, and these are increasing in number. Little is being done, however, to reforest lands that once were cleared but have been abandoned for agricultural use. A few game preserves have been established, and Muscatatuck State Park is a small area used for recreation purposes. The Civilian Conservation Corps at North Vernon has planted trees on approximately 1,000 acres of land on scattered farms. These areas are to be protected from fire and grazing.

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[7] YOUNG, E. C., and ELLIOTT, F. F. TYPES OF FARMING IN INDIANA. Ind. Agr. Expt. Sta. Bull. 342, 72 pp., illus. 1930.

As previously mentioned, most of the bedrock is covered with a comparatively uniform deposit of glacial drift derived partly from local rocks and partly from material carried in by glaciers. Since the general climatic conditions are uniform throughout, the differences in soils developed on the drift are due largely to differences in age and local drainage conditions. The more recent (early Wisconsin) glacial drift has weathered only a comparatively short time and gives rise to a group of soils decidedly different from those formed on similar slopes from the more deeply leached and more thoroughly weathered and much older Illinoian drift.

The soils developed on the Wisconsin glacial drift occupy about 15 square miles northwest of Sand Creek, and they differ from other soils in the county in being less acid, leached about one-half as deep, and of higher average productivity and value. Although general farming is practiced and the same major crops are grown in this section as in the rest of the county, better average yields are obtained. In addition to the light-colored soils—Fincastle and Russell silt loams—this group includes one minor soil quite unlike any other in this county—Brookston silty clay loam. This is an important and extensive soil in central Indiana, where it is commonly called blackland.

On the basis of topography and drainage and of soil characteristics dependent upon these factors, the soil types may be placed in three groups for convenience in this discussion: (1) Soils of the poorly drained upland flats and stream terraces; (2) soils of the better drained slopes; and (3) soils of the overflow bottoms. The uses of the soils of group 3 for agriculture and some of their soil characteristics are dominated by the periodic flooding and deposition of sediments by streams.

The agricultural relationships of the soils are discussed in detail in the following pages, their location and distribution are shown on the accompanying soil map, and their acreage and proportionate extent are given in table 3.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Jennings County, Ind.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Clermont silt loam	44,864	18.3	Jennings silt loam, slope phase	6,976	2.6
Calhoun silt loam	576	.2	Jennings silt loam, eroded phase	832	.3
Bartle silt loam	1,600	.7	Russell silt loam, slope phase	1,088	.4
Avonburg silt loam	38,144	15.6	Corydon silty clay loam	768	.3
Whitcomb silt loam	960	.4	Waverly silt loam	192	.1
Fincastle silt loam	2,816	1.2	Waverly silty clay loam	320	.1
Brookston silty clay loam	256	.1	Stendal silt loam	4,672	1.9
Gibson silt loam	41,280	16.8	Stendal silty clay loam	1,088	.4
Gibson silt loam, shallow phase	704	.3	Wayland silt loam	1,280	.5
Cana silt loam	2,560	1.1	Philo silt loam	5,760	2.4
Pekin silt loam	1,536	.6	Philo sandy loam	256	.1
Cincinnati silt loam	11,968	4.9	Pope silt loam	832	.3
Jennings silt loam	6,080	2.5	Eel silt loam	4,032	1.7
Grayford silt loam	9,856	4.0	Genesee silt loam	8,768	3.6
Elk silt loam	2,944	1.2	Genesee loam	448	.2
Elk fine sandy loam	128	.1	Genesee fine sandy loam	1,856	.8
Russell silt loam	2,816	1.2			
Cincinnati silt loam, steep phase	35,456	14.5	Total	245,120	
Cincinnati silt loam, eroded phase	1,408	.6			

SOILS OF THE POORLY DRAINED UPLAND FLATS AND STREAM TERRACES

The relief of the soils in this group is smooth and nearly flat. Drainage is poor or imperfect, externally and internally, because of the flat relief and impervious lower layers. The texture of the surface soil in all except one of these soils is silt loam, and the subsoils of all are heavy textured. Clermont silt loam, Calhoun silt loam, Bartle silt loam, Avonburg silt loam, Whitcomb silt loam, Fincastle silt loam, and Brookston silty clay loam are included in the group, which comprises 36.5 percent of the area of the county.

The Fincastle and Brookston soils are leached only about half as deeply as are the other soils, which are thoroughly leached to depths of 10 feet or more. The Clermont and Calhoun soils are the flattest, grayest, and most poorly drained in the county; the Bartle, Avonburg, Whitcomb, and Fincastle soils are somewhat better drained than the first two soils mentioned, and are mottled with yellow and brown in their various layers. The Brookston soil formerly was swampy, but most of it has been artificially drained.

As a whole, these soils occupy the flattest parts of the uplands and terraces, farthest removed from natural streams and open draws. The land is almost entirely free from the small draws that dissect the surrounding better drained soils. Crawfish holes are characteristic of these poorly drained soils, and the mud chimneys made by these crustaceans are a characteristic feature of the landscape. The members of this group are known locally as crawfishy soils or crawfish land. In many places the wettest and flattest areas have been left in timber or have been allowed to revert to forest after having been cleared, and the areas with slightly better drainage, or those near outlets, are preferred for agricultural use. The old soils developed on Illinoian glacial drift have a great capacity to absorb water, which is held up by a rather impervious, very acid horizon about 3 feet below the surface. The heavy horizon in Fincastle silt loam, however, lies from 12 to 20 inches below the surface, and the underlying material is not very acid.

Clermont silt loam.—Clermont silt loam is the most extensive soil in the county. It occurs on the flattest central parts of the main divides, separated from all the open drainageways by nearly continuous strips of Avonburg silt loam. It is a very light colored soil, with a distinctly acid reaction and, under natural conditions, very poor drainage, owing to its flat relief and impervious lower horizons.

The 4-inch surface soil is light-gray or gray silt loam with a fine floury texture which is especially noticeable when the material is dry. Glacial pebbles and small dark iron concretions are present in places on the surface and in the material beneath. Except for its somewhat greater compaction and the presence of brownish-yellow and light-gray spots, the material does not vary much from the surface to a depth ranging from 30 to 40 inches. Here the color grades rapidly from light gray to darker gray, and the texture changes abruptly to silty clay loam. This layer is compact, has a columnar structure, and is sometimes known as claypan or hardpan. Below this heavier layer, as typically developed, the material becomes lighter in texture and more gritty, and the color changes to mottled yellowish brown, brown, and gray. Unleached calcareous glacial material is reached at a depth ranging from 120 to 150 inches.

The cold wet acid nature of Clermont silt loam is unfavorable to the growth of crops. On the other hand, its flatness makes it easy to cultivate without causing erosion or loss of applied fertilizers, its great water-holding capacity is an asset in dry seasons, and its response to almost all kinds of good treatment results in greatly increased yields. Although the natural level of productivity of this soil is low, under optimum conditions it may produce yields as high as or higher than those obtained on soils that are naturally more fertile. Improved drainage is recognized as the first need of this soil. Little tiling has been done, but many fields are laid out in lands with the soil thrown up toward the middles from dead furrows about 2 rods apart and extending the length of the fields. This affords surface drainage and improves yields on the higher part of the field. Through the use of lime and fertilizers, some farmers raise the yields on this soil to high levels and are able to grow clover as well as corn, wheat, and soybeans, but they still have difficulty in maintaining good stands of alfalfa because the very acid impervious subsoil is too deep to be corrected by liming. Some of this soil lies practically idle, probably because of lack of money to finance soil-improvement programs, which would cost much more than the market value of the unimproved land.

Another soil, very similar to typical Clermont silt loam and included with it on the map, grades into bedrock of marly shale within a depth of 10 feet from the surface and does not contain unweathered glacial till. Small areas of such soil were observed along the eastern border of the county, and the indications are that soils of this kind may be more extensive in Ripley County. Agriculturally this soil is comparable to typical Clermont silt loam.

Calhoun silt loam.—Calhoun silt loam resembles Clermont silt loam in that it is flat and has poor surface and internal drainage, a light-gray color, and a strongly developed impervious layer. In contrast to Clermont silt loam, however, it is developed on stratified deposits of stream terraces. In representative areas, as along Muscatatuck River, Calhoun silt loam is acid in reaction throughout and is developed from acid silty and clayey alluvium. As mapped, the soil includes areas along Sand Creek in which the materials in the substratum are sandy and are neutral or slightly alkaline in reaction. Agriculturally, this soil corresponds closely to Clermont silt loam and has similar uses, crop adaptations, and drainage and fertilization requirements.

Bartle silt loam.—The 12-inch surface soil of Bartle silt loam consists of friable light brownish-gray silt loam containing some soft iron concretions. Beneath this is a compact yellowish-brown silt loam or so-called claypan, mottled and streaked with gray. At a depth ranging from 4 to 5 feet this grades into stratified silty and clayey terrace materials that are acid in areas along the Muscatatuck River but tend to be alkaline in areas along Sand Creek. The agricultural use and degree of productivity are similar to those of Avonburg silt loam. Drainage is better than in Calhoun silt loam.

Avonburg silt loam.—The surface soil of plowed areas of Avonburg silt loam is pale brownish-gray smooth friable silt loam to a depth of 5 or 6 inches. This is underlain by light yellowish-gray and rust-mottled silt loam, which, at a depth ranging from 10 to 15 inches, grades into brownish-yellow slightly heavy compact silt loam mottled with gray. At a depth between 2 and 3 feet there is an abrupt contact with a so-called claypan or hardpan like that in Clermont silt loam, below which leached Illinoian glacial till extends to a depth ranging from 8 to 10 feet. Calcareous till lies beneath this horizon.

Avonburg silt loam differs from Clermont silt loam in the upper part of the soil chiefly as a result of better surface drainage. The surface color is more brownish gray or grayish brown, and the upper part of the subsoil in many places is highly mottled with yellow and brown and contains less iron segregated as black concretions. The depth to the heavy impervious layer, or hardpan, is 10 or 15 inches less than in Clermont silt loam. Below this horizon there is little difference between the two soils, as both have calcareous till substrata at a depth of 10 or more feet. Where areas of Avonburg silt loam grade into Gibson silt loam, the upper part of the subsoil, above the impervious layer, may be a little heavier in texture than elsewhere.

For agricultural use, the Avonburg soil has some natural advantage over the Clermont soil because of better surface drainage due to its slight slope and proximity to more sloping lands and open draws. For this reason it is a little preferable for farming. This soil occurs in practically all parts of the county.

Included on the map with Avonburg silt loam are a few small areas of a very similar soil which lacks the calcareous till and grades into limestone material. The lower layers include some cherty reddish-brown clay and generally rest on hard limestone within 10 feet of the surface. This inclusion is inextensive and occurs only in the central part of the county, in most places on benchlike situations near some of the larger streams where there is a thin deposit of glacial drift over limestone. Its nearly level relief causes imperfect drainage in spite of its proximity to drainageways. It compares favorably with typical Avonburg silt loam in general agricultural use and value.

Another inclusion, which is of very minor importance in Jennings County, may prove to be more extensive in Ripley County where the glacial drift is thinly deposited over bedrock. It has a flat relief, pale brownish-gray color in the surface soil, mottled subsoil, and imperfect internal drainage due to impervious layers like the typical Avonburg soil, but it lacks a calcareous till substratum. It passes into low-lime marly shale strata from 8 to 12 feet below the surface. Its agricultural value seems to be equal to that of typical Avonburg silt loam. The largest two areas of this included soil are 2 miles northeast and 2 miles southeast of San Jacinto near the Ripley County line.

Whitcomb silt loam.—The surface soil of Whitcomb silt loam consists of light brownish-gray smooth friable silt loam to a depth of about 6 inches. This material is underlain by light yellowish-gray silt loam, with some rust-colored mottles, which continues to a depth of about 15 inches. Beneath this a brownish-yellow heavy compact silt loam, mottled with gray, extending to a depth ranging from 30 to 36 inches, where it gives way abruptly to a so-called claypan or hardpan like that of Avonburg silt loam. Beneath the claypan the parent material consists of leached glacial till of Illionian age, which grades into dark-colored acid oil shale at a depth of 10 feet or less. Many small fragments of shale are scattered throughout the material beneath the claypan.

This soil is very similar to Avonburg silt loam, but it lacks the underlying calcareous till characteristic of the latter soil. There is little difference in agricultural value between the two soils, but Whitcomb silt loam is, perhaps, slightly less productive.

Fincastle silt loam.—Fincastle silt loam has a grayish-brown friable surface layer that grades into a lighter colored mottled gray, yellow, and brown subsurface layer. The mottling is due to imperfect drainage caused by a somewhat heavier layer that lies from 12 to 15 inches below the surface. The mottling generally decreases with depth. In some places, the upper layers contain some glacial pebbles, but in others they are smooth and silty. The material is moderately acid. Below a depth ranging from 30 to 36 inches the texture is a little lighter, the color may be faintly mottled, the material is more gritty, and the reaction is less acid. Early Wisconsin calcareous glacial till lies from 4 to 6 feet below the surface.

This soil resembles Avonburg silt loam in the upper part, but it differs from that soil in having greater variation in surface slope, a somewhat darker colored surface soil, less acidity, no strongly acid claypan, slighter depth to both the heavy subsoil and the calcareous till, and higher productivity and agricultural value.

Areas of this soil associated with Brookston silty clay loam are more productive than the typical soil for corn, clover, and bluegrass. Fincastle silt loam is naturally better for all crops than the Illinoian drift soils that comprise most of this county.

A few small areas of a soil that would be mapped as Delmar silt loam were they more extensive are included with Fincastle silt loam. This soil corresponds to Clermont silt loam in having a flat relief and a gray surface soil; it differs from that soil in several important respects. Its surface soil and subsurface soil are a little darker than the corresponding layers of the Clermont soil and extend to a depth of only 10 or 12 inches, where the material becomes much heavier. The upper layers are moderately acid, but the substratum becomes less acid and a little lighter textured with depth, until the calcareous early Wisconsin glacial till is reached from 40 to 60 inches below the surface. Only a few small areas of this included soil are in Jennings County, and it is not extensive anywhere in Indiana. The largest area is 7½ miles north and 1 mile west of North Vernon. It occurs as somewhat flat areas associated with the Brookston and Fincastle soils and in general represents less productive spots in a background of Fincastle silt loam. Corn does not produce good ears on such spots, and clover does not do well because of the cold, wet nature of the soil and its relatively low fertility.

Brookston silty clay loam.—The surface soil of Brookston silty clay loam is dark gray when dry and dark brown or black when wet. The color fades to mottled gray, yellow, and brown at a depth ranging from 15 to 20 inches below the surface. Calcareous glacial till lies at a depth ranging from 5 to 6 feet. This soil is neutral to slightly acid and is well supplied with organic matter and other plant nutrients.

