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Soil Survey

Franklin County Indiana

By

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United States Department of Agriculture

and

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with a section on

Management of the Soils of Franklin County

by

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils, and Agricultural Engineering
In Cooperation with the
PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

SOIL SURVEYS provide a foundation for all land use programs. This report and the accompanying map present information both general and specific about the soils, the crops, and the agriculture of the area surveyed. The individual reader may be interested in the whole report or only in some particular part. Ordinarily he will be able to obtain the information he needs without reading the whole. Prepared for both general and detailed use, the report is designed to meet the needs of a wide variety of readers of three general groups: (1) Those interested in the area as a whole; (2) those interested in specific parts of it; and (3) students and teachers of soil science and related agricultural subjects. Attempt has been made to meet the needs of all three groups by making the report comprehensive for purposes of reference.

Readers interested in the area as a whole include those concerned with general land use planning—the placement and development of highways, power lines, urban sites, industries, community cooperatives, resettlement projects, and areas for forest and wildlife management and for recreation. The following sections are intended for such users: (1) General Nature of the Area, in which physiography, relief, and drainage, climate, water supply, vegetation, organization and population, industries, transportation and markets, and cultural development and improvement are discussed; (2) Agriculture, in which a brief history and the present status of the agriculture are described; (3) Estimated Yields and Productivity Ratings, in which the productivity of the soils is given; and (4) Management of the Soils of Franklin County, in which the present uses of the soils are described, their management requirements discussed, and suggestions made for improvement.

Readers interested chiefly in specific areas—as some particular locality, farm, or field—include farmers, agricultural technicians interested in planning operations in communities or on individual farms, and real estate agents, land appraisers, prospective purchasers and tenants, and farm loan agencies. The readers should (1) locate on the map the tract with which concerned; (2) identify the soils on the tract by locating in the legend on the margin of the map the symbols and colors that represent them; and (3) locate in the table of contents in the section on Soils the page where each type is described in detail and information given as to its suitability for use and its relations to crops and agriculture. They will also find useful specific information relating to the soils in the sections on Estimated Yields and Productivity Ratings and on Soils.

Students and teachers of soil science and allied subjects, including crop production, forestry, animal husbandry, economics, rural sociology, geography, and geology, will find their special interest in the section on Morphology and Genesis of Soils. They will also find useful information in the section on Soils, in which are presented the general scheme of classification of the soils of the area and a detailed discussion of each type. For those not already familiar with the classification and mapping of soils, these subjects are discussed under Soil Survey Methods and Definitions. Teachers of other subjects will find the sections on General Nature of the Area, Agriculture, Estimated Yields and Productivity Ratings, and the first part of the section on Soils of particular value in determining the relations between their special subjects and the soils of the area.

This publication on the soil survey of Franklin County, Ind., is a cooperative contribution from the—

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SOIL SURVEY OF FRANKLIN COUNTY, INDIANA

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CONTENTS

[1] The field work for this survey was done while the Division of Soil Survey was a part of the Bureau of Chemistry and Soils.

AGRICULTURE in Franklin County, Indiana, had its beginning with the coming of the first settlers about 1803 and centered around three main crops—corn, wheat, and hay. With its expansion came improved methods of farming, together with a change to a more stabilized system of cropping. A general type of farming is practiced, including chiefly corn, wheat, oats, soybeans, clover, timothy, and alfalfa, combined with raising livestock for crop consumption. Tobacco, rye, and potatoes are grown to a less extent, and vegetables chiefly for home consumption. To provide a basis for the best uses of the land a soil survey of the county was undertaken beginning in 1938 by the United States Department of Agriculture in cooperation with the Purdue University Agricultural Experiment Station, the report on which is here presented. The essential features may be summarized as follows.

SUMMARY

Franklin County is in the Dearborn Upland physiographic region in the southeastern part of Indiana and has an area of 395 square miles, or 252,800 acres. The subsurface or bedrock formation of limestone and calcareous shale belong to the Ordovician and Silurian geologic periods. They are largely covered by a mantle of glacial drift of the Illinoian and Early Wisconsin glaciations of the Pleistocene geologic period.

The soils of the county represent a wide variation in color, natural drainage, fertility, consistence, slope, and susceptibility to erosion. They are grouped into four main divisions as follows: (1) Soils of the uplands; (2) soils developed on glaciofluvial outwash plains and terraces; (3) soils developed on alluvial terraces; and (4) alluvial soils.

The upland soils are derived from four kinds of parent material—(1) calcareous Early Wisconsin glacial drift, (2) calcareous Illinoian

glacial drift, (3) Ordovician and Silurian limestone, and (4) calcareous wind-deposited sand.

Soils developed on Early Wisconsin glacial drift material include the Russell, Wynn, Bellefontaine, Hennepin, Fincastle, Delmar, Cope, Brookston, Washtenaw, and Clyde.

The Russell and Wynn are the most productive well-drained soils of the uplands. Occurring typically on undulating to gently sloping relief, Russell silt loam is also mapped on nearly level and sloping to steep relief. Wynn silt loam, principally on nearly level relief, but also on gently sloping to steep relief, is underlain by limestone bedrock at an average depth of about 45 inches. Bellefontaine silt loam is well to excessively drained and underlain by gravel at a depth of 40 to 60 inches. Hennepin clay loam occurs on steep slopes, and the dark-colored 2- to 5-inch surface soil is underlain by calcareous glacial till. Fincastle silt loam, one of the chief agricultural soils in the northeastern part, is imperfectly drained and is light-colored. Delmar silt loam is poorly drained, is light-colored, and is less productive than the Fincastle soils. Cope silt loam, occurring in shallow depressions and broad flats, is poorly drained and moderately dark-colored. The very poorly drained dark-colored Brookston silty clay loam occupies depressional areas and broad flats. The Brookston and Cope soils are potentially the most productive in the county. Clyde silty clay loam is naturally more poorly drained than the Brookston soil, but its productivity is potentially high. Washtenaw silt loam, consisting of a deposit of washed-in material over areas of the Brookston and Clyde soils, is productive when sufficiently drained.

The soils developed on Illinoian glacial drift are the silt loams of the Cincinnati, Edenton, Rossmoyne, Avonburg, and Clermont series. These have a light-colored surface soil relatively low in organic content and strongly acid surface soil and subsoil. They all are leached of free lime carbonates to an average depth of about 10 feet, except Edenton silt loam, which, at a depth of 40 to 80 inches, is underlain by limestone.

The Cincinnati and Edenton soils are well drained, Rossmoyne silt loam moderately well drained, Avonburg silt loam imperfectly drained, and Clermont silt loam poorly drained. The steeper slopes of the well-drained soils are either in forest or in large part severely eroded, with sizable areas of the Cincinnati soils destroyed for agricultural use. Owing to heavy siltpan subsoil characteristics and nearly level relief, the Clermont and Avonburg soils require artificial drainage for crop production.