The rather small areas of this soil are interspersed with areas of Fincastle silt loam. In few places do they comprise more than one-third of any given 40-acre field. Although the land formerly was swampy, most of the shallow depressions have been drained by open ditches or tile lines to make strong land well adapted to corn and clover. This soil helps to increase the production of corn and hogs in the section where it is developed, so that yields approach those on similar land in central Indiana. It also partly accounts for the fact that Geneva Township has nearly one-third of the total clover acreage reported for the county.

Where good drainage is established, winter wheat can be grown and very good yields are obtained. In fact this is one of the best soils in this part of the country for all the crops commonly grown.

SOILS OF THE BETTER DRAINED SLOPES

This group includes all soils of the uplands and terraces except those already listed as developed on poorly drained flats. As a whole, these soils have fair to good surface drainage as a result of open draws, streams, or uneven relief. The soils suitable for clean cultivation are: Gibson silt loam; Gibson silt loam, shallow phase; Cana silt loam, Pekin silt loam, Cincinnati silt loam, Jennings silt loam, Grayford silt loam, Elk silt loam, Elk fine sandy loam, and Russell silt loam. Those too steep or too badly eroded for clean cultivation are Cincinnati silt loam, steep phase; Cincinnati silt loam, eroded phase; Jennings silt loam, slope phase; Jennings silt loam, eroded phase; Russell silt loam, slope phase; and Corydon silty clay loam.

Gibson silt loam.—Cultivated areas of Gibson silt loam are characterized by a 5- or 6-inch light grayish-brown or yellowish-brown surface soil, and a pale brownish-yellow heavier subsoil that becomes more or less mottled with light gray at a depth ranging from 25 to 35 inches owing to imperfect drainage caused by a heavy impervious layer corresponding to the so-called hardpan of soils of the poorly drained uplands and terraces. This soil occurs on moderate slopes having sufficient gradient to allow some aeration and oxidation of the upper layers but not enough to overcome the poor internal drainage. In places where this soil borders areas of Avonburg silt loam, the gray-mottled and impervious layers are well developed, whereas in areas adjacent to Cincinnati silt loam they are inconspicuous. This soil is strongly or very strongly acid down through the impervious layer, but becomes less acid and more gritty in the lower layers. At an average depth of 130 inches the material grades into calcareous Illinoian till.

This soil has sufficient slope to render it favorable for agricultural use with comparatively little danger of erosion, although some sheet erosion occurs at the heads of drainageways. In many places Gibson silt loam forms continuous belts between areas of Avonburg silt loam on the flatter side and Cincinnati silt loam on the more sloping side. Its agricultural use is about the same as that of Cincinnati silt loam.

Gibson silt loam, shallow phase.—The shallow phase of Gibson silt loam resembles the typical soil in the upper part but differs from that soil in parent material and substrata. In place of calcareous till, it grades into limestone about 10 feet below the surface. Its total area is small. It is associated with the more important and extensive Grayford silt loam, to which it corresponds in most respects, except that it is less well drained.

Gibson silt loam, shallow phase, includes small areas of very similar soil developed on marly shale rather than on limestone. This included soil, which is very inextensive, occurs only in the eastern part of this county but may prove to be more extensive in Ripley County. It is similar to the typical Gibson soils in the upper layers, but below a depth of 4 feet it grades into material influenced by the slightly calcareous low-lime shale strata that lie within 10 feet of the surface.

Cana silt loam.—In cultivated fields the surface soil of Cana silt loam consists of smooth light grayish-brown silt loam to plow depth, that is, 4 to 6 inches. This material grades into somewhat heavier pale brownish-yellow silt loam mottled with light gray and speckled in the lower part. At a depth ranging from 2 to 3 feet this gives way to a heavy and impervious layer similar to but not so strongly developed as the so-called claypans of the soils of the poorly drained upland flats and terraces. The glacial till, where present, is thin, is leached of its free lime, and grades rapidly into dark-colored disintegrated oil shale and finally into the unweathered rock that lies at a depth of about 10 feet or less.

This soil has many features in common with Gibson silt loam, but it is more or less modified by the dark oil shale that underlies it and takes the place of the calcareous till substratum normal to the Gibson soils. The influence of the shale is indicated in some places in a slightly heavier texture and a faint speckling in the upper part of the subsoil, but in most places this layer appears as heavy material below the impervious layer and grades down through partly weathered brown shale to the darker bluish gray bedrock. In places the rock is within 5 feet of the surface.

It is evident that this is distinctly poorer land than Gibson silt loam, and it is exceedingly poor in places where there is a tendency for erosion to expose the lower layers.

Cana silt loam occurs in the central and western parts of the county where the oil shale is the upper rock formation.

Pekin silt loam.—Pekin silt loam is a terrace equivalent of Gibson silt loam and has similar surface appearance and upper layers. In the lower part of the profile it shows a variety of stratified layers due to deposition of material by streams. Areas of this soil are developed on glacial and local stream terrace materials. The terraces along Muscatatuck River are silty, acid, and free from lime to a depth of many feet. Along Sand Creek, however, some of the deep substrata contain some sandy and calcareous materials. The agricultural value of this soil is about equal to that of Gibson silt loam.

Cincinnati silt loam.—Cincinnati silt loam consists of light grayish-brown, yellowish-brown, or light-brown silt loam to a depth ranging from 8 to 12 inches, where it grades into a brownish-yellow or light brownish-yellow layer of heavier textured and distinctly compact material. This material breaks into angular fragments less than one-fourth inch in diameter. The surfaces of the structure fragments have a somewhat red tint, as this is the best oxidized soil in this locality. Beneath the well-oxidized subsoil is a layer corresponding to the so-called hardpan or claypan described in connection with the soils of the flats. In Cincinnati silt loam the texture is not so distinctly heavier at this depth as it is, for example, in Clermont silt loam. A little gray color appears, chiefly along cleavage planes, but there is no definite columnar structure. As in the hardpan or claypan of the flats, the reaction is very strongly acid.

Below this layer, the material is somewhat darker yellowish brown or brown in color and somewhat lighter in texture. Unleached limy material lies from 100 to 140 inches below the surface. Glacial pebbles are scattered throughout the soil, especially in the lower part.

This soil occurs in practically all parts of the county and includes the more sloping and better drained land, the smoother parts of which are used for the production of all the common crops. It is subject to some sheet and gully erosion, but the steepest and most eroded areas are separated on the map as phases. Although its content of plant nutrients and organic matter is low, this soil is suitable for growing tobacco. Acre yields ranging from 400 to 1,200 pounds of tobacco are obtained when the soil is fertilized and well managed. An application of 200 pounds of 2–12–6 fertilizer in the hill gives good results. The soil is also benefited by using lime, as it is acid. Corn yields from 5 to 35 bushels an acre, according to the amount of fertilizer used and climatic conditions. Generally it is grown on the less steep land. Wheat yields from 5 to 30 bushels and soybean hay ½ to 1½ tons an acre. In dry seasons crop yields are limited somewhat by lack of moisture, as the water runs off readily after rains. Tomatoes yield from 2 to 10 tons an acre.

The relief limits the area that can be devoted to clean-cultivated crops, but all the land is suitable for pasture and wood lots. The relatively small yield of pasture grasses is offset somewhat by permitting only a small number of cattle to graze over a large area.

Cincinnati silt loam, as mapped, includes a very small total area of a similar soil developed on marly shale that lies within 10 feet of the surface. The agricutural uses and value of the included soil are the same as for the typical soil.

Jennings silt loam.—Jennings silt loam, in cultivated areas, consists of light grayish-brown smooth silt loam to a depth ranging from 6 to 10 inches. This material grades into light brownish-yellow more or less compact silty clay loam or heavy silt loam that breaks into angular fragments less than one-fourth inch in diameter. This material has a slightly red tint similar to the color of the corresponding layer in Cincinnati silt loam. The next layer is a weakly developed claypan like that in Cincinnati silt loam. The glacial material beneath is leached, acid in reaction, and somewhat lighter in texture than the material above. At a depth of 10 feet or less it grades into dark-colored oil shale.

This soil corresponds to typical Cincinnati silt loam in the soil proper. The chief difference is in the slight thickness of glacial material and the absence of unleached calcareous glacial till in the substratum. It rests on dark oil shale within 12 feet of the surface and, as mapped, includes small spots where the soil is only 20 to 24 inches thick over the bedrock. In such spots the soil materials are essentially residual from the shale, and the soil would be classified and mapped as a different type were the areas more extensive.

Jennings silt loam occurs only in the western part of the county where the dark oil shale is the highest layer of the bedrock and lies near the surface because of dissection of the land by streams. A considerable area is in the vicinity of Sixmile Creek. This is generally regarded as poorer land than Cincinnati silt loam because of its higher acidity, lower natural fertility, and erodibility.

Grayford silt loam.—In plowed areas, Grayford silt loam consists of smooth light-brown or light grayish-brown silt loam to a depth of 6 or 8 inches, where it is underlain by pale reddish-yellow or brownish-yellow heavy silt loam or silty clay loam. This layer extends to a depth ranging from 2 to 3 feet and, in places, is slightly mottled with gray in the lower part. The reddish-brown heavy layer is less well developed and more brightly colored than the corresponding layer in Cincinnati silt loam. The weathered parent material is light reddish-brown and less mottled than the till under Cincinnati silt loam. At a depth of 12 feet or less the till grades into limestone.

This soil is very much like Cincinnati silt loam in superficial appearance, but it is somewhat better oxidized or more red in the upper part of the soil material. It differs from that soil in the lower part of the soil profile. In place of yellow mottled drift and limy till, the lower layers of this soil, in many places, are intensely red and grade into limestone bedrock within 12 feet of the surface. There is much evidence of glacial material in this deep subsoil, which may be very old glacial drift, but the soil as mapped also includes soils containing some heavy clay and chert, which seem to be derived from the local bedrock.

Most areas of this soil occur in old preglacial valleys along several of the major streams in the central part of the county. They occupy terracelike positions in relation to the bottoms but lie a little below the general level of the till plain. Their good drainage resulting from sufficient surface slope and proximity to streams is further enhanced by numerous sinkholes that have outlets for rainfall through crevices in the underlying rock strata. Areas of this soil cover as much as 100 acres. The soil is known locally as limestone land and is considered very desirable for farming. The gently rolling relief renders the land easy to cultivate except near some of the sinkholes where the surface soil has washed from the slope and the reddish-brown subsoil is exposed.

All the important general crops are grown, and good yields are obtained. Corn returns from 15 to 40 bushels, wheat 10 to 35 bushels, oats 15 to 50 bushels, and soybeans for hay 1 to 2 tons an acre. The amount of pasture land is relatively small because the soil is utilized to greater advantage for cultivated crops. A complete fertilizer is used with nitrogen and phosphorus, the more important elements.

The soil is also well suited to the cash crops—tobacco, tomatoes, and potatoes—as it is well drained yet retains sufficient moisture for good growth of crops. The compact plastic sticky subsoil retains moisture well, and the friable surface soil makes cultivation reasonably easy. Tobacco grows well and when fertilized produces from 600 to 1,500 pounds per acre. Tomatoes yield from 4 to 10 tons and potatoes 50 to 300 bushels, depending on climatic conditions, fertilization, and management. This soil is moderately well supplied with organic matter which is so essential to these crops. The response to good treatment is rapid.

Elk silt loam.—Elk silt loam has a 10- or 12-inch light-brown or light grayish-brown silt loam surface soil. It is underlain by light reddish-brown silty clay loam to a depth ranging from 30 to 36 inches, below which the material is reddish brown, slightly streaked with yellowish brown and grayish brown. Stratified clays, silts, and coarse sands underlie the soil at a depth of 40 inches or more.

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Elk silt loam is developed on the best drained parts of the terraces along Muscatatuck River, Vernon Fork Muscatatuck River, Sand Creek, and, to some extent, along other large streams. It resembles Cincinnati silt loam in its surface soil and its well-oxidized subsoil with a slight red cast, but the substrata consist of stratified water-laid materials ranging from heavy clays and silts to medium and coarse sands.

This soil is utilized in much the same way as Cincinnati silt loam, with similar crop yields. A few small associated areas of slope and eroded phases of Elk silt loam are included on the map. The slopes are neither long enough nor high enough to cause much erosion on the terraces.

Elk fine sandy loam.—Elk fine sandy loam occupies a very small area in this county. It differs from Elk silt loam chiefly in having a sandy surface texture, which makes it easy to cultivate, but the subsoil is heavy enough to hold moisture well. One very small area on the Jackson County line near Sand Creek is probably a wind-blown deposit related to Princeton fine sandy loam, which is extensive in Jackson County along the eastern border of the valley of East Fork White River.

Russell silt loam.—The 6- or 8-inch surface soil of Russell silt loam is light-brown friable silt loam. It is underlain by a heavy moderately compact yellowish-brown subsoil with a slight red tinge. Below a depth of 18 or 20 inches the texture and color gradually become lighter, and at a depth ranging from 50 to 70 inches the unleached limy (calcareous) glacial material is reached. The typical soil occurs on moderate slopes and, in most places, is adjacent to drainageways. It is the best drained and most extensive soil on the early Wisconsin drift and as such is an important soil in this county.

Russell silt loam is used for the same general crops as most other soils in the county, and it returns yields above the average. It is well suited to the production of wheat and where well managed also produces good crops of corn and hay. In few places it is badly injured by erosion.

Cincinnati silt loam, steep phase.—The soil profile of this steep soil is much like that of typical Cincinnati silt loam, but the degree of slope is much greater and some very steep broken land is included. The average depth to parent material is less than in the typical soil, and the surface soil has been partly washed away. Many areas have never been cleared and remain as wood lots, others are in pasture, and a few of the smoothest ones are used for cultivated crops. The cleared land has suffered more or less sheet erosion. Little destructive gullying has taken place, but all the land might become gullied rapidly were it not protected by vegetation.

The principal uses for this soil are the production of timber, fuel wood, and pasture.

Some steep and sloping areas of Grayford silt loam are included in mapping. They have profile characteristics much like typical Grayford silt loam except for the slighter depth to parent material. Their profile also corresponds to that of the steep phase of typical Cincinnati silt loam in the upper part, but it is strongly modified by the underlying limestone. The color of the surface soil varies from light brown to dark yellowish brown with a slight red tint, and in some places the included soil has been formed by direct weathering of limestone outcrops. In places the subsoil is dark reddish brown, heavy, plastic, and compact, and it contains fragments of chert derived from the limestone. The included soil is used for timber and pasture. Part of it is comparatively sweet and fertile, so that good stands of bluegrass and of sweetclover grow on it in some places.

Cincinnati silt loam, steep phase, is extensive in the central and eastern parts of the county. It is developed on the steep lower slopes along the larger valleys, in close association with Grayford silt loam.

Cincinnati silt loam, eroded phase.—The eroded phase of Cincinnati silt loam includes areas of Cincinnati silt loam, steep phase, that have been cleared, cultivated, and seriously damaged or almost destroyed by sheet and gully erosion. This soil is an example of what all the steep soil might become if it were cultivated. Where gullies have cut 10 feet or more through the soil, they expose the underlying calcareous drift. In most places the subsoil above the drift is very acid and barren material. The eroded land supports little vegetation other than a few weeds, bushes, and briers.