Fairmount silty clay loam, a well-drained soil developed on Ordovician and Silurian limestone, occupies some of the steepest slopes in the county—those of more than 12 percent. Its agricultural use is confined chiefly to pasture and the growing of tobacco, corn, and alfalfa. A large part is in forest.

Developed on wind-deposited sand, Princeton fine sandy loam is excessively drained.

The soils developed on glaciofluvial outwash plains and terraces, on calcareous gravel and sand, include the Fox and Westland series, which occur in the valleys of the Whitewater River system.

The Fox soils are well to excessively drained, occur principally on nearly level relief, and are underlain by loose calcareous gravel and sand. Westland silty clay loam is poorly drained, dark-colored, and occupies the depressional areas associated with the Fox soils.

Martinsville silt loam, developed on glaciofluvial outwash terraces on calcareous silt and fine sand, with minor quantities of clay and gravel, is well drained and occurs principally on nearly level relief.

Williamsburg silt loam, a well-drained soil developed on calcareous silt and fine sand, occurring on high terraces, is largely in pasture and forest.

The soils developed on alluvial terraces of acid silt and clay occurring in the Illinoian glacial drift region—the Elkinsville, Pekin, and Bartle silt loams—are used for general farm crops but are only fairly productive. Elkinsville silt loam is well drained and occurs principally on nearly level to undulating relief but is also mapped on sloping relief. The moderately well-drained Pekin silt loam occurs on nearly level to gently undulating relief, and the imperfectly drained Bartle silt loam on nearly level relief.

The alluvial soils derived from neutral to slightly alkaline alluvium from Early Wisconsin glacial drift regions—the Genesee, Ross, Hartman, and Eel—occur principally along the Whitewater River and its larger tributaries. The heavier textured Genesee soils and Ross silty clay loam are well drained and among the most productive in the county, especially for corn. Hartman gravelly stony loam, used principally for alfalfa, has good to excessive drainage. Eel silt loam, occurring principally in swales and old channels, is moderately well drained to imperfectly drained, and used chiefly for pasture.

Soils occurring on medium acid alluvium in the Illinoian glacial drift regions and Ordovician and Silurian limestone and calcareous shale slopes include the Haymond and Wilbur silt loams. The former is well drained and the latter moderately well drained.

Estimated average acre yields of the principal crops have been made for each soil under both common and better farming practices. To compare directly the yields obtained in this county with those in other parts of the country, yield figures have been converted (in table 11) to indexes based on standard yields according to two broadly defined types of management. These estimates were derived primarily from interviews with farmers, the county agent, members of the Purdue University Agricultural Experiment Station, direct observation by members of the soil survey party, and results obtained on experimental farms by the State experiment station.

This county lies in the region of Gray-Brown Podzolic soils occupying the east-central part of the United States. Most of the soils have developed under a heavy forest cover of deciduous trees, with sufficient rainfall to wet them to an indefinite depth. The climatic and biologic conditions permit only a relatively thin surface accumulation of organic litter and a few inches of dark-colored soil in the upper part of the profile.

The soils are classified and discussed on the basis of their characteristics in three orders—zonal, intrazonal, and azonal. Zonal soils include Gray-Brown Podzolic soils; intrazonal soils include Planosols, semi-Planosols, Wiesenboden, and Rendzina soils; and the azonal order includes the Alluvial soils.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

Franklin County, in the southeastern part of Indiana (fig. 1), is the fourth county north of the most southeastern part of Indiana adjacent to the Ohio-Indiana State line. Its area is 935 square miles, or 252,800 acres. Brookville, the county seat, is 65 miles southeast of Indianapolis, the State capital; 120 miles southeast of La Fayette, the location of the Purdue University Agricultural Experiment Station; 115 miles south of Fort Wayne; 170 miles northeast of Evansville; 165 miles southeast of South Bend; and 125 miles east of Terre Haute.

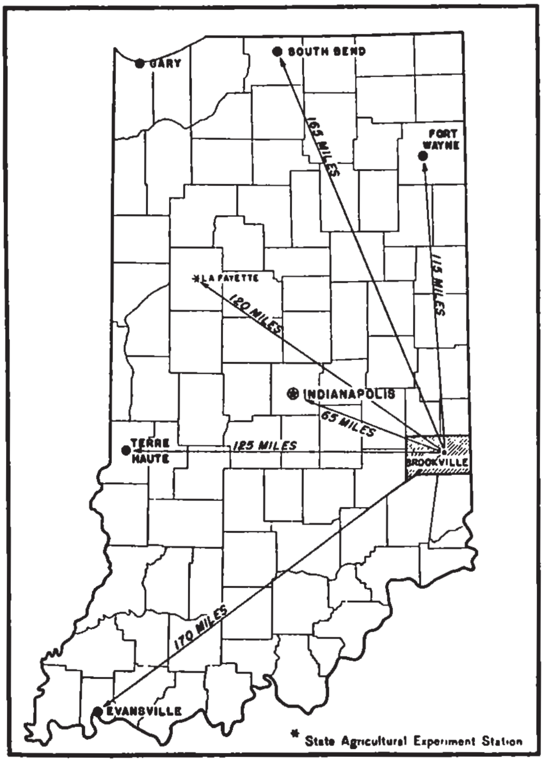

FIGURE 1.—Location of Franklin County in Indiana.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Franklin County is in the Dearborn Upland physiographic region.[2] The subsurface formations belong to the Ordovician and Silurian geologic periods and are covered largely by a mantle of glacial drift of the Illinoian and Early Wisconsin glaciations of Pleistocene geologic period. The surface geology is shown in figure 2.

[2] LOGAN, W. N., CUMINGS, E. R., MALOTT, C. A., and others. HANDBOOK OF INDIANA GEOLOGY. Ind. Dept. Conserv. Pub. 21, 1120 pp., illus. 1922.

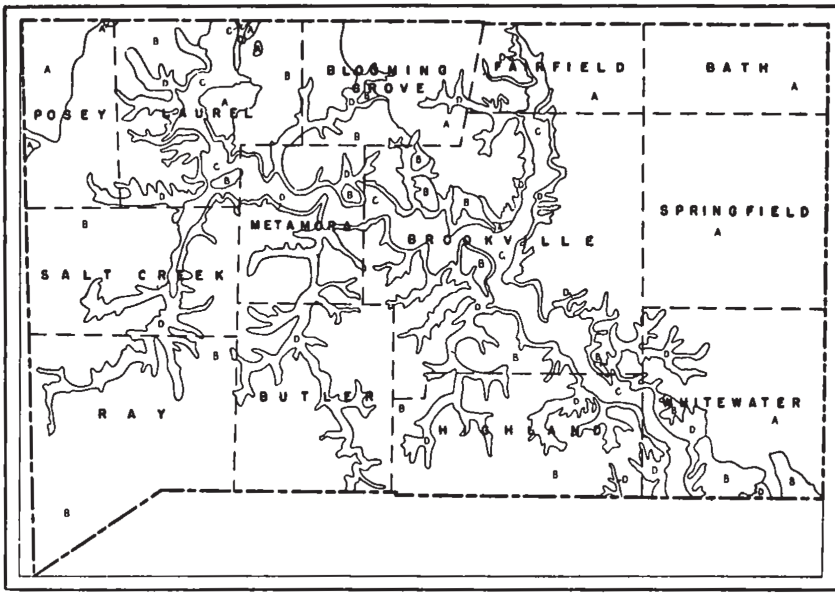

FIGURE 2.—Surface geology of Franklin County, Ind.: *A*, Early Wisconsin glacial drift; *B*, Illinoian glacial drift; *C*, glaciofluvial outwash plains and terraces and neutral to slightly alkaline alluvium from Wisconsin drift; *D*, Ordovician and Silurian limestone, with thin beds of calcareous shale.

That part of the county lying west of the West Fork of Whitewater River and Whitewater River, with the exception of the slope areas and a small area in the extreme northwestern part, an area lying east and north of the West Fork of Whitewater River and extending irregularly eastward within about 1 mile of State Highway No. 1, and a small area in the southeastern part, is covered with the deposit of unassorted unconsolidated drift of the Illinoian glaciation. The surface of the Illinoian glacial drift area is that of a gently undulating plain deeply dissected by stream valleys, differences of 300 feet in relief being common between the valley floor and the ridge crests. The drift, seldom exceeding 30 feet in thickness, generally disappears entirely along the steep slopes, where geologic erosion has been a prominent factor. Except under a forest cover, accelerated erosion is usually severe on the sloping areas. Relatively broad nearly flat poorly drained areas occur in the southwestern part.

Rather extensive terraces, consisting of glaciofluvial stratified gravel, sand, silt, and clay of Wisconsin age, occupy different levels, often in step formation, in the valleys of the Whitewater River system and its larger tributaries. Terraces composed of stratified silt and clay, which probably were alluvial plains elevated to low terrace positions, occur adjacent to the streams of the Illinoian drift regions in the southwestern part.

Limestone bedrock of the Ordovician and Silurian geologic periods outcrops on a large part of the steeper areas, especially along the larger streams and rivers.

The alluvial flood plains, composed of silt, clay, sand, and gravel and representing an accumulation of material deposited by receding floodwaters, are rather extensive along the Whitewater River system.

The rest of the county is covered with unassorted drift of the Early Wisconsin glaciation that varies in thickness from a few inches to 50 feet or more. The areas adjacent to the drainageways are in many instances severely sheet- and gully-eroded. In central, southern, and northern Bath Township and in northern Springfield Township is a smooth to very gently rolling till plain. Natural drainage is imperfect to poor over a large part of this area along the northeastern and east-central parts of the county. The overburden of till is relatively thin, and limestone bedrock occurs at an average depth of about 42 inches. This area extends about 10 miles southward from the northern boundary and irregularly westward a maximum distance of about 3 miles.

The maximum elevation, 1,040 feet above sea level, is in the vicinity of Blooming Grove; and the minimum, 525 feet, is in the southeastern part, where Whitewater River leaves the county. The maximum difference in elevation, therefore, is 515 feet, although the maximum local relief is 300 feet. Other elevations are Brookville 630 feet, Peoria 999 feet, Raymond 1,008 feet, and Bath 1,012 feet.[3] The drainage system is shown in figure 3.

Except for a small area in the eastern part and a smaller one in the southwestern, the county is drained by the Whitewater River system and its tributaries. The area in the eastern part is drained by Indian Creek and its tributaries, flowing south and southeast into Ohio, and that in the southwestern part by Little Laughery Creek and its tributaries, flowing south into Ripley County.

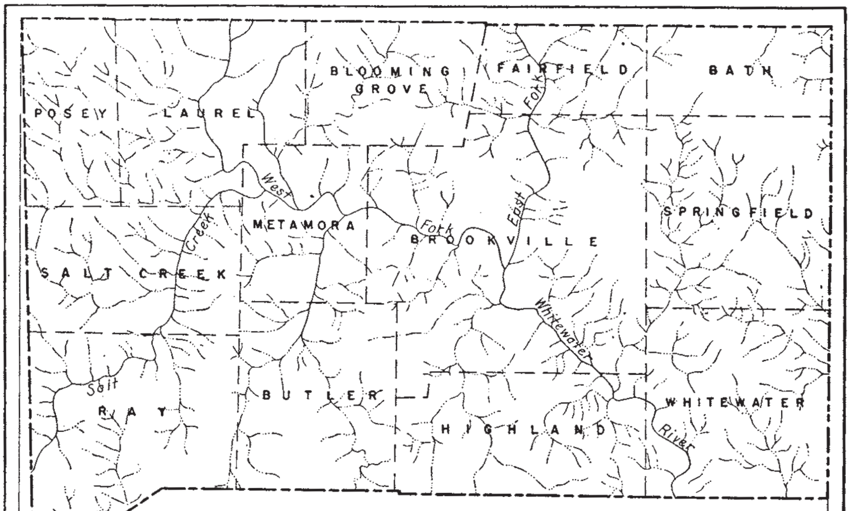

FIGURE 3.—Drainage system of Franklin County, Ind.

[3] See footnote 2, p. 5.

The West Fork of Whitewater River enters the county from the north about 6½ miles from the western boundary, flows almost due south for about 5 miles, then eastward to a point just south of Brookville. The East Fork of Whitewater River enters from the north about 10 miles west of the eastern boundary and flows southward to Brookville, uniting with the West Fork about half a mile south of Brookville. After the union of the two forks, Whitewater River flows southeastward and leaves the county at a point about 4½ miles west of the eastern boundary. The principal tributaries of the East and West Forks of Whitewater River and of the Whitewater River are Salt, Blue, Wolf, Big Cedar, Duck, Wolfe, Pipe, and Johnsons Fork Creeks. The drainage pattern is erratic, with no definite system of dissection.

CLIMATE

The climate of Franklin County is humid, temperate, and continental. Wide variations in temperature occur throughout the year, from an average of 29.4° F. in January (minimum −22°) to 75.3° in July (maximum, 108°).

In general, the summers are warm and humid and the winters moderately cold, characterized by sudden changes in temperature and general climatic conditions. The type of agriculture practiced is, in general, adjusted to the prevailing climatic conditions, and over a period of years the growing season is sufficient to mature crops. With a few exceptions, the crops grown are adapted to the climate.