Small areas of an eroded phase of Grayford silt loam also are included on the map with Cincinnati silt loam, eroded phase. Because of the limestone-derived clays and bedrock, which are exposed, greater possibility exists for reclaiming this included soil for pasture or for the production of timber than for reclaiming much of the other eroded land in this section. These small included areas are closely associated with typical Grayford silt loam.

Jennings silt loam, slope phase.—The profile characteristics of the slope phase of Jennings silt loam are similar to those features of typical Jennings silt loam, except that the individual layers are, on the average, somewhat thinner. In many places, much of the surface soil has been removed by sheet erosion. The depth to the underlying acid oil shale varies; in most places it is less than 10 feet, and in many places the shale lies very near the surface. This shallow and strongly acid soil is less productive than Cincinnati silt loam, steep phase. It occurs chiefly in the central and western parts of the county and is used for timber or pasture land or is allowed to become waste land. Cleared areas are very likely to erode severely because the vegetation generally is too sparse to protect the slopes.

Jennings silt loam, eroded phase.—The eroded phase of Jennings silt loam is very poor land that has been cleared and cultivated and subsequently deeply cut by gullies—in many places down to the black oil shale bedrock that is from 3 to 7 feet below the original surface. The poorer areas support no vegetation other than a few stunted cedars, bushes, and weeds. The small quantity of soil material left has little or no value, even for the growth of forest. This eroded soil is closely associated with the typical soil.

Russell silt loam, slope phase.—The slope phase of Russell silt loam is essentially like typical Russell silt loam except that the soil layers are, for the most part, thinner. The slope is unfavorable for clean cultivation, and some areas are so steep that they are obviously unfit for anything but wood lots and are still in timber. Other areas have been cleared and, in most places, are kept in permanent pasture to prevent washing. All the cleared areas have suffered more or less from sheet erosion.

A very small total area of Russell silt loam, eroded phase, is included on the map with areas of the slope phase. This soil has been cleared, cultivated, and partly destroyed by sheet and gully erosion. The upper part of the soil, to a depth of 10 or 12 inches, has washed away, and deep gullies have cut through to the parent material in many places. In their present condition these areas support little vegetation of any kind and have little value. They should be protected by plantings of locust trees or other vegetation and should be kept in timber. Three small areas are mapped: (1) in the SW¼SE¼ sec. 28, R. 7 E., T. 8 N.; (2) at the northern edge of sec. 26, R. 7 E., T. 8 N; and (3) near the northeast corner of sec. 32, R. 7 E., T. 8 N.

Corydon silty clay loam.—Corydon silty clay loam is developed over limestone on such steep slopes that any cover of glacial drift that it may have had has washed away long ago. The surface soil is dark silty clay loam or clay loam, only a few inches thick, and the subsoil is yellow or slightly red clay loam or clay. Rock fragments are present throughout the shallow soil, and rock outcrops in places. Most of this land is in woods—its only possible use because of its steepness and stoniness. Bodies of this soil occur chiefly in the central part of the county where the larger streams have cut deep valleys in the underlying limestone formations. Their total extent is small.

SOILS OF THE OVERFLOW BOTTOMS

Soils of the first bottoms or flood plains adjacent to streams range from wide areas along the main creeks to narrow strips near the heads of small tributaries. These soils are well distributed throughout the county, the largest areas lying along Vernon Fork Muscatatuck River near the western boundary of the county and along Muscatatuck River, which forms part of the southern boundary.

As these soils are subject to frequent overflow, which washes away material and likewise deposits fresh sediments, they have had no opportunity to be greatly modified by soil-forming processes. Any change of texture in the profile is due to the character of the deposited sediments. The deposition of rich soil material increases the fertility by adding plant nutrients. In normal seasons these soils retain sufficient moisture for the production of good crops.

Corn, the principal crop grown in the bottoms, yields from 25 to 100 bushels per acre, depending on the type of soil, drainage conditions, and management. Little or no fertilizer is used, as the soils are naturally productive. The highest yields are obtained on the better drained soils. For best results, crops must be sown in the spring and harvested in the fall, because the streams usually overflow in the winter or early spring. Wheat, therefore, can hardly be grown. Occasionally overflows are very destructive even to corn and also injure other spring-seeded crops. Hay produces good yields, and on the sweet well-drained soils alfalfa returns from 2 to 5 tons of hay an acre without the necessity of liming. Soybeans for hay do equally well and in addition are better suited to the more poorly drained and more acid soils. Timothy hay yields well on both acid and sweet soils. Along the larger streams, some of the more poorly drained areas are used for pasture, but, since little of the land is fenced, it is largely used for cultivated crops. In the smaller valleys, pasture is the principal use for this land, as most of the areas are small, irregular in shape, and not suitable for cultivation.

These soils may be considered as belonging to two subgroups—the more poorly drained soils and the better drained soils. Soils of the more poorly drained bottoms are Waverly silt loam, Waverly silty clay loam, Stendal silt loam, Stendal silty clay loam, and Wayland silt loam. Wayland silt loam is a "sweet" soil, and the other types are acid. All these soils occupy the lower situations on the bottoms and, in most places, are farther from the stream channels and nearer the hills than the better drained soils. They are flooded frequently, both from the main streams and from the adjacent uplands. The floodwaters are deeper, stay on the land longer, and are harder to drain away artificially than on the better drained bottom soils. The overflow currents for the most part are gentle, and the finest sediments are deposited, making the texture of the low bottoms comparatively heavy. The soils in this subgroup are not so well suited to cultivation as the better drained soils of the bottoms, because crops cannot be planted early and they are subject to greater loss from flood. Some areas are still covered by thriving forests, and others are in pasture or meadows. The subgroup of better drained soils includes Philo silt loam, Philo sandy loam, Pope silt loam, Eel silt loam, Genesee silt loam, Genesee loam, and Genesee fine sandy loam. The Philo and Pope soils are acid, whereas the Eel and Genesee soils are sweet. All these soils occur nearer the open stream channels and on the slightly higher part of the bottoms, therefore they are flooded for comparatively short periods and to comparatively slight depths compared with the poorly drained soils. They are subject to some washing by swifter overflow currents and receive the coarser sediments deposited by the streams. These soils dry earlier in the season and are more easily cultivated because of their loamy texture. Most of the areas are cleared and are used for clean-cultivated crops, except the narrow strips along stream channels that are fringed with trees.

Waverly silt loam.—Waverly silt loam includes low, flat, poorly drained acid soils of the bottoms, which have gray or light-gray silt loam or loam surface soils and light-gray, slightly mottled with rusty brown, subsoils of fairly heavy but variable texture to a depth of 3 feet or more. There is no consistent arrangement of textural layers. This soil is developed on the bottoms along the lower reaches of Vernon Fork Muscatatuck River and along a few other streams. Average acre yields of the principal crops are approximately as follows: Corn, 15 bushels; oats, 20 bushels; and timothy, 1 or 1½ tons.

Waverly silty clay loam.—Waverly silty clay loam is very similar to Waverly silt loam, but the surface soil has a silty clay loam texture. It is mapped almost exclusively on the broad bottoms of Vernon Fork Muscatatuck River in the southwestern part of the county. Forest still covers much of the land because the soil is too wet to use for other purposes. The reaction of this soil is acid, but timber grows very well on it.

Stendal silt loam.—Stendal silt loam consists of light brownish-gray silt loam, more or less mottled with gray, yellow, and brown to a depth of several feet. This soil is somewhat better drained than Waverly silt loam but is more poorly drained than Philo silt loam. It is acid in reaction and is more suitable for pasture, hay, or timber than for cultivated crops. In cultivated areas average acre yields are slightly higher than on Waverly silt loam.

Stendal silty clay loam.—Stendal silty clay loam has a light brownish-gray silty clay loam 12- to 15-inch surface soil mottled with gray, yellow, and brown. Textures of the substrata are, on the average, as heavy as or heavier than the texture of the surface soil, and the proportion of gray color increases with depth. This soil occurs in the broad bottoms of Vernon Fork Muscatatuck River near the Jackson County line, as well as along Muscatatuck River. It is acid in reaction. It includes small areas of a better drained soil that would be mapped as Philo silty clay loam if the areas were larger.

Wayland silt loam.—To a depth of several feet, Wayland silt loam is light grayish-brown silt loam mottled with gray, yellow, and brown. It resembles Stendal silt loam but differs from that soil in having an almost neutral reaction owing to the fact that the sediments that compose it were washed from more or less limy materials. It is more poorly drained than Eel silt loam. Where drainage is provided, Wayland silt loam is considerably more productive than Stendal silt loam.

Philo silt loam.—Philo silt loam is grayish-brown friable silt loam to a depth ranging from 10 to 30 inches, below which the subsoil is strongly mottled with gray, yellow, and brown, owing to a water-logged condition. In some places the browner surface soil is due to the higher elevation above the water table; in others it is caused by brown superficial sediments washed from the uplands since the land has been cleared.

This soil occurs along many streams, especially on the narrow bottoms in the western part of the county where dark-colored acid shales have contributed acid materials to the bottoms. Corn, the principal crop, produces average yields of about 25 bushels an acre. Oats, timothy, vegetables, and tobacco are minor crops.

Philo sandy loam.—This soil occurs in a few narrow bottoms in the northeastern part of the county where stream action has assorted the sediments and deposited sandy material. Otherwise, this soil corresponds with Philo silt loam in appearance, reaction, and use, except that it is possibly somewhat less productive of corn.

Pope silt loam.—Pope silt loam consists of light-brown, grayish-brown, or yellowish-brown friable silt loam that in places becomes a little lighter colored below plow depth but is free from the mottlings indicative of poor drainage to a depth of 3 feet or more. The texture remains silt loam throughout, although layers of slightly different texture have been deposited by different floods. The reaction is decidedly acid, as the sediments are derived from very acid upland soils. This soil includes the highest and best drained parts of certain bottom lands and is developed along several streams south of Hayden. It is used for the production of corn, hay, and soybeans. The average yield of corn is about 30 bushels per acre.

Eel silt loam.—In plowed fields the surface soil of Eel silt loam is grayish-brown friable silt loam. At a depth ranging from 15 to 30 inches the subsoil becomes quite distinctly mottled with gray, brown, and yellow, owing to poor drainage. As in Philo silt loam, lack of mottling in the surface layer may be due either to a lower water table than is typical of bottom soils or to an overwash of fresh brown sediment. Eel silt loam is nearly neutral in reaction and is regarded as somewhat more fertile than Philo silt loam.

Genesee silt loam.—Genesee silt loam is brown or grayish brown to a depth of 3 feet or more. Slight differences in texture of the lower layers are due to stratification by streams and not to soil-forming processes. The Genesee soils are better drained than the other bottom soils of the county, except Pope silt loam, and are more productive than the Pope soil because they are composed of more alkaline and more fertile material.

Most of the Genesee soils in this county are not quite the same as the Genesee soils of central Indiana, which are developed on alluvial wash from moderately weathered calcareous Wisconsin glacial till. In Jennings County, streams have cut deeply through the Clermont, Cincinnati, and associated soils into underlying calcareous drift or limestone bedrock and have deposited neutral sediments that are classified as Genesee soils. Genesee silt loam, the best bottom-land soil mapped, is used almost entirely for the production of corn, which returns an average yield of about 55 bushels an acre.

Genesee loam.—Genesee loam is like Genesee silt loam in all respects except for its loam texture, which has resulted from the assorting action of floodwaters that deposited loamy material near the stream channels. It is somewhat more easily worked than the silt loam but is somewhat less productive during dry years.

Genesee fine sandy loam.—Genesee fine sandy loam resembles Genesee silt loam except for its sandy texture due to deposition of coarse sediments nearest the streams on the natural levees along the channels. Most of the land has the advantage of good drainage without being excessively droughty, and it is easy to cultivate. It is not quite so strong a soil as the silt loam. In some places, it is partly occupied by a fringe of trees along the stream channels, as along Sand and Graham Creeks.

As mapped, Genesee fine sandy loam includes a small total area of a poorly drained soil similar to Wayland silt loam but having a fine sandy loam texture. This included soil has a slightly heavier subsoil than that of Wayland silt loam. It occurs in a few small stream bottoms where limy sediments have made the soil sweet or only slightly acid and where swifter currents have deposited material of a sandy texture.

MORPHOLOGY AND GENESIS OF SOILS

The normally developed soils of Jennings County are leached and belong to the Gray-Brown Podzolic soils group,[8] which is normal to a humid temperate climate under a forest cover. On flat and gently sloping imperfectly or poorly drained timberland, characteristic of much of the county, soil development has been extreme, and Planosols, or so-called claypan soils, have been formed.[9] Planosols develop under a humid climate in places where the relief is sufficiently flat to prevent erosion and good drainage. Most of them have been exposed to

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[8] MARBUT, C. F. SOILS OF THE UNITED STATES. U. S. Dept. Agr., Atlas of American Agriculture, pt. 3, Advance Sheets No. 8, 98 pp., illus. 1935.

[9] A definition of planosol may be found in A Glossary of Special Terms Used in the Soils Yearbook, U. S. Dept. Agr., Yearbook of Agriculture, 1938: 1174.

soil-forming processes for a very long time, and in Jennings County they seem to represent the extreme of profile development for this section. They are characterized by heavy horizons, in most places, at a considerable depth below the surface. The almost impenetrable layer prevents subdrainage. Certain of the soil profiles are definitely correlated with the environmental factors of soil formation—climate, vegetation, and relief—as well as time, and where all these factors are more or less in balance, typical Gray-Brown Podzolic soils develop. The Planosols, as has already been suggested, owe their character primarily to the predominating influences of relief and time, with climate and native vegetation playing minor roles.

The United States Weather Bureau reports show that the mean annual temperature in this county is 54.3° F. and the mean annual precipitation is 47.47 inches. The annual evaporation from open water probably is slightly more than the precipitation, and the average relative humidity generally is high.

The native vegetation in recent ages consisted mostly of hardwoods, such as oak, beech, gum, maple, tuliptree, hickory, ash, elm, and walnut. As the soils existed under a forest cover for a long time, they are generally low in organic matter and light in color. The nitrogen content within plow depth in cultivated soils is about 0.1 percent and the organic-matter content is about 2 percent.

The original parent material from which the soils have been developed by the local environmental influences is chiefly glacial drift,[10] which was deposited at two different periods, separated by many thousands of years. The first, or Illinoian, glaciation covered all the county, whereas the second, or early Wisconsin, glaciation affected only the northwestern part, where it probably capped the earlier drift.

Drift is an unconsolidated mixture of rocks and minerals. In this locality it generally contains more than 20 percent of limestone, considerable shale and sandstone, and more or less exotic rocks, such as granite, diorite, quartzite, and gneiss, which must have been brought in by the glacial ice from very distant sources. A large part of the drift probably came from local limestone, dark acid shale, and marly shale bedrock. Where the drift mantle is thin the underlying bedrock affects the soil in important respects.