The normal monthly, seasonal, and annual temperature and precipitation at Brookville are given in table 1.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Brookville, Franklin County, Ind.*[1]

[Elevation, 630 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year	Total for the wettest year	Average snowfall
	°F	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	31 8	74	−19	3.14	1.81	2.95	2.4
January	29.4	68	−22	3.40	.95	4.75	6.3
February	30 8	77	−21	2.32	.63	2.83	3.2
Winter	30 7	77	−22	8.86	3 39	10 53	11 9
March	41.2	86	4	3.96	2 81	2.73	1.2
April	51.7	89	19	3.44	.83	3.96	(2)
May	62.2	95	28	3.63	1.09	8.12	.0
Spring	51.7	95	4	11.03	4 73	14.81	1.2
June	70 9	101	38	3.48	3.45	5.79	.0
July	75.3	108	45	3.38	.77	5.78	.0
August	73.2	105	40	3.53	1.45	2.82	.0
Summer	73 1	108	38	10.39	5.67	14.39	.0
September	67.4	99	23	3.45	3 36	3.36	.0
October	55.4	89	15	3.12	.12	3.33	.1
November	42.8	81	−1	2.66	1.40	2.93	.6
Fall	55.2	99	−1	9.23	4.88	9.62	.7
Year	52.7	[3] 108	[4] −22	39.51	[5] 18.67	[6] 49.35	13.8

[1] From U. S. Weather Bureau records.
[2] Trace.
[3] In 1936.
[4] In 1930.
[5] In 1934.
[6] In 1929.

The mean winter temperature is 30.7°, with wide variations from a minimum of 22° below zero to a maximum of 77°. These variations, often rather sudden, are accompanied by alternate freezing and thawing, which occasionally cause considerable damage to fall-sown small grains, alfalfa, and clover, especially when severe cold occurs without a protective cover. If protected by a snow cover, these crops, especially wheat and other fall-sown small grains, withstand extremely low temperatures unless they occur when the soil is saturated or when a coating of ice forms over the plants. The frequency of this damage, however, is not such as to discourage growing these crops.

The mean summer temperature is 73.1°, the maximum 108°, and the minimum 38°. The wide variations do not often affect the general farm crops, except when the high temperatures occur during prolonged periods of drought.

The average length of the growing season is 166 days—from April 30 to October 12, the average dates, respectively, of the last killing frost in spring and the first in fall. The latest recorded date of a killing frost is May 25, and the earliest, September 19. Although some crops are occasionally injured by late spring or early fall frosts, the average frost-free period is usually ample for growing and maturing most crops. Injury to corn by late spring frost is uncommon; however, injury to corn and soybeans may result from early fall frosts when weather conditions delay their planting or when excessive moisture in fall prevents their maturing. Tomatoes and other vegetables are occasionally damaged by early frosts in fall, and fruits, especially apples and peaches, by late spring frosts.

The mean annual precipitation is 39.51 inches—for the driest year, 18.67 inches, and for the wettest, 49.35 inches. The mean precipitation for the growing season is about 52 percent of the mean annual precipitation. About 86 percent (11.9 inches) of the average snowfall of 13.8 inches occurs in December, January, and February.

Much of the rainfall during spring and summer is associated with cyclonic storms and is unevenly distributed. Hailstorms are uncommon. High wind velocities are infrequent, and destructive tornadoes rare. Low precipitation during summer results in crop injury, especially when associated with high temperatures and strong winds. Excessive rainfall early in fall retards the maturing of corn, soybeans, and special crops, whereas hot, dry weather in fall delays the sowing of small grains and reduces the yields of corn, tomatoes, and other crops. When the precipitation during winter occurs as rain, the run-off, especially on the steeper slopes, is usually rapid; however, much of it occurs as snow.

Climatic conditions are usually suitable for the normal pursuit of farm operations, including preparation of the seedbed, seeding, cultivation, and harvesting. Total crop losses throughout the county or in an extensive part of it are not only uncommon but rarely, if ever, occur.

WATER SUPPLY

Water supply for both people and livestock is obtained from wells either driven into the unconsolidated glacial drift material or drilled into the underlying bedrock and also from springs where limestone bedrock outcrops. Water for livestock is also obtained from the various rivers and streams of the county. Wells driven into the upland drift areas range from 25 to 200 feet deep or more, depending upon the presence of substrata of gravel or sand, and those driven into the glaciofluvial outwash plains and terraces range from 15 to 100 feet deep. The depth of the relatively shallow wells drilled into the alluvial or first-bottom areas is usually governed by the height of the bottom land above the stream channel. Wells driven into the limestone bedrock are generally deeper than those in glacial drift areas, and the water is usually of good quality.

VEGETATION

Before the coming of the white settlers practically all of the county, except some poorly drained dark-colored areas, was covered with a heavy growth of deciduous forest. The varieties of trees on the well-drained upland areas included white oak (*Quercus alba* L.), black oak (*Q. velutina* Lam.), red oak (*Q. borealis* var. *maxima* (Marsh.) Ashe), hickory (*Carya* sp.), black walnut (*Juglans nigra* L.), white ash (*Fraxinus americana* L.), American elm (*Ulmus americana* L.), tuliptree (yellow-poplar) (*Liriodendron tulipifera* L.), and buckeye (*Aesculus glabra* Willd.). The poorly drained upland areas in the Illinoian drift regions had a predominance of sweetgum (*Liquidambar styraciflua* L.), black tupelo (*Nyssa sylvatica* Marsh.), and pin oak (*Quercus palustris* Muench.). The poorly drained upland areas in the Wisconsin drift region had a predominance of beech (*Fagus grandifolia* Ehrh.), maple (*Acer* sp.), ash, and elm. The lower lying areas and bottom lands sustained a growth of Carolina poplar (cottonwood) (*Populus deltoides* Marsh.), ash, linn (basswood) (*Tilia americana* L.), European white willow (*Salix alba* L.), and sycamore (buttonwood) (*Platanus occidentalis* L.).

The trees on the forested areas are, for the most part, reproductions of the original species. A large part of the forested area has an understory of blackberry (*Rubus* sp.), wild rose (*Rosa* sp.), persimmon (*Diospyros virginiana* L.), small sassafras (*Sassafras albidum* (Nutt.) Nees), black locust (*Robinia pseudoacacia* L.), sumac (*Rhus* sp.), and dogwood (*Cornus florida* L.). The common wild grass is Kentucky bluegrass (*Poa pratensis* L.). On abandoned fields poverty oatgrass (*Aristida dichotoma* Michx.) and broomsedge (*Andropogon virginicus* L.) are prevalent.

The most extensive forest areas now present are on the steeper slopes and the upland areas of Illinoian glacial drift. Very little merchantable timber remains, and most of the trees are cut for railroad cross ties as soon as they reach the required size (12 to 18 inches in diameter). A few areas in the region of Early Wisconsin glacial drift remain in timber or pasture, but most of the woodland is pastured; thus forest regeneration is prevented.

ORGANIZATION AND POPULATION

The present area of the county is formed of parts of four land grants obtained by the United States Government by treaty with the Indians—(1) Wayne's Purchase, or the Treaty of Greenville, in 1795; (2) Grouseland Purchase, in 1805; (3) Twelve Mile Purchase; and (4) New Purchase, in 1818. The land was plotted and placed on sale about 1802. The first regular settlement seems to have been what was known as the "Carolina Settlement," on the East Fork of Whitewater River, about 1803, and was principally confined to the river bottoms.

Between 1810 and 1820 there was a large immigration into the county, principally from New York, New Jersey, Pennsylvania, and the New England States. The southwestern part was settled almost wholly by people of German extraction, the northwestern largely by people of Irish extraction, and the other parts by a mixture of racial extractions with no one race predominating.

This county, the seventh one organized within the present limits of Indiana, included a much larger area than at present. It was formed February 1, 1811, with Brookville as the county seat. Settlement progressed rapidly from a population of 5,000 at the time of organization to 19,549 by 1860, after which it decreased steadily until in 1940, when it was 14,412.

Brookville, with a population of 2,194 in 1940, is the largest town and principal trading center. Numerous other small towns and villages serving as local trading centers are Laurel, Oldenburg, Fairfield, Mount Carmel, Metamora, Bath, New Trenton, Cedar Grove, Blooming Grove, Whitcomb, Hamburg, Saint Peters, Peppertown, and South Gate.

INDUSTRIES

A small factory at Brookville manufactures funeral supplies, and a brick and tile kiln is in operation in Ray Township, just north of Batesville (Ripley County). As the subsoil in the western part of the county is suitable for the manufacture of brick and tile, it has been extensively used for this purpose. Practically all the brick used in the construction of a convent and monastery at Oldenburg was manufactured from clay obtained in the immediate vicinity. About 1835 a few salt wells were drilled along Salt Creek but as they were not very productive they were soon abandoned.

The county is well supplied with limestone and gravel. Limestone is ground or crushed locally for road-building material and agricultural use, both in the county and surrounding areas. Gravel and sand are obtained from the rivers and gravelly terraces for use in building construction and as road-building material and railroad ballast.

TRANSPORTATION AND MARKETS

Three railroads serve the county—the New York Central (Beeson Branch), which parallels the West Fork of Whitewater River and Whitewater River; the Chesapeake and Ohio Railway, which cuts across the extreme northeastern part of the county and serves Bath, Raymond, and Peoria; and the New York Central system, which touches the extreme southwestern corner but serves that part of the county through Batesville just across the county line.

A good network of hard-surfaced Federal and State highways traverse the county. Good county roads, which are practically all graveled or hard-surfaced and passable at all times, serve that part of the county lying east of the West Fork of Whitewater River and Whitewater River, with the exception of the Illinoian drift region. Roads serving the rest of the county are fair, but those infrequently traveled are impassable during periods of wet weather.

The 1940 Federal census reports 406 farms on hard-surfaced roads; 1,181 on gravel, shale, or shell roads; 99 on improved dirt roads; and 103 on unimproved dirt roads. The establishment of a good system of Federal and State highways, together with increased use of motortrucks, has changed the marketing methods, as practically all the livestock, livestock products, and crops are being marketed by truck.

The first survey for a canal within the county was made in 1823, and the building of it was authorized by the State in 1836. It was completed from Lawrenceburg to Brookville in 1839 and was known as the Whitewater Canal. Completed along the West Fork of Whitewater River to Hagerstown, in Wayne County, and in use until 1865, this canal was the principal outlet for the produce of the Whitewater Valley and the means of obtaining necessary supplies from outside areas. A canal was begun along the East Fork of Whitewater River, north from Brookville, but was abandoned before completion.

CULTURAL DEVELOPMENT AND IMPROVEMENT

A good system of consolidated schools is maintained in the county. Numerous churches serve the various religious elements. Free mail delivery service reaches all districts, and telephone service is readily available in the vicinity of Brookville and the northeastern part but somewhat limited in the rest of the county. The 1940 census reported 651 farms served by telephone. Electric service is available to a large part of the county. The 1940 census reported electric distribution lines within one-fourth mile of 683 farm dwellings, of which 480 receive current from power lines and 145 from home plants.

AGRICULTURE

Agriculture had its beginning with the coming of the first settlers, about 1803. The well-drained terrace, bottom, and upland areas were first selected for home sites, and trees were felled to make way for the crops. Forest wood was used almost exclusively for building houses and barns and for fuel. Corn, wheat, barley, hay, and vegetables were the principal crops grown by the early settlers. Wild game, which was plentiful in the forests, was an important source of meat for the pioneers.

The influx of settlers was steady, and with the increase in population agriculture expanded, and the more desirable well-drained areas, including the slopes, were cleared and cropped. The productivity of the steep slopes has been materially lowered by the practice of clearing and cropping them to wheat and barley until the fertile surface soil has largely been washed away and the land abandoned for other uncleared areas. Gradually artificial drainage was installed in the poorly drained areas, and in many instances, especially in the northeastern part of the county, they proved to be some of the more productive in the county.

With agricultural expansion came improved farming methods, together with a change to a more stabilized cropping system. The rotation system and agricultural practices vary somewhat in this part of the county but, in general, consist of growing corn, small grains. especially wheat and oats, and hay.

CROPS

The acreages of the principal crops, as reported by the United States census, are given in table 2.

TABLE 2.—*Acreage of the principal crops in Franklin County, Ind., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1939
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn harvested for grain	39,756	32,954	33,879	39,193	39,255	3[illegible],236	34,268
Oats threshed	8,747	9,688	3,475	5,481	2,250	2,038	407
Wheat	27,951	29,459	35,653	22,088	30,524	23,406	20,501
Rye	466	127	244	898	3,606	1,642	562
Barley	2,374	456	34	30	39	25	351
Buckwheat	187	66	18	28	20	-------	-------
Hay, total	12,425	22,725	20,395	19,532	20,167	21,608	19,466
Timothy or clover, alone or mixed	-------	-------	-------	14,722	13,908	13,851	11,829
Clover alone	-------	-------	8,641	3,359	3,964	5,029	[1] 287
Alfalfa	-------	-------	1	807	1,509	1,936	4,224
Small grain hay	-------	-------	303	245	603	600	797
Legume hay	-------	-------	-------	-------	25	132	2,168
Other hay	-------	-------	11,450	399	158	60	161
Silage crops [2]	-------	-------	-------	-------	1,343	1,438	895
Coarse forage	-------	-------	271	1,292	16,437	1,231	415
Tobacco	5	6	5	542	1,305	1,095	828
Potatoes	([3])	1,451	978	1,154	932	639	420
Other vegetables (for sale)	-------	-------	-------	-------	45	166	173

[1] Includes sweetclover and lespedeza.
[2] Mostly corn.
[3] Production, 87,122 bushels; acreage not available.

The acreage used for cereal crops reached its peak in 1879, when 79,481 acres were in corn, oats, wheat, rye, barley, and buckwheat. This was about 29 percent greater than that in 1939. Since 1879 the acreage in corn has fluctuated somewhat, with no great decided change. Owing to the natural productivity of the soil in the north-central and northeastern parts and the alluvial areas adjacent to the Whitewater River, more land there is used for corn than in other parts of the county.