The influence of limestone material on the well-drained soils in this section is seen in the more reddish brown lower subsoil layers with heavier texture, yet rather pervious structure, and in the chert fragments in the profile. The numerous limestone sinkholes generally improve drainage through the substratum. The effect of black acid oil shale on soils is to make the texture heavier, the drainage poorer, the reaction more acid, the fertility lower, and the erodibility of the soil greater. Soils with marly shale substrata are so limited in extent in this county that the importance or significance of this distinction cannot be fully determined.

The glacial drift here is fairly uniform and heavy in texture. It contains a large proportion of clay and silt particles with larger fragments ranging in size from sand grains to boulders. Till, or unassorted glacial drift, is composed of mixed clay, silt, sands, and

[10] Glacial drift is a general term used to cover material brought in by glaciers. Part of the drift has been reworked and stratified by water, but more of it remains unstratified as originally deposited by the ice and is known as glacial till.

stones and is the kind of drift commonly found on the uplands. The drift on the terraces is more or less assorted as to sizes of particles and is stratified in layers of various textures. Little difference can be observed in the composition and texture of local unleached tills of early Wisconsin and Illinoian age. The present environment of the soils developed on the two till deposits is essentially the same, so their differences are ascribed to the fact that Illinoian drift has been weathered several times as long as the early Wisconsin drift.

The main characteristics of the soil types by which they are identified, distinguished, and classified are shown in the key to the soils of Jennings County in table 4. Soil types of different textures but belonging to the same series have the same general profile features as are indicated in the key.

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TABLE 4.—*Key to the soils of Jennings County, Ind.*[1]

SOILS OF THE UPLANDS AND TERRACES

Soil characteristics	General profile[2]							
	I	II	III	IV	IV (slope)	VI	VII	VIII
Surface drainage	Poor	Imperfect	Fair	Good	Excessive	Excessive	Excessive	Very poor.
Internal drainage	Very poor	Poor	Imperfect	do	Good	Fair	Good	Do.
Surface color	Light gray	Brownish gray	Grayish brown	Light brown	Reddish yellow	Dark brown	Reddish yellow	Dark gray.
Subsoil color	do	Mottled	Yellow	Reddish yellow	do	Reddish brown	do	Dark, mottled.
Leached and weathered 4-7 feet, early Wisconsin drift:								
Upland:								
High-lime till		Fincastle silt loam.		Russell silt loam	Russell silt loam, slope phase.			Brookston silty clay loam.
Horizons		ABYC		ABYC	(A)BYC			HMU
Leached and weathered 10 feet or more, Illinoian drift:								
Upland:								
High-lime till	Clermont silt loam.	Avonburg silt loam.	Gibson silt loam	Cincinnati silt loam.	Cincinnati silt loam, steep phase.		Cincinnati silt loam, eroded phase.	
Horizons	AXYC	A(B)XYC	ABXYC	AB(X)YC	(A)B(X)YC		YC	
Leached till on oil shale.		Whitcomb silt loam.	Cana silt loam	Jennings silt loam	Jennings silt loam, slope phase.		Jennings silt loam, eroded phase.	
Horizons		A(B)XYC	ABXYC	AB(X)YC	(A)B(X)YC		YC	
Leached till on limestone.			Gibson silt loam, shallow phase.	Grayford silt loam.				
Horizons			ABXYC	AB(X)YC				
Terrace:								
Leached terrace materials (assorted silt, clay, and some sand and gravel).	Calhoun silt loam	Bartle silt loam	Pekin silt loam	Elk silt loam and Elk fine sandy loam.				
Horizons	AXYC	A(B)XYC	ABXYC	AB(X)YC				
Leached and weathered 6 to 24 inches, impure limestone residual from bedrock.						Corydon silty clay loam.		
Horizons						AC		

SOILS OF THE BOTTOM LANDS

Relative elevation	Low	Low	Slightly elevated	Elevated			
Surface color	Light gray	Mottled	Grayish brown	Brown			
Subsoil color	do	do	Mottled	do			
First bottoms, alluvium from Illinoian drift, Wisconsin drift, and residual sources:							
Acid alluvium from Illinoian soils and acid shales.	Waverly silt loam and Waverly silty clay loam.	Stendal silt loam and Stendal silty clay loam.	Philo silt loam and Philo sandy loam.	Pope silt loam			
Layers	DDD	DDD	DDD	DDD			
Neutral alluvium from lime-bearing rocks and soil.		Wayland silt loam.	Eel silt loam	Genesee silt loam, Genesee loam, and Genesee fine sandy loam.			
Layers		DDD	DDD	DDD			

[1] The key presented in this table shows the same general information (with minor changes) given in the following publication: BUSHNELL, T. M. MAP OF SOIL REGIONS AND KEY TO SOIL SERIES OF INDIANA. Ind. Agr. Expt. Sta., La Fayette, Ind. 1933.

[2] The significance of the letters in the profile formulas is explained in the text (p. 29). The letters in parentheses indicate weakly developed or almost lacking horizons.

The names of all soil series are placed in spaces of the key so that their descriptions are found at the heads of columns or on the left of the table. The members of all series found in any given column are very much alike, especially in the features of their upper layers, which depend on surface slope, drainage, aeration, and oxidation, regardless of physiography, parent material, or length of time of weathering. All series in any horizontal tier are related by having a common parent material, the influence of which shows up in the nature of their lower horizons. Such a group is known as a catena, provided all the members occur in one soil zone. Horizontal subdivisions are also made to provide for different soils from similar parent material weathered for different lengths of time.

Letters placed with the series names indicate the main horizons present in each profile. These letters are chosen to represent definite groups of soil characteristics and are not merely indicative of the order in which the layers occur in the profiles. This system of notation will be explained in developing theories of soil genesis.

It may be supposed that when the glaciers retreated from this area they left a comparatively smooth land surface covered with drift containing perhaps 20 percent or more of carbonates throughout. In a humid climate, the land was subject to the formation of a drainage network of streams, leaving uplands, terraces, and first bottoms with many different degrees of slope.

In an area such as this, there are three general sets of conditions under which soil formation proceeds with very divergent results. The first of these is the "high-ground" condition, including all the uplands and terraces (general profiles I to VII) except depressed areas ("low ground") occupied by Brookston silty clay loam. Rainfall may run off the surface of the high ground or through the soil down to the permanent water table at some point in the substratum. Ever since the retreat of the glaciers, freezing, thawing, and other physical and chemical processes have been breaking down the larger particles into smaller ones, and the finest particles have tended to move downward through the soil mass to be concentrated in a zone of finer or heavier texture, leaving coarser or lighter textured materials in the upper horizons. The percolating waters also dissolve soluble materials and reprecipitate part of them in the lower horizons by chemical interaction. Carbonic acid formed through the decomposition of organic matter is especially effective in dissolving calcium carbonate or limestone, so that eventually all limestone in the older soils will become entirely dissolved and gradually moved down and out of the soil profile and carried away in the ground water. The depth to carbonates in the present soil profiles is roughly indicative of the relative length of time that weathering processes have been active.

Under a forest cover, such as existed over the entire county until recently, the formation of soil is affected by trees, which extract certain materials from the deeper soil horizons and return them to the surface in the leaf fall. Under virgin conditions leaves formed a mat of fresh litter on the surface, and beneath it was a highly decomposed layer of organic matter. The immediate surface soil of the mineral soil also contained a considerable amount of organic matter, and in this area the visible organic material generally penetrates the soil to a depth of several inches, owing to the action of earthworms, insects, and roots. Although leaves are a source of organic acids, which further the leaching of soils, they also contain lime and other bases, which are added to the immediate surface soil. For this reason the reaction of the material in the surface layer is nearer neutrality than that of the lower horizons, where the leaching process reaches its maximum intensity and produces acidic clay compounds. The extra calcium in the surface layers helps to make the organic matter less soluble and darker. Nitrogen is associated with the organic matter, and both decrease rather rapidly with depth. When the soils are well aerated they become well oxidized, as evidenced by yellowish-brown and reddish-brown compounds of iron well distributed over the soil particles. Under poor aeration the iron is reduced, thereby producing gray or mottled colors, and it also tends to be segregated as soft brown or hard black concretions.

In brief, weathering of high-ground soils results in removal of basic material, especially lime carbonate, accumulation of acidic clays, especially in the middle of the soil profiles, accumulation of organic matter in the surface layers, concentration of clay in the subsoil, and formation of iron pigments in the profile, according to drainage and aeration.

Many of the differences between soils seem to be definitely a matter of the equilibrium between the accumulation of leached weathered material and its removal by erosion and also between aeration and oxidation as opposed to waterlogging and reduction.

Profiles formed in this way have lighter textured, leached, eluviated surface mineral horizons, indicated by A in the key, and heavier textured zones of accumulation, or illuviated horizons, shown by B. In this key, C is used only for unleached parent material, identified in most places by the presence of carbonates. The original material generally contained limestone, whereas the weathered soil profile contains none. Many soil profiles have thick horizons between the unleached calcareous C and the normal B as identified by heavier texture, nutlike structure, and color. These intermediate layers are designated as Y horizons. They are weathered parent material. The X, or claypan, horizon lies just below the B and just above the Y position. It is characterized by columnar structure, somewhat heavier texture, and high acidity. It is an impervious claypan and supports a temporary water table by retarding percolation of soil water.

The second condition of soil formation is that of "low ground," illustrated in the Brookston soils. These were formed in depressions of the uplands that formerly were covered by water much of the time, and as a result weathering processes were greatly modified. The cover of more or less stagnant water prevented deep freezing and thawing and high temperatures, as well as aeration, oxidation, and leaching. Instead, there was waterlogging, reduction of oxides, water flowing in from higher land and bearing fine earth and basic material in solution, a rank growth of vegetation, and an accumulation of dark-colored organic matter, generally nearly neutral in reaction. This is general profile VIII in the key. The letters used to indicate the main horizons of the Brookston silty clay loam profile have the following meanings: H is the zone of visible humus accumulation as indicated by the darkening of the soil; M is the modified mineral material of the subsoil, which has little or no visible humus and no carbonates; U is the underlying material, which in this instance is much like the parent material of associated better drained soils, such as Fincastle silt loam. It is not parent material of the Brookston soil in the usual sense of the word. No definite horizons of eluviation or illuviation are developed in the Brookston soils.

The third condition is that of bottom land or alluvium. Neither horizons of eluviation nor horizons of humus accumulation are formed in the bottom-land or alluvial soils, even in places where the relief is such that they might be expected to occur. The layers that do appear in these soils merely represent deposits of local flood currents. These layers are indicated as D layers in the key. DDD indicates several layers of deposition. The colors in alluvial profiles do reflect local drainage conditions that may cause oxidation or reduction of the iron somewhat as in the poorly drained soils of the upland flats, but the better drained bottoms are so constantly renewed by fresh sediments that they are not oxidized to yellowish-brown and reddish-brown colors as in the uplands but are brown and unmottled throughout. General profiles of the first bottoms resemble those of the uplands only in drainage and in color.

Although the comparatively simple hypotheses of soil formation suggested above account for many facts, the actual history and genesis of the existing soil types probably was much more complicated. For instance, there probably were several distinct climatic cycles, each long enough to cause the development of soils reflecting the prevailing climatic conditions. Perhaps, instead of the modern types being formed directly from material like the underlying unweathered parent material, they should be thought of as being developed from a succession of intermediate soils. For instance, the parent material of Cincinnati silt loam may really have been a soil like Russell silt loam rather than calcareous Illinoian till.

It is reasonable to suppose that as the Illinoian glacier receded the climate was cold and soils like those of the Tundra were first formed. These might have been succeeded by true Podzols, and by Gray-Brown Podzolic soils, in turn, as the climate moderated; but when the early Wisconsin glacier reached the northern border of what is now Jennings County, it must have produced a cold climate over the adjoining area, which would favor re-formation of Tundra and later a repetition of the sequence of Podzol and Gray-Brown Podzolic soils. The whole process might have been repeated a third time when the late Wisconsin glacier came within 20 miles of this county and then receded.

Probably the Illinoian drift area once had irregular "till billow" relief with soils resembling the Brookston soils in the depressions, but slow erosion moved materials from the higher places down into the swales so that the surface became uniformly smooth. When most of the lime was leached away the dark color of soils similar to the Brookston could no longer be maintained in the wet depressions and flats.

A few slick spots occur in the Clermont, Cincinnati, and associated soils. These spots are alkaline, even in the surface soil, although normally this land is acid to a depth of over 6 feet. Very little carbonate or water-soluble salt is present, but fairly large quantities of salts are contained, which may be extracted by leaching with ammonium chloride. It has been suggested that these slick spots may have formed in a period of dry climate at some time in the past. Another curious feature that may be related to the last-mentioned condition is the presence of lime concretions at a depth ranging from 5 to 6 feet in the leached zone of a Clermont profile, although all lime is removed from the parent material to a depth ranging from 10 to 12 feet.

Detailed descriptions of the profiles of the different soil types were made, and some of the more important ones are given to illustrate the range of soil conditions in this county.

The following description of samples of a profile of Clermont silt loam, taken 3 miles southwest of San Jacinto, represents general profile I of the key:

A_0. Partly decomposed dark-brown organic litter with a pH value of 5.7.

A_1. 0 to ½ inch, dark-gray silt loam. The color is influenced by the presence of organic matter. The pH value is 4.9.

A_2. ½ to 4 inches, somewhat lighter colored silt loam than in the above layer and slightly streaked with dark brownish yellow. The material in this layer is vesicular, phylliform, and somewhat more compact than in A_1. The pH value is 4.8.

A_3. 4 to 36 inches, light-gray slightly compact vesicular silt loam, faintly mottled with brownish yellow. Small dark iron concretions are noticeable, and channels of root hairs are stained a darker color. The material has a pH value of 4.6.

X_1. 36 to 40 inches, silty material, somewhat heavier and lighter colored than that in the horizon above. Some light brownish-yellow or brownish-yellow mottlings appear. Dark-colored concretions are present. The pH value is 4.5.

X_2. 40 to 45 inches, silty clay loam, which represents an abrupt change in texture from that of the overlying material. The color ranges from light gray in the upper part to gray, mottled with dark brownish yellow, in the lower part of the horizon. Vertical cleavage planes are apparent, and iron concretions one-fourth inch in diameter and less and a few small angular pebbles are present. Root-hair channels are stained a dark reddish brown. The pH value is 4.4.

Y_1. 45 to 80 inches, dark-gray to brownish-yellow silt loam or silty clay loam. The gray material is dominant, with the brownish yellow occurring in most places as streaks. The material has a pH value of 4.6.

Y_2. 80 to 120 inches, silty clay loam, somewhat darker gray than in the layer above, mottled with dark brownish yellow. When moist the material is plastic. The pH value is 5.3.

Y_3. 120 to 145 inches, dark brownish-yellow silty clay loam slightly tinged with red and mottled with light gray, gray, or dark gray.

Y_4. 145 to 155 inches, brownish-yellow light silty clay loam. This horizon is separated on account of its slight acidity. The pH value is 6.8 to 7.0.