Land for corn is usually plowed late in fall or in spring, depending upon the soil type, degree of slope, and weather conditions. Because of susceptibility of a large part of the area to accelerated erosion, a much smaller part than formerly is plowed in fall. Before seeding, the land is thoroughly disked and smoothed with a harrow, drag, or cultipacker. Two-row corn planters are in general use, except in the steep sloping area. Depending on the use for which corn is grown and on seasonal conditions, varieties planted vary somewhat from year to year. A few farmers grow open-pollinated varieties, but most of them plant hybrid corn. Methods of harvesting corn depend upon its use—it may be husked in the field either by hand or mechanical pickers, cut and placed in shocks in the field to be husked later, cut for silage, or "hogged-off" or grazed by putting hogs in the field. The greater part of the corn grown is fed to livestock on the farm, the surplus being sold to local elevators or livestock feeders from surrounding areas.

Wheat was grown on 20,501 acres in 1939, or 15,152 acres less than in 1899, the year of the highest acreage. Wheat may follow either corn, oats, or soybeans, or be sown on land where legumes have failed. When following corn, it is drilled between the corn rows or after the corn has been cut for silage or fodder. When following other crops, the land is prepared by plowing and disking or by disking and then leveling with a harrow or drag. Seeding takes place late in September or early in October, usually after the "fly-free" date (the date after which the hessian fly ceases to be a danger), as given by the Purdue University Agricultural Experiment Station. It is a general practice to drill fertilizer with wheat at the time of seeding, the quantity and analysis varying somewhat. Although not a common practice, some manure is used as a top dressing. Harvesting is accomplished either with binders, the wheat being placed in shocks to be threshed later, or with mechanical combines. The use of combines is confined to the smooth land in the north-central and northeastern parts of the county. On a few very steep areas wheat is cut with a hand scythe, tied into bundles, and later threshed. This is one of the most important cash crops, and most of it is sold to local elevators.

The acreage in oats has fluctuated somewhat in the last 60 years, and there has been a general rapid decrease from 8,747 acres in 1879 to only 407 acres in 1939. Oats may follow either corn, wheat, soybeans, or special crops, or may be grown where hay crops have failed. This crop is seeded in April or early in May, either broadcast or drilled in a seedbed prepared by plowing or disking and leveling. Very little commercial fertilizer is used. A part of the crop is cut green for hay, but most of it is threshed, under harvesting methods similar to those for wheat. The grain is either sold to local elevators or fed on the farm, depending upon the need for additional feed.

In the last few years a greatly increased acreage has been used for soybeans, the Federal census reporting 220 acres in 1929 and 2,980 acres in 1939. In the rotation, soybeans follow corn, small grains, or special crops. Land for soybeans is usually plowed and disked or harrowed. This crop is seeded late in May or early in June in a well-prepared seedbed. Very little commercial fertilizer is used, although a few farmers plow under heavy fertilizer applications before seeding or drill 150 to 300 pounds an acre at that time. The greater part of the crop was formerly grown for hay, but in recent years the increased acreage has been largely grown for seed. The seed should be inoculated until the soil in the producing field carries abundant inoculation, and it should be well developed in the pod for maximum feeding value of the hay. Harvesting the seed is accomplished almost entirely with combines. Most of it is marketed through elevators as a cash crop, although some is retained on the farm for seed and livestock feed.

Minor cereal and grain crops grown to a limited extent include barley, buckwheat, sorghum, rye, and cowpeas. Except on a few areas in the regions of Illinoian glaciation, they do not usually have a place in the crop-rotation system but are grown largely as an emergency crop where other crops have failed. Rye occasionally takes the place of wheat in the rotation in the regions of Illinoian glaciation, barley and buckwheat are usually limited to small individual fields in the western part of the county, sorghum is grown both for silage and molasses, and cowpeas are grown both for hay and for seed.

The increase in alfalfa acreage from 1 acre in 1899 to 4,224 in 1939 is due to a more general knowledge and appreciation of its feeding value and to the knowedge that liming most of the soils is a necessary prerequisite for its successful growth. Very few farmers attempt to grow it until the soil has received sufficient applications of lime, usually in the form of ground limestone. Alfalfa is not adapted to the strongly acid soils of the Illinoian drift regions, where little success with it has been obtained, but it is well adapted to soils of the Early Wisconsin glacial regions, the glaciofluvial outwash terrace regions, and to the sweet alluvial soils. For its most successful growth and for the storage of nitrogen in the roots of the plants, inoculation of the seed is essential.

The total acreage in hay crops in the last 50 years has shown little fluctuation, but there have been radical changes in the kinds grown. The most significant has been the rapid increase in the acreage used for alfalfa and the reduction of that used for clover alone. These changes are the result of the increased popularity of alfalfa both for pasture and for hay and of the general practice of seeding a mixture of clover, timothy, alsike, alfalfa, and other legumes instead of clover alone.

Alfalfa is either seeded with wheat, oats, or other small grains in spring, or seeded in fall with or without a nurse crop. In fall seeding a good seedbed is prepared and the soil packed with the cultipacker or roller to maintain good moisture conditions. Alfalfa is grown both for pasture and for hay, depending largely on the type and number of livestock on the farm.

Land used for clover alone has decreased from 8,641 acres in 1899 to only 255 acres in 1939, owing to the more general practice of seeding with the hay mixture. Both red and mammoth clover are extensively grown in the hay mixture, and sweetclover is increasing in importance for hay and seed and as an intercrop principally for soil improvement.

Clover grown both for hay and seed is usually sown at the time of seeding oats or is seeded in fall-sown small grains early in spring. It is not generally fertilized, but a trend in recent years toward heavy applications of commercial fertilizer with small grains indirectly fertilizes the clover crop. A rather common practice is to cut the common red clover early in summer and allow the crop to seed in fall.

Timothy forms part of the hay mixture throughout the county but is more extensively grown on the strongly acid soils of the Illinoian glacial regions and the associated strongly acid terraces and bottoms. Although some is grown for seed, it is largely grown for hay, will tolerate greater acidity than clover or alfalfa, and will grow fairly successfully under poor drainage conditions. Methods of seeding are similar to those for clover and alfalfa.

The minor hay crops are lespedeza, Sudan grass, bromegrass, millet, and rape. Lespedeza is well adapted to the acid soils of the Illinoian drift regions, and the acreage has increased somewhat in recent years. Sudan grass, millet, and rape are grown to a limited extent, usually as an emergency crop to supplement other pastures. Bromegrass has been used to a limited extent as part of the hay mixture, usually taking the place of timothy. As recent experiments by the Purdue University Agricultural Experiment Station have shown that it is equal or superior to timothy as pasture for cattle and hogs, there will probably be an increase in the quantity used in future years.

Tobacco growing is largely confined to the soils developed on limestone and to sweet bottoms and low-terrace areas. Light burley is the most important popular variety, but some dark burley also is grown. In 1939 tobacco was grown on 828 acres. The seed is planted in small seedbeds early in spring, and when the plants have attained correct size they are transplanted to the field when weather conditions permit. The crop is harvested by hand early in fall and placed in tobacco barns to cure. It is sold at auction markets in Lawrenceburg, Ind., and in Louisville and other northern Kentucky markets.

The acreage in vegetables has never been large. In 1939 there were 420 acres in potatoes. Vegetables other than potatoes and sweetpotatoes were harvested for sale from 173 acres, of which 106 were in tomatoes. Some tomatoes grown in the southwestern part are marketed at canning factories in adjoining counties. Only one canning factory (at Metamora) is in the county.

The values of certain crops and livestock products produced in the county in 1939, as reported by the United States census, are given in table 3.

TABLE 3.—*Value of agricultural products by classes, Franklin County, Ind., 1939*

Crops	Value	Livestock products	Value
Cereals	$1,140,700	Dairy products sold	$298,717
Corn harvested for grain	886,654	Whole milk	204,113
Wheat threshed	240,793	Cream [2]	91,218
Other grains and seeds	33,312	Butter	3,386
Hay and forage	319,875	Butter churned (including any sold)	16,509
Tobacco	114,941	Wool shorn	11,425
Vegetables, total	86,105	Poultry raised, total	164,655
For sale [1]	7,577	Chickens	154,658
For home use	49,873	Turkeys	8,838
Potatoes and sweetpotatoes	28,655	Ducks	441
Fruits and nuts	22,785	Other poultry	718
All other crops	2,277	Chickens sold (alive or dressed)	70,721
Forest products sold	13,334	Chicken eggs produced	142,367
		Honey produced	1,182
		Animals sold or butchered on farms, total	1,136,480
		Cattle and calves	267,461
		Hogs and pigs	842,835
		Sheep and lambs	26,184

[1] Excluding value of potatoes and sweetpotatoes.
[2] Includes value of both sweet cream and sour cream (butterfat).

ROTATIONS AND FERTILIZERS

Crop rotations commonly used in the regions of Early Wisconsin glaciation are: (1) Corn, wheat or oats, and legumes, including clover, alfalfa, sweetclover, or a mixture of these, with timothy and some bromegrass; (2) corn, soybeans, wheat or oats, and a mixture of legumes and grasses; and (3) corn, wheat or oats, and 2 years or more of alfalfa. These rotations are varied to include special field and vegetable crops, and the order in the rotation is occasionally changed to meet special seasonal and feed requirements and unusual economic conditions. Fields consisting largely or entirely of Brookston or Cope soils are occasionally cropped to corn for 2 or more consecutive years.

Rotations in common use on the glaciofluvial outwash plain and terrace areas are similar to those on areas of Early Wisconsin glaciation, except that very little oats is grown and the hay crops are largely alfalfa or a mixture of alfalfa and clover. Probably more vegetables, especially tomatoes and potatoes, are grown on these areas than elsewhere in the county.

On the sweet alluvial soils the rotations usually include 2 years or more of corn, wheat or oats, and a mixed hay crop or corn, wheat, and alfalfa. Those on bottoms less subject to flooding include more fall-sown grains and hay crops.

In the regions of Illinoian glaciation, including the associated strongly acid alluvium and low terraces, the rotation includes corn, wheat, and either timothy or a mixture of timothy and clover, with some lespedeza. This is varied to include soybeans and some vegetable crops, especially tomatoes, and occasionally oats, barley, and other field crops.

Because of the rather wide range in slope conditions, the rotation on soils developed on limestone is rather irregular but usually includes tobacco, corn, wheat, and alfalfa. Most of the tobacco is grown on these soils. After tobacco or wheat crops are harvested areas are occasionally sown to alfalfa, which is allowed to remain for several years when good stands are obtained.

For 1939, 1,200 farms (64.5 percent of all farms) reported an expenditure of $94,662, or an average of $78.88 a farm, for commercial fertilizer, and 204 farms purchased 4,741 tons of liming materials at a total cost of $8,617. This was slightly less than in 1929, when 65.7 percent of the farms spent $129,579, averaging $102.92 a farm.

The use of commercial fertilizer is rather general, especially in the regions of Early Wisconsin glaciation and the glaciofluvial outwash plains and terraces. Less is used in the regions of Illinoian glaciation than in other parts of the county, with a wide variation in quantity among individual farmers. Although a small number of farmers do home mixing of fertilizer, it is largely purchased ready-mixed both cooperatively and individually, an increasing quantity being purchased through cooperative farm organizations. There is a trend toward the use of higher analyses fertilizers, in larger quantities to the acre.

Tobacco, tomatoes, and other special crops are rather heavily fertilized. It is common practice to fertilize wheat, corn, and vegetables in the regions of Early Wisconsin glaciation. A few farmers plow under fertilizer before planting soybeans, and some apply it at the time of planting. There is also a trend toward indirect fertilization of clover and alfalfa by applying large quantities with wheat, oats, and other small grains.

Supplementing commercial fertilizer with barnyard manure is a common practice. Most of it is applied to the light-colored soils before the land is plowed for corn, with smaller quantities used as a top dressing for wheat. Sweetclover is occasionally grown as an intercrop to be plowed under before planting corn, and some rye is grown as a green-manure crop.

The value of lime for correcting soil acidity is becoming more generally recognized, an increasing quantity, principally in the form of ground limestone, having been used in recent years. Many farmers collect limestone rocks from the hillsides and crush them to obtain agricultural limestone. In determining the lime requirements of a soil or of all soils in a given field, it is important that an accurate test be made. This can be accomplished with a number of available acidity indicators. Probably the best procedure is for the person interested to take samples of both surface soil and subsoil of the different soils

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in the field and mail or take them to the county agricultural agent at Brookville, or mail them to the Purdue University Agricultural Experiment Station, La Fayette, Ind.

PERMANENT PASTURES

The permanent pastures, principally Kentucky bluegrass, are in the regions of Early Wisconsin glaciation, including the glaciofluvial outwash plains and terraces and sweet alluvium. They occur as relatively small fields on a large number of farms throughout the areas or on the more sloping areas adjacent to drainageways. A large number of the woodland pastures contain a sparse stand of timber, with a good undergrowth of bluegrass. Fertilization of these permanent pastures is not a common practice, although most of them could be materially improved by the use of fertilizer and a pasture-improvement program. Many of them are overgrazed.

In the regions of Illinoian glaciation, including the strongly acid alluvial and terrace areas, the permanent pastures are generally of inferior quality. A fair to good stand of bluegrass is maintained on a few areas, but in general, the cover consists largely of broomsedge and poverty oatgrass, with some bluegrass and some lespedeza. To obtain and maintain adequate pasture in these regions, a pasture-improvement program that includes the use of sufficient lime and fertilizer is essential.

Bluegrass is well adapted to the limestone slopes of the county, and where accelerated erosion is controlled, excellent stands are maintained. Numerous sparsely wooded areas have a good undergrowth of bluegrass.

LIVESTOCK AND LIVESTOCK PRODUCTS

Raising livestock has been a very important source of farm income in the county for the last 60 years and is the medium through which a large part of the crops is marketed. The number of livestock on farms, as reported by the Federal census, is given in table 4.