C_1. 155 inches +, calcareous Illinoian till.

Where the thickness of Illinoian till is less than the normal depth of leaching in this section—about 10 feet—no calcareous till, C, is present under the Clermontlike soils, although these soils correspond to true Clermont soils from the surface down through the X to the Y horizon. Below the X horizon they show more or less influence of the local bedrock. The Clermontlike soils underlain by black acid shale belong to the Whitcomb series. Clermontlike soils underlain by marly shale and by limestone are included with typical Clermont silt loam on the map, because of their small total area.

The profile of Calhoun silt loam also is similar to that of Clermont silt loam down through the X horizon, but the lower part of the profile includes several kinds of stratified, water-laid, and assorted layers. Along Sand Creek the underlying material consists of calcareous sands and gravels, probably washed from Wisconsin drift materials, whereas in Muscatatuck River Valley the lower horizons consist of silts and clays that are free from lime to great depths.

Delmar silt loam, included on the map with Fincastle silt loam, resembles the Clermont soil in general features of relief, color, and drainage, but leaching is less than half as deep as it is in the Clermont soil, and the acid columnar claypan horizon of the Clermont is lacking, the depth of the friable surface layer is much less than in the Clermont, and the first heavy horizon is a B horizon, or normal zone of illuviation.

General profile II, or the second step in the natural sequence between the most poorly drained flats and the best drained slopes, is represented by Avonburg silt loam. The lower horizons in this profile are very similar to those in the profile of Clermont silt loam, therefore only the upper horizons are given in the following description of the profile of Avonburg silt loam, observed 2 miles east of San Jacinto:

A_0. ½ to 0 inch, dark-brown partly decomposed organic litter with a pH value of 5.2.

A_1. 0 to 1 inch, dark-gray friable silt loam, in which organic matter affects both texture and color. The pH value is 5.5.

A_2. 1 to 5 inches, light-gray or light brownish-yellow somewhat vesicular silt loam. Some organic stains penetrate this material. The pH value is 5.2.

$A_{2\,1}$. 5 to 9 inches, a somewhat lighter colored silt loam than in the above layer, much of which is mottled. The material is vesicular and also phylliform to some extent. The pH value is 4.9.

A_3. 9 to 19 inches, light brownish-yellow or brownish-yellow, mottled with light gray, silt loam, which is more compact and perhaps slightly heavier than that in the layer above. The pH value is 4.7.

Three inclusions in the mapping of Avonburg silt loam are distinguished by different kinds of bedrock that take the place of the calcareous till C horizon and modify the Y horizon without greatly affecting the profiles from the surface down through the X horizon. The underlying rocks are dark-colored oil shale, limestone, and marly shale.

Bartle silt loam is a terrace equivalent of Avonburg silt loam. It has a profile very similar to Avonburg silt loam except that the Y and C layers are characterized by assorted stratified drift and water-laid materials of stream terraces.

Fincastle silt loam is regarded as having general profile II, as it corresponds to the Avonburg soil in slope, surface drainage, and mottled colors in the upper horizons. The lower horizons, however, are distinctly different. It has no X horizon, and the heavy layer that retards the movement of moisture enough to cause the mottlings indicative of poor drainage is the B layer, which lies from 10 to 15 inches below the surface. This material is not so thoroughly leached as the Avonburg soil, therefore the acidity is less and the fertility of the soil is higher than in the Avonburg soil. The calcareous till C horizon lies at a depth ranging from 4 to 7 feet.

General profile III is represented by Gibson silt loam, which has two distinct heavy layers in the subsoil and is the soil that affords the best insight into the profile relationships of soils developed on Illinoian till. The upper part of the subsoil is well oxidized, moderately heavy, and has a distinct fine nutlike open structure. If this horizon is traced from Gibson soil areas into the adjacent Avonburg soil areas, it is discovered that it gradually loses its textural and structural identity until it blends with the deeper A_2 horizon of the Avonburg soils. Below the normal B horizon in the Gibson profile is a lighter textured, soft, mottled or light-gray transitional material corresponding to the A_3 horizon of Avonburg silt loam. In other words, the horizon that is called A_3 in the Avonburg soil, because no heavy B horizon is present in the profile, is commonly called an X_1 in the Gibson profile, because it lies below a distinct B horizon and is transitional into the heavier columnar impervious claypan, which is called the X_2. The X horizon of Gibson soils can be traced as a continuous layer through adjacent Avonburg soil areas to Clermont soils, where its claypan characteristics are intensified. This is the reason the first heavy layer in the Clermont profile is called an X layer—not a B. This contrasts with the facts concerning the Delmar-Fincastle-Russell catena of soils, because the heavy layer under the Delmar and Fincastle soils is stratigraphically identical and continuous with the B horizon of Russell soils and has similar structure and reaction. B horizons have neither the extremely high exchange acidity nor the strongly developed columnar structure characteristic of the X layers.

No general profile III comparable to that of the Gibson soil has ever been separated as intermediate between the Fincastle and Russell soils. This is because soils developed from Wisconsin drift have no X horizons and no imperfect drainage below well-oxidized A and B layers and therefore lack the distinguishing characteristics of this general profile.

Following is a description of a profile of Gibson silt loam as observed 2¾ miles east of Lovett. It is representative of general profile III.

A_0. ½ to 0 inches, dark-brown partly decomposed organic litter with a pH value of 6.2.

A_1. 0 to 1 inch, dark-gray to grayish-yellow friable silt loam, in which the dark color is due to organic matter. The pH value is 5.2.

A_2. 1 to 5 inches, grayish-yellow slightly laminated slightly vesicular friable silt loam with a pH value of 4.9.

A_3. 5 to 10 inches, light grayish-yellow vesicular silt loam, friable, yet more compact than the material in the horizon above. The pH value is 4.7.

B_1. 10 to 14 inches, light brownish-yellow or pale-yellow silt loam or heavy silt loam, which breaks into fragments three-sixteenths of an inch or less in diameter. The pH value is 4.7.

B_2. 14 to 19 inches, heavy silt loam or light silty clay loam, slightly darker than the material in the horizon above. It breaks into angular and subangular fragments one-half inch or less in diameter. The pH value is 4.4.

X_1. 19 to 24 inches, brownish-yellow heavy silt loam or light silty clay loam, mottled with gray and light gray. The surfaces of some of the particles are a little darker. The material has a pH value of 4.4.

X_2. 24 to 40 inches, light brownish-yellow or brownish-yellow silty clay loam mottled with gray. Gray material also coats the particles. Dark brownish-yellow stains from root hairs penetrate this horizon. Vertical cleavage planes extend from this horizon into the ones above and below. The pH value is 4.3.

Y_1. 40 to 80 inches, brownish-yellow or dark brownish-yellow silt loam mottled with light gray. The material contains small dark-brown concretions and has a pH value of 4.6.

Y_2. 80 to 100 inches, dark reddish-brown, dark-gray, or brown mottled with gray silty clay loam, plastic when wet. The pH value is 5.3.

Y_3. 100 to 130 inches, dark brownish-yellow, mottled somewhat with dark gray, silty clay loam. Small iron concretions are present. The pH value is 6.1.

C_1. 130 inches +, light brownish-yellow or brownish-yellow calcareous Illinoian till. Pebbles are scattered throughout the material.

There are soils in this county in which the upper horizons are derived from till and are similar to the typical Gibson soil, but their Y horizons are derived partly from the underlying bedrock. From these soils all the limestone fragments of the till have been leached. In places the B horizon of Cana silt loam, developed from shallow till on oil shale, reflects the influence of the dark-colored shale material in its color and texture.

Pekin silt loam has a profile similar to that of the Gibson soil down through the X horizon, but the Y and C horizons consist of more or less assorted and stratified drift or water-laid material. This soil occurs on terraces.

General profile IV includes the best drained soils. They have developed on sloping land and have good internal as well as external drainage. This is regarded by many as the mature regional profile, of which the profiles of Cincinnati and Russell silt loams are good examples. Following is a description of a profile of Cincinnati silt loam as observed 2 miles south of Hayden:

A_0. ½ to 0 inch, dark-brown partly decomposed organic litter with a pH value of 5.3.

A_1. 0 to ½ inch, light-gray somewhat laminated silt loam with a pH value of 5.0.

A_2. ½ to 3 inches, light yellowish-gray laminated silt loam. The pH value is the same as in the horizon above.

A_3. 3 to 7 inches, light grayish-yellow laminated silt loam. The reaction is the same as in the two horizons above.

B_1. 7 to 11 inches, brownish-gray silt loam, which breaks into angular and subangular particles one-eighth inch or less in diameter. When the particles are broken or crushed, the color of the material is light brownish yellow. The pH value is 4.8.

B_2. 11 to 24 inches, brownish-yellow heavy silt loam or light silty clay loam, which breaks into angular fragments three-eighths of an inch or less in diameter. Cleavage planes are a little darker and have a more red tint. The crushed material is lighter brownish yellow. The color is paler in the lower part of the horizon, and gray streaks are noticeable. Roots and root hairs are present. The material has a pH value of 4.6.

X_1. 24 to 28 inches, dark reddish-brown silty clay loam which is somewhat more silty in the upper part and breaks into large aggregates. The vertical cleavage planes are coated with light-gray material. Pebbles are numerous in the lower part. Roots tend to follow cleavage planes. The pH value is 4.4.

Y_1. 32 to 56 inches, yellowish-brown or brown, slightly tinged with red, silty clay loam or clay loam. The breakage planes are smooth, and the material breaks into long narrow pieces. Numerous fragments of light-colored chert are present. The pH value is 4.7.

Y_2. 56 to 72 inches, material similar to that in the layer above in texture and color, except that the red tinge is not present. Iron concretions and a moderate quantity of gritty material appear in the lower part of this horizon. The material has a pH value of 5.5.

Y_3. 72 to 100 inches, yellowish-brown or brown silty clay loam, not quite so dark as that in the layer above. Iron concretions and some gritty material are present. The reaction is slightly alkaline. The pH value is 7.3.

Y_4. 100 to 120 inches, light brownish-yellow silty clay loam mottled with light gray. The surfaces of some particles are darker—a dark brown. The material in the lower part of this horizon contains some yellowish-brown or brown sandy clay. Numerous white specks, as well as iron concretions, are noticeable. The pH value is 7.8.

C_1. 120 inches +, brownish-yellow calcareous Illinoian till. Chert and glacial pebbles are numerous.

The description of a profile of Russell silt loam, as observed 5 miles northwest of Scipio, follows:

A_0. ½ to 0 inch, dark-brown partly decomposed organic litter with a pH value of 6.2.
A_1. 0 to 1 inch, dark-gray friable silt loam. The pH value is 5.2.
A_2. 1 to 7 inches, light grayish-yellow or light brownish-yellow vesicular and somewhat laminated silt loam. The reaction is the same as that in the material above.
B_1. 7 to 12 inches, brownish-yellow silt loam, slightly heavier and more compact than in the layer above. It breaks into angular fragments ¼ inch or less in diameter. The interiors of the fragments or particles are a little lighter in color. The pH value is 4.9.
B_2. 12 to 18 inches, yellowish-brown heavy compact silt loam or silty clay loam, which breaks into well-defined angular fragments or particles ½ inch or less in diameter. The particles are coated with material having a red cast, whereas their interiors are lighter colored light yellowish brown. The material has a pH value of 4.6.
Y_1. 18 to 27 inches, light or dark yellowish-brown heavy silt loam or silty clay loam, mottled to some extent with dark gray. The pH value is 4.5.
Y_2. 27 to 33 inches, yellowish-brown or dark yellowish-brown silty clay loam. The structure particles are coated to some extent with light gray. The pH value is 5.3.
Y_3. 33 to 48 inches, material similar in color and texture to that in the layer above. The separation is made because of difference in degree of acidity. The pH value is 5.6.
C_1. 48 inches +, calcareous light brownish-yellow early Wisconsin till.

The profiles of Cincinnati silt loam and Russell silt loam are nearly enough alike in surface slope, color, and drainage to justify placing them in the same general group, but they differ in depth to the C horizon, owing partly to the presence of a weakly developed X horizon in Cincinnati silt loam, which is lacking in Russell silt loam. The X horizon in Cincinnati silt loam does not have so definite a claypan character as does the X horizon of the Gibson, Avonburg, and Clermont silt loams, but it is distinguishable as a zone below the B horizon with slightly heavier texture and some vertical cleavage planes with faint gray coatings on the surfaces. Its highly acid reaction also is distinctive.

Cincinnati silt loam as mapped includes, as do other types of soil developed on Illinoian drift, a shallow phase in which the upper horizons are derived from till and the Y horizon is formed on underlying marly shale bedrock. Both Grayford and Jennings silt loams resemble Cincinnati silt loam throughout the solum, but these two soils are developed on shallow Illinoian till from which the limestone fragments have been leached. The Y horizon of the Grayford soil is derived from limestone residuum, whereas the corresponding horizon of the Jennings soil is derived from acid dark-colored oil shales. The influence of the rock is more in evidence in the Cincinnatilike soils than it is in the soils with smoother relief. Some of the soil mapped as Jennings silt loam contains so little till material and the bedrock lies so near the surface that most of its parent material has been weathered from the oil shale.

Elk silt loam has a profile like that of Cincinnati silt loam except for the differences in the Y and C layers, due to stratified and assorted materials laid down on the terraces where it occurs.

The profiles of the steep and slope phases of the Cincinnati and similar soils have practically the same horizons as the typical soils except that each averages a little thinner and part of the A horizon has been eroded from most of them. The eroded phases of these soils have lost much of their A and B horizon materials, and in places the X, Y, or even the C, horizons have been exposed.

Some areas of steep and slope phases may be so very steep that they have profiles related to that of Corydon silty clay loam, which is placed under general profile VI. Corydon silty clay loam is a soil transitional in character between the Brown Forest and the Rendzina soils. It is developed on limestone on such steep slopes that leached material has been washed away almost as fast as formed, and nearly all the remaining soil is held in the crevices of rocks or by tree roots and other vegetation. It is neutral or alkaline in reaction, dark in color, high in organic matter, nitrogen, and other soluble plant nutrients, and loose in structure. Zones of eluviation are lacking. This is a fertile soil, although it is too steep and stony for cultivation. The parent rock belongs to the group of limestones that weather to form red clays, so Corydon silty clay loam has a somewhat red cast which helps to distinguish it from the olive-colored subsoil of Fairmount silty clay loam, derived from a different kind of shaly limestone. The Fairmount soils are not recognized in Jennings County.

Following is a description of a profile of a soil as observed one-half mile north of Zenas. It is that of the eroded phase of an included soil mapped with Cincinnati silt loam and developed on thin till on limestone. In several respects it resembles Corydon silty clay loam, but it is more acid in reaction and more highly leached.

A_0. ½ to 0 inch, dark-brown partly decomposed organic litter with a pH value of 6.8.

A_1. 0 to 6 inches, dark yellowish-brown compact plastic silty clay loam having a slight red tint. The pH value is 5.7.

B_1. 6 to 18 inches, dark reddish-brown compact plastic silty clay loam or silty clay, containing chert fragments. The pH value of this material is 6.8.

Y_1 18 to 24 inches, material similar to that in the layer above. It has the same reaction but is slightly darker.

C_1. 24 inches+, hard calcareous limestone rock.

Brookston silty clay loam is the only soil representing general profile VIII. The following description is of a profile observed 3¼ miles north of Scipio in a cultivated field. The color of the subsoil in this place is a little more gray than is considered typical for the Brookston soils.

H_1. 0 to 5 inches, gray to dark-gray compact silty clay loam slightly mottled with light yellowish brown and rusty brown. The pH value is 6.5.

H_2. 5 to 12 inches, gray or drab plastic silty clay loam or silty clay, mottled with brown and dark brown. The reaction of this material is exactly neutral, and this reaction continues throughout the rest of the soil.

H_3. 12 to 26 inches, plastic silty clay loam or silty clay similar to the material in horizon H_2 but with more mottling of brown and rusty brown. As in horizons H_1 and H_2, the dark color of this horizon is due to the presence of organic matter.

M_1. 26 to 33 inches, light-gray and bluish-gray plastic silty clay loam or silty clay mottled with yellowish brown and rusty brown.

M_2. 33 to 42 inches, light yellowish-gray or dark-gray silty clay loam, mottled with brown and rusty brown, similar to the material in the layer above except that it is lighter in color and is not nearly so plastic as horizon M_1.

M_3. 42 to 60 inches, light yellowish-brown or brown silty clay loam mottled with light gray and gray. This material is slightly heavier than that in the overlying layer.

U_1. 60 to 80 inches, calcareous early Wisconsin till.

Alluvial soils are placed under general profiles I, II, III, and IV in the key, because they answer the general descriptions as regards topography, drainage, and color, but they do not have any developed textural or structural horizons in the profiles within 3 feet of the surface. Some developed structural features have been observed in the deeper layers of wet bottom-land soils that may have developed in place and therefore should be regarded as features of complete profiles. The morphology of alluvial soils, however, has never been studied carefully. The colors of the better drained alluvial soils differ from those generally occurring in upland IV profiles in that they are dull brown rather than yellowish brown or reddish brown.

Much of the material in alluvial soils has been washed from leached and weathered upland soils before being deposited on the bottoms. The degree of acidity or alkalinity of the alluvial soils is the basis of an important distinction in the classification and generally can be traced directly to the reaction of the upland material of the watersheds. The texture of the alluvial soils is largely dependent on the velocity of the water currents that laid down the sediments. The coarser textured soils almost invariably occur closer to stream channels than do the finer textured soils.

The results of quick tests for phosphorus and potash, pH determinations by colorimetric methods, and exchange acidity by the Hopkins method agree very well with one another in their significance and have logical relationships to the horizons of profiles and to the classification of these profiles as worked out in the key.

The Hopkins test shows low values in the A horizons and higher ones in the B horizons, whereas the maximum exchange acidity generally occurs in or near the X horizon. For the most part, exchange acidity is greatest in the soils developed on shallow Illinoian till underlain by oil shale, and it is relatively low in those developed on shallow Illinoian till on limestone. The exchange acidity of C layers generally is low except in soils weathered from dark oil shale known to contain sulfur and probably more or less sulfuric acid.

Sweet alluvial soils show almost no exchange acidity, whereas the acid alluvium does show it.

Naturally, the pH tests correspond fairly closely to the exchange acidity tests, but the A horizons tend to be acid by the pH test when they have little exchange acidity.

The quick test for phosphorus is an acid extraction and seems to indicate very little available phosphorus to great depths in the well-developed soils of this county. This is to be expected in very deeply leached and thoroughly weathered soil profiles. To some extent the content of available phosphorus shows a close relationship to the pH reaction and is generally higher in less acid horizons. The test serves to distinguish the horizons, even though it probably is not a good indicator of available phosphorus in the alkaline layers.

The quick test for potash is an exchange reaction and as such might be expected to follow the Hopkins test more closely. It gives, however, fairly high tests for potash in the alkaline layers, whereas the Hopkins test, of course, goes down to zero. The potash test also shows some correlation with texture, as generally it is higher for the B and X horizons, where clay has been accumulated, and is lower in sandy textured horizons. It also gives a low estimate for potash in the most highly leached A horizons, especially of the gray soils of upland flats and terraces, and this element is relatively higher in the A horizons of the better drained soils.

Just as the Brookston silty clay loam differs from all other soils in the county morphologically and in trend of processes of soil formation, so it also contrasts with other soil types in its quick tests. In the Brookston soil the pH value is between 7 and 8, the Hopkins test about 0, and the phosphorus test is uniformly higher than the potash test, a phenomenon seldom observed in other soils except in their C horizons.

MANAGEMENT OF THE SOILS OF JENNINGS COUNTY

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The farmer should know his soil and have a sound basis for every step in its treatment. Building up the productivity of a soil to a high level, in a profitable way, and then keeping it up, is an achievement toward which the successful farmer strives. As in any other enterprise, every process must be understood and regulated in order to be uniformly successful, and a knowledge of the soil is highly important. Different soils present different problems as to treatment, and these must be studied and understood in order that crops may be produced in the most satisfactory and profitable way.

The purpose of the following discussion is to call attention to the deficiencies of the several soils of the county and to outline in a general way the treatments most needed and most likely to yield satisfactory results. No system of soil management can be satisfactory unless it produces profitable returns in the long run. Some soil treatments and methods of management may be profitable for a time but ruinous in the end. One-sided or unbalanced soil treatments have been altogether too common in the history of farming in the United States. A proper system of treatment is necessary in making a soil profitably productive.

CHEMICAL COMPOSITION OF JENNINGS COUNTY SOILS

Table 5 gives the results of chemical analyses of the different types of soil in Jennings County, expressed in pounds of elements in 2,000,000 pounds of plowed surface soil of an acre.

TABLE 5.—*Approximate quantities of nitrogen, phosphorus, and potassium in certain soils of Jennings County, Ind.*

[Elements in pounds per acre of surface soil, 6 to 7 inches deep]

Soil type	Total nitrogen	Total phosphorus [1]	Total potassium	Weak-acid-soluble phosphorus [2]	Weak-acid-soluble potassium [2]
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Clermont silt loam	2,000	610	21,700	35	84
Avonburg silt loam	1,800	610	23,200	18	100
Whitcomb silt loam	2,000	610	19,700	18	150
Gibson silt loam	2,000	525	24,700	18	150
Gibson silt loam, shallow phase	2,400	610	29,300	26	150
Cana silt loam	2,000	610	29,600	18	170
Cincinnati silt loam	1,800	700	26,900	44	100
Grayford silt loam	2,400	700	31,300	18	170
Delmar silt loam (small area included on map with Fincastle silt loam)	1,600	610	30,300	18	84
Fincastle silt loam	2,000	610	29,300	26	150
Russell silt loam	2,200	520	31,500	78	218
Brookston silty clay loam	3,200	960	32,600	105	269
Bartle silt loam	1,800	790	25,600	26	135
Pekin silt loam	2,000	700	23,400	18	118
Elk silt loam	2,200	960	30,300	26	200
Elk fine sandy loam	1,600	440	25,200	44	118
Waverly silt loam	2,200	525	26,900	35	135
Stendal silt loam	2,400	610	25,600	18	150
Philo silt loam	2,200	700	24,000	26	150
Wayland silt loam	2,200	790	26,900	35	135
Eel silt loam	2,600	700	28,600	26	150
Genesee silt loam	2,400	875	28,800	52	168
Genesee loam	2,400	790	28,200	70	250
Genesee fine sandy loam	1,400	350	21,200	105	168

[1] Soluble in strong hydrochloric acid (specific gravity 1.115).
[2] Soluble in weak nitric acid (fifth normal).

The total plant-nutrient content is more indicative of the origin and age of a soil than of its fertility. This is particularly true of potassium. The amount of total potassium in a soil is seldom indicative of its need for potash. Some Indiana soils that have more than 30,000 pounds of total potassium to the acre in the 6-inch surface layer fail to produce corn satisfactorily without potash fertilization, because so little of the potassium they contain is available.

The total content of nitrogen is generally indicative of the need for nitrogen, although some soils with a low total may have a supply of available nitrogen sufficient to grow a few large crops without the addition of that element. Soils having a low total nitrogen content soon wear out, as far as that element is concerned, unless the supply is replenished by the growing and turning under of legumes or by the use of nitrogenous fertilizer. The darker soils are generally higher in organic matter. Organic matter and nitrogen are closely associated in soils, hence it is a fairly safe rule that the darker a soil, the richer it is likely to be in nitrogen.

The amount of total phosphorus in ordinary soils is usually about the same as that shown by a determination with strong acid. For this reason a separate determination of total phosphorus has been omitted. The supply of total phosphorus usually indicates whether or not the soil needs phosphatic fertilizers.

The amount of phosphorus soluble in weak acid is considered by many authorities to be a still better indication of the phosphorus needs of a soil. The depth of a soil may modify its need for phosphates. Everything else being equal, the more weak-acid soluble phosphorus a soil contains, the less likely it is to need phosphate fertilizers. Where the weak-acid soluble phosphorus runs less than 100 pounds to the acre, phosphates are usually needed for high yields of crops.

The quantity of potassium soluble in strong or weak acid is to some extent significant. This determination, however, is not so reliable an indicator as is the determination for phosphorus, particularly with soils of high lime content. Sandy soils and muck soils are more often in need of potash than clay and loam soils. Poorly drained soils and soils with impervious subsoils usually need potash more than well-aerated deep soils.

The use of strong or weak acid in the analysis of a soil has been criticized by some, yet such analyses can more often be correlated with crop production than can analyses of the total elements of the soil. For this reason acid solutions have been employed in these analyses.

It must be admitted, however, that no one method of soil analysis will definitely indicate the deficiencies of a soil. These chemical data, therefore, are not intended to be the sole guide in determining the needs of the soil. The depth of the soil, the physical character of the horizons of the soil profile, and the previous treatment and management of the soil are all factors of great importance and should be taken into consideration. Pot tests indicate that nitrogen and phosphorus are much less available in subsurface soils and subsoils than they are in surface soils. On the other hand, potash in the subsoil seems to be of relatively high availability. Crop growth depends largely on the amount of available plant nutrients with which the roots may come in contact. If the crop can root deeply, it may be able to make good growth on soils of relatively low analysis. If the roots are shallow, the crop may suffer from lack of nutrients, particularly potash, even on a soil of higher analysis. The better types of soils and those containing large amounts of plant-nutrient elements will endure exhaustive cropping much longer than the soils of low plant-nutrient content.

The nitrogen, phosphorus, and potassium contents of a soil are by no means the only chemical indications of high or low fertility. One of the most important factors in soil fertility is the degree of acidity. Soils that are very acid will not produce crops common to this section well, even though there be no apparent lack of plant-nutrient elements. Although nitrogen, phosphorus, and potassium are of some value when added to acid soils, they will not produce their full effect where calcium is deficient.

Table 6 shows the percentage of nitrogen and the acidity of certain soils.

TABLE 6.—*Nitrogen, acidity, and lime requirement of certain soils in Jennings County, Ind.*

Soil type	Depth	Nitrogen	pH value	Average depth of acid soil	Indicated limestone requirement per acre
	Inches	*Percent*		*Inches*	*Tons*
Clermont silt loam	0–6	0.10	5.1	95	2–4
	6–12	.07	4.9		
	12–33	.03	4.7		
Avonburg silt loam	0–7	.09	5.1	95	2–4
	7–21	.05	4.8		
	21–39	.03	4.7		
Whitcomb silt loam	0–6	.10	5.1	(1)	2–4
	6–15	.07	5.0		
	15–40	.03	4.4		
Gibson silt loam	0–7	.10	5.1	95	2–4
	7–17	.05	4.9		
	17–32	.04	4.7		
Gibson silt loam, shallow phase	0–6	.12	5.0	(2)	2–4
	6–16	.08	5.0		
	16–34	.04	4.9		
Cana silt loam	0–6	.10	5.5	(1)	2–4
	6–20	.06	5.0		
	20–35	.04	4.8		
Cincinnati silt loam	0–7	.09	6.4	85	2–4
	7–15	.08	5.2		
	15–35	.03	4.8		
Grayford silt loam	0–6	.12	5.6	(1)	2–4
	6–16	.09	5.1		
	16–35	.04	4.9		
Delmar silt loam (small area included on map with Fincastle silt loam)	0–6	.08	5.0	40	2
	6–15	.06	4.8		
	15–39	.04	5.0		
Fincastle silt loam	0–6	.10	5.4	40	2
	6–21	.07	5.0		
	21–36	.04	4.6		
Russell silt loam	0–6	.11	6.4	50	2
	6–14	.07	5.2		
	14–34	.04	4.8		
Brookston silty clay loam	0–6	.16	6.1	(3)	0–2
	6–20	.10	6.8		
	20–33	.05	7.6		
Bartle silt loam	0–6	.09	5.1	95	2–4
	6–23	.04	4.8		
	23–42	.03	4.6		
Pekin silt loam	0–6	.10	5.1	50	2–4
	6–14	.07	4.8		
	14–33	.03	4.8		
Elk silt loam	0–6	.11	5.2	(4)	2–4
	6–17	.09	5.0		
	17–32	.04	4.9		
Elk fine sandy loam	0–6	.08	5.4	40	2–4
	6–15	.07	5.7		
	15–34	.04	5.9		
Waverly silt loam	0–6	.11	5.9	(4)	2
	6–28	.06	5.3		
	28–42	.04	5.0		
Stendal silt loam	0–6	.12	5.5	(5)	2
	6–14	.06	5.0		
	14–36	.03	4.9		
Philo silt loam	0–6	.11	5.7	40	2
	6–15	.09	4.9		
	15–35	.07	5.3		
Wayland silt loam	0–6	.11	6.6	(3)	0–2
	6–18	.09	6.0		
	18–32	.07	5.5		
Eel silt loam	0–6	.13	6.8	(3)	0
	6–15	.10	6.6		
	15–34	.06	6.5		
Genesee silt loam	0–6	.12	7.6	(6)	0
	6–36	.10	7.5		
	36–44	.08	7.5		
Genesee loam	0–6	.12	7.6	(6)	0
	6–36	.10	7.5		
	36–44	.08	7.5		
Genesee fine sandy loam	0–6	.07	7.6	(6)	0
	6–18	.06	7.5		
	18–36	.04	7.5		

[1] Acid to bedrock.
[2] Acid to limestone.
[3] Slightly acid.
[4] Acid throughout.
[5] Alkaline in places at a depth of 40 inches.
[6] Not acid.

The acidity is expressed as pH, or approximate hydrogen-ion concentration. For example, pH 7 is neutral, and a soil with a pH value of 7 contains just enough lime to neutralize the acidity. If the pH value is more than 7 there is some lime (or other base) in excess. From pH 6 to pH 7 indicates slight acidity, and from pH 5 to pH 6 shows strong to medium acidity. If the pH value runs below 5 the soil is very strongly acid. As a rule, the stronger the acidity the more a soil needs lime. Samples were taken from the surface soil (0 to 6 inches), from the subsurface soil, and from the subsoil. It is important to know the reaction, not only of the surface soil, but of the lower layers of the soil as well. Given two soils of the same acidity, the one with the greater acidity in the subsurface layer is in greater need of lime than the other. The slighter the depth of acid soil, the less likely it is to need lime. Those soils having the greater clay content will need a greater amount of lime to neutralize them, given the same degree of acidity. The less phosphorus, calcium, and magnesium the soil contains, the more likely it is to need lime. It is well to remember that sweetclover, alfalfa, and red clover need lime more than do other crops. As it is advisable to grow these better soil-improvement legumes in the rotation, it is in many places desirable to lime the land in order that sweetclover or alfalfa will grow.

In interpreting the soil survey map and soil analyses, it should be borne in mind that a well-farmed, well-drained, well-fertilized, well-manured soil, that is naturally low in fertility, may produce larger crops than a poorly farmed soil naturally higher in fertility.

SOIL MANAGEMENT

For convenience in discussing the management of the several soils of this county, they are arranged in groups according to certain important characteristics that indicate that in many respects similar treatment is required. For example, several of the silt loams of the uplands and terraces, which have practically the same requirements for their improvement, may be conveniently discussed as a group, thus avoiding the repetition that would be necessary if each were discussed separately. Where different treatments are required they are specifically pointed out. The reader should study the group including the soils in which he is particularly interested.

LIGHT-COLORED SILTY SOILS OF THE UPLANDS AND TERRACES

The group of light-colored silty soils of the uplands and terraces includes the silt loams of the Clermont, Avonburg, Gibson, Cincinnati, Grayford, Whitcomb, Jennings, Cana, Calhoun, Bartle, Pekin, Elk, Fincastle, and Russell series, together with their phases and Corydon silty clay loam. Clermont silt loam is by far the most important soil of the group. It occupies 18.3 percent of the total area of the county. The Cincinnati soils, of which Cincinnati silt loam, steep phase, is by far the most extensive, are next in importance. They occupy, in all, 20 percent of the total area of the county. The Gibson and Avonburg soils occupy 17.1 and 15.6 percent, respectively.

Some of the soils of this group, including practically all of the Corydon soils and the eroded, steep, and slope phases of the Cincinnati and Jennings silt loams, are so steep or dissected as to be unfit for cultivation and are classed as nonarable lands. A separate discussion of these has been made.

The agricultural soils of this group, though differing greatly in appearance, owing to relief and natural drainage, have certain important characteristics in common. They all are low in content of organic matter and nitrogen, all are acid and in need of liming, and all are low in available phosphorus and potassium, except Russell silt loam, which seems to be a little better supplied with both elements than do the other soils.

DRAINAGE

The Gibson, Cincinnati, Grayford, Jennings, Cana, Pekin, Elk, and Russell silt loams have good to excessive surface drainage, owing to their sloping relief. Penetration of rain water and internal drainage, however, are slow, on account of the heavy subsoils, and in periods of heavy rains there may be much run-off with attendant damage from erosion. This feature will be discussed later.

The Avonburg, Clermont, Whitcomb, Calhoun, Bartle, and Fincastle soils have flat or gently undulating relief, and this feature, together with their heavy subsoils, makes them naturally wet and more or less seriously in need of artificial drainage. The flatter areas, especially those of the Clermont and Calhoun soils, need surface furrow drainage as well as tile underdrainage. Without artificial drainage these soils cannot be managed to the best advantage, and no other beneficial soil treatment can produce its full effect. In most places where these soils are farmed, some provision is made for drainage, confined mainly to surface furrows. Tile underdrainage should be installed as soon as possible, because this is necessary to enable these soils to respond properly to other needed treatments.

With reasonable provision for drainage, these soils respond well to lime, legumes, manure, and fertilizer and can be made highly productive. This has been fully demonstrated on the experiment fields conducted by the Purdue University Agricultural Experiment Station on these soils, particularly on Clermont silt loam near North Vernon in this county and on Avonburg silt loam in Scott County. The results of experiments on these fields indicate that tile lines laid 30 inches deep and not more than 3 rods apart will give satisfactory results. Where the land is flat, great care must be exercised in tiling, in order to obtain an even grade and uniform fall. Unsatisfactory results in tiling these flat lands are traceable to errors in grades, which cause silting up in low spots, and to poor grades of tile, which chip and break down easily. Only the best grade of tile should be used. Grade lines should not be established by guess or by rule-of-thumb methods. Nothing less accurate than a surveyor's instrument should be used, and the lines should be accurately staked and graded before the ditches are dug, to make sure that all the water will flow to the outlet with no interruption or slackening of the current. The grade, or rate of fall, should be not less than 3 inches to 100 feet. The rate of fall may be increased toward the outlet, but it should never be lessened without the introduction of a silt well or settling box, as checking the current in the line may cause the tile to become choked with silt. Silt wells may be made of brick or concrete and should be at least a foot square inside. The bottom should be a foot lower than the bottom of the tile. The well should have a removable cover, so that it may be opened once or twice a year for the purpose of dipping out the silt that has settled in the bottom. It is an excellent plan, before filling the ditches, to cover the tile to a depth of a few inches with a layer of straw, weeds, or grass. This prevents silt from washing into the tile at the joints while the ground is settling, thus insuring perfect operation of the drains from the beginning.

CONTROL OF EROSION

On about one-half of the soils of this group, especially the Cincinnati, Grayford, Gibson, Jennings, Elk, and Russell silt loams, the problems of the control of erosion are of major importance in practical systems of soil management. Taking out of cultivation all the rough and very sloping land, which should never be plowed, is not enough. The remaining tillable land needs special care in order to prevent further destructive erosion. In many places the surface soil already has gone, and further sheet erosion and gullying are constantly making matters worse. The surface soil contains the better part of the store of fertility and should be protected against erosion by every practical means. Gradual sheet erosion, whereby the run-off of rain water moves the surface soil down the slope a little at a time and rather evenly, is the most insidious form of erosion and may not be noticed until the subsoil begins to appear. Many one-time fertile fields are now irreparably damaged in this way, and many others retain only a small part of the surface soil, so that the plow reaches into the unproductive subsoil. Plowing and other tillage operations should extend crosswise of the slopes wherever possible, to prevent the formation of watercourses down the slopes, which are sure to carry away much valuable surface soil and may start serious gullies. Contour plowing and contour strip cropping may be most practical on fields of irregular slopes, whereas terracing may be most practical on long, even slopes. By rearranging fences or other field boundaries, it may be possible to arrange the cropping system in such a way as to facilitate the carrying out of all tillage operations crosswise of the slopes. Intertilled crops should be interspersed with small-grain and sod-forming crops. Incipient gullies, or draws, forming natural drainageways down the slopes, should be kept permanently in grass with a good sod of sufficient width to allow the water to spread and thereby prevent soil cutting.

LIMING

All the soils of this group are acid in reaction and more or less in need of liming. The lime requirement should be determined by soil-acidity tests in each instance. If the farmer himself cannot make the test, he may have it made by the county agricultural agent or by the agricultural experiment station at La Fayette. A very acid soil will not respond properly to other needed treatments until it has been limed. On the Jennings County experiment field, located on Clermont silt loam, land that was tiled in 1920 and has been well fertilized since then, but not limed, has averaged 47.4 bushels of corn, 12.3 bushels of wheat, and 1,411 pounds of weedy hay to the acre up to the end of 1935 in a corn-wheat-clover rotation; whereas similarly tiled and fertilized land that was limed at the beginning of the experiment has averaged 61.1 bushels of corn, 17.8 bushels of wheat, and 2,797 pounds of high-quality hay. The total increase in return as a result of this liming, which was at the rate of 3 tons of ground limestone to the acre, amounts to $92.10 per acre over the 15-year period, and the total cost of liming was $10.50 for the ground limestone spread on the land. Most of the soils of this group will not produce clover at all without liming. Ground limestone generally is the most economical form of lime to use, and in most places a supply can be procured conveniently. As a rule, the first application should be at least 2 tons to the acre. After that a ton to the acre every second round of the crop rotation will keep the soil sufficiently sweet for most crops. Where alfalfa or sweetclover is to be grown on any of these acid soils, as might be done on the better drained areas, heavier applications of limestone will be needed.

The effect of ground limestone on yields of wheat is shown in plate 1, *A*.

ORGANIC MATTER AND NITROGEN

All the soils of this group are naturally low in organic matter and nitrogen. Constant cropping without adequate returns to the land and more or less soil erosion on sloping areas are reducing steadily the original supplies of these plant nutrients. In many places the original content of organic matter has become so low that the soil has lost much of its natural mellowness and readily becomes puddled and baked. The only practical remedy for this condition is to plow under more organic matter than is used in the processes of cropping. Decomposition is constantly going on and is necessary to maintain the productivity of the soil. Decomposing organic matter must also supply the greater part of the nitrogen required by crops. For this reason, legumes should provide large amounts of the organic matter to be plowed under. Soybeans may be used to start with, because they will withstand considerable soil acidity, but the land should be thoroughly limed and put into condition to grow clover as soon as possible. The naturally poor soils should also be liberally fertilized with phosphate and potash.

Clover or some other legume should appear in the rotation every 2 or 3 years; as much manure as possible should be made from the produce that is utilized as feed for livestock; and all produce not utilized, such as cornstalks, straw, and cover crops, should be plowed under. It must be remembered that legumes are the only crops that can add appreciable quantities of nitrogen to the soil, and then only in proportion to the quantity of top growth that is returned to the land, either directly or in the form of manure. Wherever clover seed is harvested, the threshed haulm should be returned to the land and plowed under. Cover crops should be grown wherever possible, to supply additional organic matter for plowing under. Planting soybeans, cowpeas, or sweetclover between the corn rows at the time of the last cultivation and seeding rye as a cover crop early in the fall on cornland that is to be plowed the following spring are good practices for increasing the supply of both nitrogen and organic matter. It is important to have a cover crop of some kind on these soils during the winter, in order to take up soluble nitrogen that otherwise would be lost through leaching. Without living crop roots to take up the nitrates from the soil water, large losses will occur between crop seasons through drainage. In this latitude the ground is not frozen much of the time during the winter, and frequent heavy rains cause much leaching and loss of plant nutrients, especially nitrates, if they are not taken up by crops. The winter rains also cause much soil erosion on slopes and hillsides in places where the ground is not well covered with vegetation. Both of these losses may be considerably lessened by a crop of winter rye on all land that otherwise would be bare during the winter. The rye should be run down with a heavy disk and plowed under before heading.

CROP ROTATION

With proper fertilization, liming, and artificial drainage where needed, these soils will produce satisfactorily all the ordinary crops adapted to the locality. On account of the prevailing shortage of organic matter and nitrogen, every system of cropping should include clover or some other legume to be returned to the land in one form or another. Corn, wheat, and clover, or mixed clover and timothy, constitute the best short rotation for general use on these soils after liming, especially where the corn can be cut and the ground can be disked and properly prepared for wheat. In this position in the rotation, wheat needs a high-analysis complete fertilizer, and the quantity applied should be sufficient to help the clover also. On the Jennings County experiment field, started in 1921, the corn, wheat, and clover rotation has produced average crop yields, during the 15 years since the experiments were begun, of 57.6 bushels of corn, 19.9 bushels of wheat, and 3,077 pounds of hay to the acre, as compared with 46.8 bushels of corn, 15.2 bushels of wheat, and 1,908 pounds of hay in the corn, wheat, and timothy rotation with otherwise similar treatment. This shows a considerable advantage in using clover instead of timothy in the rotation. All this land was underdrained with tile and limed at the rate of 3 tons of ground limestone to the acre in the fall of 1920, and it has since received 100 pounds of 0–12–6 fertilizer an acre in the row for corn and 300 pounds of 2–12–6 fertilizer for wheat.

Corn, soybeans, wheat, and clover make an excellent 4-year rotation for these soils. This rotation has averaged 61.6 bushels of corn, 21.5 bushels of soybeans, 21.1 bushels of wheat, and 3,216 pounds of hay to the acre. The two legumes will build up the nitrogen supply of the soil. The soybean straw, or its equivalent in manure, should be spread on the wheatland in the winter. This will not only help the wheat and lessen winter injury, but it also will help to insure a stand of clover. Oats are not well adapted to the climatic conditions of this section of the State and, as a rule, are not a profitable crop. The soybean not only is a more valuable crop than oats, but it also adds some nitrogen to the soil and improves the land for the crop that follows, which generally should be wheat. If more corn is wanted, as on livestock farms, the 5-year rotation of corn, corn, soybeans, wheat, and clover may be used satisfactorily where the second corn crop, at least, can be given a good dressing of manure. Where enough livestock is kept to utilize all the grain and roughage in this rotation, there should be enough manure produced to make a fair application for each corn crop. A cover crop of rye for plowing under the following spring should be seeded in September on all the cornland. Even though the land has been properly limed, clover may be uncertain on some of these soils owing to climatic conditions, and it has proved to be a good plan to sow a mixture of seeds made up of about 4 pounds of red clover, 3 pounds of alfalfa, 2 pounds of alsike clover, and 1 pound of timothy to the acre. Where the seeding fails to make a satisfactory stand, soybeans make a good substitute hay crop.

Lespedeza may be used to advantage in pasture mixtures and on thin spots in old pastures that need improvement, especially where the pasture land is acid and liming is not feasible. Alfalfa and sweetclover may be grown on the better drained areas of these soils if the soils are properly inoculated and sufficiently limed to meet the needs of these crops. In most areas, however, the deep subsoil is so very acid and so tight that alfalfa stands are difficult to maintain. Alfalfa is preferable for hay, and sweetclover is excellent for pasture and for soil-improvement purposes. Special literature on the cultural requirements of these crops may be obtained from the Purdue University Agricultural Experiment Station.

FERTILIZATION

The soils of this group are naturally low in phosphorus, and in most of them the available supplies of this element are so very low that the phosphorus required by crops should be wholly supplied in applications of manure and commercial fertilizer. The nitrogen supplies in these light-colored soils are also too low to meet satisfactorily the needs of corn, wheat, and other nonleguminous crops, and provisions for adding nitrogen should be an important part in the soil-improvement program. The total quantities of potassium in these soils are large, but the available supplies are low, and in most places some potash fertilizer would be profitable, especially where little manure is applied. Without substantial provision for supplying all three of these fertilizer elements, the productivity of these soils is bound to decline.

The problem of supplying nitrogen has been discussed in connection with provisions for supplying organic matter. Legumes and manure are the logical and only really practical materials for supplying the greater part of the nitrogen needed by crops, and they should be employed largely for this purpose. A system of livestock farming, with plenty of legumes in the crop rotation, is best for these soils. It will pay on most farms, however, to have some nitrogen in the fertilizer for wheat, regardless of its place in the rotation. Even though wheat follows soybeans or other legumes, it should receive some fertilizer containing nitrogen at seeding time to start the crop properly, because the nitrogen in the residue of an immediately preceding legume does not become available quickly enough to be of much help to the wheat in the fall. The leguminous residue must first decay, and that does not take place to any considerable extent until the following spring.

Phosphorus is the mineral plant-nutrient element in which these soils are most deficient, although available potash is equally deficient on the flat, poorly drained soils. The rolling lands, where not eroded, are better supplied, but in areas where much of the surface soil has been washed away the greater part of the available phosphorus has gone with it. The only practical way to increase the supply of phosphorus in the soil is through the application of purchased phosphatic fertilizers, and it will pay well on most farms to supply the entire phosphorus needs of crops in this way. In rotations of ordinary crops, producing reasonably high yields, it may be considered that 20 pounds of available phosphoric acid to the acre is required each year. It will pay well to apply larger quantities at first, so as to create a little reserve. In applying phosphate, enough for the entire rotation may be applied at one time or the application may be divided according to convenience. Where manure is applied, each ton may be estimated as supplying about 5 pounds of phosphoric acid; therefore a correspondingly smaller quantity will be required in commercial fertilizer.

The quantity of potash that should be supplied as fertilizer depends on the general condition of the soil and the quantity of manure used. According to the analyses in table 6, all the soils of this group are low in available potash. In building up a run-down soil, much fertilizer potash should be used, at least until such time as considerable quantities of manure can be applied or until the general condition of the soil has materially improved. There is plenty of potassium in these soils for all time if it could be made available at a faster rate. As a rule it becomes available too slowly. This is particularly true of the flat gray soils of the group, and the fertilizer for these should contain more potash than that for the brown or yellow soils. The availability of the soil potash may be increased by good farm practices, including drainage, proper tillage, the growing of deep-rooted legumes, and the plowing under of liberal quantities of organic matter. The better these practices are carried out and the larger the quantity of manure applied, the less potash fertilizer need be purchased.

On the Jennings County experiment field, greatly increased yields have been obtained wherever lime, legumes, manure, fertilizer, or any combination of these has been used. During the 15 years since the experiments were begun, the land without treatment, other than tile drainage which is the same for all plots, has produced average crop yields of only 30.5 bushels of corn, 3.8 bushels of wheat, and 984 pounds of weedy hay to the acre. Land receiving manure alone has averaged 54.5 bushels of corn, 8.3 bushels of wheat, and 1,217 pounds of hay. The limed and manured land has averaged 65.5 bushels of corn, 12.6 bushels of wheat, and 2,256 pounds of hay. Land receiving lime, manure, and fertilizer, has averaged 73.8 bushels of corn, 20.8 bushels of wheat, and 3,229 pounds of hay. In the last-mentioned instance, the land received 3 tons of ground limestone to the acre in the fall of 1920 and since then has received 6 tons of manure and 100 pounds of 0–12–8 fertilizer in the row for corn and 300 pounds of 2–12–8 for wheat, in a rotation of corn, wheat, and clover.

The effects of phosphate and potash on yields of corn are shown in plate 1, *B*.

A, Effects of ground limestone on yields of wheat on Jennings County experiment field on Clermont silt loam. The crop rotation was corn, wheat, clover. The fertilizers used were 400 pounds of 2-12-6 for wheat and 100 pounds of 0-12-12 in the row for corn. The average acre yields, 1921-35, were *a*, unlimed, 13.6 bushels, *b*, limed at the rate of 1½ tons an acre in 1921, 18 5 bushels; *c*, limed at the rate of 3 tons an acre in 1921, 21.3 bushels. *B*, Effects of phosphate and potash on yields of corn on Jennings County experiment field on Clermont silt loam The crop rotation was corn, wheat, clover. The fertilizer used on plot *b* was 400 pounds of 0-12-0; and on plot *c*, 400 pounds of 0-12-8. The average acre yields, 1921-35, were *a*, lime alone, 42.4 bushels; *b*, lime and phosphate, 52.3 bushels; *c*, lime, phosphate, and potash, 60.8 bushels

In the practical fertilization of these soils, most of the manure should be plowed under for the corn crop. When the crop rotation includes wheat, as should generally be the case, a part of the manure, about 2 tons to the acre, may be applied to advantage on the wheatland as a top dressing during the winter. Manure so used not only helps the wheat and lessens winter injury, but it also helps to insure a stand of clover or other seeding in the wheat. Unless very heavily manured, corn should also receive, in addition, about 100 pounds of superphosphate to the acre in the row or hill at planting time. Without manure, corn should be given from 100 to 150 pounds to the acre of a phosphate and potash mixture at least as good as 0–14–6, applied in the row or hill. Fertilizer of an 0–12–8 analysis has been profitable on the Jennings County experiment field, even when prices for crops were very low. Wheat should be given from 200 to 300 pounds to the acre of a high-analysis complete fertilizer at least as good as 2–12–6. Where the wheat is backward in the spring, a top dressing of about 100 pounds to the acre of a good soluble nitrogen fertilizer should be applied soon after growth begins. Such top dressing will usually add from 5 to 7 bushels per acre to the yield. For special crops, such as tobacco, potatoes, and tomatoes, special fertilization will be needed.

SANDY SOILS OF THE TERRACES

Elk fine sandy loam is the only representative of this group of soils in Jennings County. It is naturally well drained but not particularly droughty because it has a fairly heavy subsoil which holds moisture well. The water-holding capacity of the surface soil may be improved by adding organic matter whenever possible. This soil, as a whole, is more or less acid in reaction and should be limed for such crops as clover, alfalfa, and sweetclover.

ORGANIC MATTER AND NITROGEN

Elk fine sandy loam is naturally low in organic matter and nitrogen, and some special provision should be made for increasing both these constituents in order to increase its productivity. As much manure as possible, as well as all unused crop materials, should be plowed under. Special green-manure crops and cover crops, such as soybeans, cowpeas, sweetclover, rye, and winter vetch, should be planted wherever possible, in order to produce nitrogenous organic matter for plowing under. What has been said concerning the nitrogen and organic-matter problems in the improvement of the light-colored silt loam soils of the uplands and terraces applies equally well here, and the practices recommended for those soils should be followed on this sandy soil. Its loose, open texture favors more rapid decomposition of organic matter than in the heavier soils. For this reason, more than ordinary quantities of organic matter should be plowed under.

CROP ROTATION

Of the extensively grown field crops, this sandy soil is best adapted to small grains and legumes, especially alfalfa after the land is limed. Corn, as a rule, does well only on the more loamy and lower lying areas or in places where the sandy surface soil is shallow and is underlain by heavier material. The higher and drier areas are better suited to such crops as melons, sweetpotatoes, early potatoes, and early tomatoes. They are also suited to soybeans and cowpeas, and, if the land is limed, alfalfa and sweetclover do well. Clover will not withstand so much drought as alfalfa and sweetclover, and perhaps it should be replaced by those crops. Alfalfa can be as satisfactorily used as clover in short rotations, after the land is once thoroughly inoculated for this crop, and it will not suffer so much from drought as the clover.

FERTILIZATION

This sandy soil is naturally deficient in nitrogen and needs especial provision for building up a supply of this element. The total supply of phosphorus is so low that it should not be further drawn on. The supply of available potash also is low. Stable manure should be applied as liberally as possible, both for its plant-nutrient constituents and for the organic matter it supplies, in order to improve the water-holding capacity of the soil as well as its productivity. Manure, however, is seldom available in sufficient quantities; therefore commercial fertilizers high in phosphorus and potassium must be used.

Legumes, in rotation or as special green-manure or cover crops, should be used to supply much of the needed nitrogen that is not provided in the form of manure.

Early potatoes, tomatoes, and other truck crops on these soils will respond to heavy applications of high-analysis complete fertilizers. An application of 500 pounds or more to the acre of a 2–10–8 mixture, or its equivalent, should be used for these crops. If wheat is grown, from 200 to 300 pounds of a 2–12–6 mixture are advisable. Where manure is not used, the fertilizer for truck crops should contain higher proportions of nitrogen and potash. Where alfalfa or sweetclover is to be grown, from 300 to 500 pounds to the acre of a high-grade phosphate-potash mixture should be applied at seeding time. A continuous stand of alfalfa should receive a top dressing of phosphate and potash fertilizer every 2 years.

DARK-COLORED SOILS

A few scattered areas of Brookston silty clay loam in the northwestern corner of the county, which was covered by the early Wisconsin glaciation, totaling about 350 acres, constitute the only dark-colored soil in the county. It occupies depressions within what are generally good farming sections, and on most farms the areas are not of sufficient size to warrant separate treatment. The most important defect of these areas is poor natural drainage. When this is remedied the land will produce good yields of all the crops adapted to the locality. This soil is well supplied with organic matter and the elements of plant food and generally does not need liming. In some places such crops as alfalfa and sweetclover might respond to light surface liming.

This dark-colored soil is especially well suited to corn, and this should be the major crop in fields where this soil predominates. Manure and fertilizer are not so necessary as on the lighter colored soils with which it is associated. Wheat, however, generally should receive a good complete fertilizer, such as a 2–12–6 mixture, to start it properly in the fall, and corn, a phosphate-potash mixture. On farms having both light- and dark-colored soils, the manure should be applied to the light-colored soils because they are more in need of the organic matter and nitrogen that it supplies.

SOILS OF THE OVERFLOW BOTTOMS

The bottom, or overflow, lands may be divided into two general classes—the sour bottoms and the sweet bottoms. The sour bottoms, comprising soils of the Philo, Pope, Stendal, and Waverly series, have received their soil deposits from the acid soils of the uplands and terraces, and most of them are in need of liming where clovers or other lime-loving crops are to be grown. The sweet bottoms, consisting of soils of the Eel, Genesee, and Wayland series, are derived from the lime-bearing glacial drift soils of the uplands and terraces. They are either alkaline or only slightly acid and seldom need liming. Natural drainage is limited by the periodic overflows and, in the heavier soils, also by tight subsoils. The latter should be underdrained by tile wherever suitable outlets can be obtained, so that the water may drain more quickly after floods or heavy rains.

LIMING

The soils of the sour bottoms, including soils of the Philo, Pope, Stendal, and Waverly series, should be limed wherever possible, so that other needed treatments may be more effective. From 2 to 3 tons to the acre of ground limestone, or its equivalent in other forms of lime, should be applied.

ORGANIC MATTER AND NITROGEN

What has been said about supplying organic matter and nitrogen to the light-colored soils of the uplands and terraces applies equally well to the light-colored soils of the bottom lands. On the lighter colored and poorer areas of these soils, especially, considerable quantities of organic matter should be plowed under, either directly as green-manure crops or in the form of animal manure, and legumes should be grown frequently in the rotation and largely returned to the land in one form or another, in order to increase the nitrogen content.

Where the land is periodically flooded, clover and other deep-rooted legumes, especially biennials and perennials, cannot be depended on, but certain shallow-rooted legumes, such as soybeans, cowpeas, and sometimes alsike clover and lespedeza, can be grown satisfactorily. These crops should be used largely for gathering nitrogen from the air, which they will do in large measure when the soil is properly inoculated. Here again it must be remembered that only the top growth plowed under, either directly or in the form of manure, can really increase the nitrogen content of the soil, on which grain crops must depend. Cover crops, such as cowpeas, soybeans, and rye, should be used to the fullest possible extent in the cornfields. Cornstalks should not be burned but should be completely plowed under whenever this is practicable.

CROP ROTATION

Where overflows cannot be prevented, the crop rotation must consist largely of annual spring-seeded crops and such grass-and-clover mixtures as will not be seriously injured by ordinary floods. For the most part, corn, soybeans, cowpeas, and in some places wheat, with a mixture of timothy and alsike clover following for a year or two, are satisfactory crops for this land, but some sort of rotation is advisable to help maintain fertility. Doubtless soybeans will become more important as a rotation crop on these soils if proper inoculation is provided. Timothy and alsike, mixed, will do well on this land after it has been limed, and this crop may be allowed to stand for 2 or 3 years. In places where the land is too acid for alsike, lespedeza may be used. For late seeding in emergencies, early varieties of soybeans and Sudan grass, for either hay or seed, will prove useful.

FERTILIZATION

Practically all of the bottom lands of this county are low in the important plant-nutrient elements. It should be recognized that in most cases the floodwater sediments coming to these bottom lands from the adjoining watersheds are not so rich as they were years ago. The rich surface soil has gone from much of the upland, and the present floods carry little except eroded subsoil material of low fertility.

Nitrogen should be supplied in applications of manure and by the growth of such legumes as will not be seriously damaged by floodwater. As a rule, commercial nitrogenous fertilizers will not pay on corn but may be used to advantage in the few places where wheat can be grown and as a top dressing on timothy meadows. For cornland, a phosphate-potash mixture, such as 0–14–6 or 0–12–12, should be drilled in the row or placed beside the hill at the rate of 100 to 150 pounds to the acre. In places where wheat is grown, a 2–12–6 fertilizer should be used for this crop at seeding time at a rate ranging from 200 to 300 pounds to the acre.

NONAGRICULTURAL LAND

The very considerable areas of slope-phase and eroded land that have been cleared should be kept out of cultivation. Some of such land can be put in permanent pasture by seeding to grass and lespedeza, but much of it should be reforested and given protection from livestock.

SUMMARY

Jennings County is in the southeastern part of Indiana. The general land surface is smooth, gently sloping, and nearly flat on the main divides and highly dissected or rough along the main streams.

The population is largely rural. The agriculture is of the general farming type, and corn, wheat, hay, dairy products, and poultry products are produced. Only about 25 percent of the land is in cultivated crops. A large proportion of the farm land is permanent pasture, idle land, and timberland.

Most of the soils are derived from Illinoian till, which has been deeply leached and strongly weathered so that it is not naturally very fertile land. In several places, the Illinoian drift is thin, and bedrock approaches the surface. In such places, black oil shale tends to make relatively poorer soils, whereas limestone and marly shale materials tend to make better soils. The poorly drained uplands, terraces, bottoms, and flats are occupied by gray wet crawfishy soils. On slightly better drained land, the surface soils and subsoils are mottled. On gently sloping land, the upper layers are well drained and oxidized, but mottled layers below indicate imperfect internal drainage. The most sloping or best drained soils are well oxidized and show little evidence of imperfect drainage or lack of aeration anywhere in the profile. Very steep slopes are recognized as unfit for cultivation and are mapped as slope or steep phases. Sloping land that has been cultivated and subjected to washing is mapped as eroded phases of various soil types. A small area of land in the northwestern corner of the county is covered by early Wisconsin glacial till. In this area the soils are not so deeply leached and are more productive than soils developed on Illinoian till. Brookston silty clay loam of this group is regarded as one of the better agricultural soils in Indiana.

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There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than two hundred and fifty copies shall be for the use of each Senator from the State and not more than one thousand copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.

Areas surveyed in Indiana, shown by shading.

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