TABLE 4.—*Number of livestock on farms in Franklin County, Ind., in stated years*

Livestock	1880	1890	1900	1910	1920	1930	1940
Horses	6,095	6,960	6,395	6,757	6,524	4,604	[1] 3,684
Mules	667	562	402	492	805	851	[1] 864
Cattle	15,238	15,045	15,702	14,807	17,061	17,458	[1] 16,294
Swine	36,206	28,421	30,736	42,074	50,913	44,859	[2] 26,076
Sheep	10,346	9,092	13,071	15,530	6,638	13,970	[3] 7,287
Chickens	79,186	195,423	105,746	[4] 146,644	194,874	[1] 175,863	[2] 735,021
Other poultry	14,789	18,501	7,193	([5])	10,866	([5])	[2] 1,073
Bees ... hives			1,061	867	946	970	200

[1] Over 3 months old, Apr. 1
[2] Over 4 months old, Apr. 1.
[3] Over 6 months old, Apr. 1.
[4] Includes other poultry.
[5] Not available.

The number of horses and mules over 3 months old on farms on April 1, 1940, was 4,548, compared with 5,429 in 1930. The decrease is due to increased use of tractors and other mechanized equipment. Some of the work stock is raised on the farm and some purchased from adjacent areas. Practically all the feed for the stock is grown on the farm, with oats and hay the favorite feeds for both horses and mules.

There were 16,294 cattle over 3 months old on farms on April 1, 1940, compared with 14,534 over 3 months old on April 1, 1930. With the present trend toward soil conservation practices, large acreages are being used for permanent and semipermanent pastures and hay crops, thus encouraging the feeding of a greater number of cattle.

The breeds most commonly raised for beef production are Hereford and Shorthorn. Although some beef cattle are raised on the farm, most of them are shipped in when small from Cincinnati, Indianapolis, and other markets. They are marketed after grazing during summer and early fall, or are "finished" on corn, commercial feeds, and hay and then marketed, the latter commanding the more attractive price. They are usually marketed at Cincinnati or Indianapolis.

Of the total number of cattle on farms in 1940, 8,072 were kept mainly for milk production. A few dairy cattle are kept on a number of farms throughout the county, and a few farmers specialize in dairy products. Trucks from Brookville and from towns outside the county call at the farms at regular intervals for dairy products, including sweet and sour cream, whole sweet milk, and butter. The value of dairy products sold in 1939 was $298,717, of which 68.3 percent represents the value of whole milk.

The peak year of swine production was 1920, when 50,913 were raised. The number over 4 months old on farms on April 1, 1940, was 26,076, compared to 24,192 over 3 months old on April 1, 1930. Small or utility type Spotted Poland China is the breed grown almost exclusively in the northeastern part of the county, the largest hog-producing section. Poland China, Duroc-Jersey, and Hampshire are popular breeds raised in other parts. Practically all are shipped by truck to markets in Cincinnati and Indianapolis.

On April 1, 1940, there were 7,287 sheep over 6 months old on farms, a slight decrease from the number on April 1, 1930. In general, the flocks are not large but are well distributed. Most of the sheep are raised on the farm, but a few feeder sheep or lambs are bought from other parts of the country, fattened on the farm, and then marketed by truck in Cincinnati, Indianapolis, and other nearby markets.

Poultry and poultry products are an important source of steady cash income, practically every farmer having a few dozen poultry and a few having flocks of several hundred. The poultry and products are either shipped by truck to Cincinnati or sold to produce dealers in nearby towns or to produce buyers whose trucks call at the farm. The total value of poultry raised in 1939 was $164,655, of which that of chickens represents 93.9 percent.

TYPES OF FARMS

The 1940 Federal census classified the farms by major source of income in 1939, as follows: Livestock, 620; field crops, 590; subsistence, 418; dairy products, 94; poultry and poultry products, 75; forest products, 11; truck, 4; fruit, 4; and other livestock products, 2. Accordingly, more than 33 percent of the farms in the county were classified as obtaining the main source of income from livestock, about 32 percent from field crops, 22 percent from farm products used by farm households, 5 percent from dairy products, 4 percent from poultry and poultry products, and the rest from various other sources.

LAND USE

The most extensive development of agriculture in the county was reached about 1890, when there was 71.9 percent of improved land in farms. The greater percentage (98.4 percent) of the county in farms was in 1920. The proportion in farms in 1940 was 94.4 percent, of which about 55 percent was available for crops. The total acreages in farms and farm land according to the various uses in 1929 and 1939 are given in table 5.

TABLE 5.—*Acreage in farms and farm land according to use in Franklin County, Ind., in stated years*

Farm land	1929	1939
	Acres	*Acres*
All land in farms	235,196	238,005
Cropland harvested	92,698	81,946
Crop failure	1,601	1,750
Cropland, idle or fallow	13,312	9,049
Plowable pasture	24,079	39,325
Woodland	43,989	36,313
All other land [1]	59,517	69,622
Land used for crops (harvested and failure)	94,299	83,696
Land available for crops (harvested, failure, idle or fallow, and plowable pasture)	131,690	132,070

[1] This classification includes pasture land other than plowable and woodland pasture, all wasteland, house yards, barnyards, feed lots, lanes, and roads.

The Federal census shows that the total land in farms increased from 235,196 acres in 1930 to 238,005 in 1940. There was, however, a decrease of about 12 percent in cropland harvested in 1939 from that in 1929. Crop failures increased about 8 percent in 1939 over those in 1929, idle or fallow cropland was 32 percent less, the acreage in plowable pasture was about 39 percent larger, and farm woodland decreased about 17 percent. The larger areas of woodland are on the steeper slopes throughout the county and on nearly level to sloping areas in the regions of Illinoian glaciation.

The number of farms and the farm acreage, classified by size of farm in 1940, are given in table 6.

Of the 1,860 farms in the county in 1940, about 41 percent (46,546 acres) range from 70 to 139 acres, and 59 percent (127,482 acres), from 70 to 179 acres.

TABLE 6.—*Farms and farm acreage, classified by size, Franklin County, Ind., 1940*

Size (acres)	Number of farms	Acres	Size (acres)	Number of farms	Acres
Under 10	75	370	140 to 179	330	52,087
Under 3	5	(1)	175 to 179	14	(3)
3 to 9	70	(1)	180 to 219	150	29,287
10 to 29	67	1,135	220 to 259	89	20,992
10 to 19	42	(2)	260 to 379	81	24,412
30 to 49	137	5,486	380 to 499	23	9,813
50 to 69	131	7,641	500 to 699	14	7,862
70 to 99	388	31,914	700 to 999	3	3,531
100 to 139	371	43,481	1,000 acres and over	1	

[1] Acreage included in group under 10 acres.
[2] Acreage included in group 10 to 29 acres.
[3] Acreage included in group 140 to 179 acres.

FARM TENURE

The tenure of farms in the county, by owners, tenants, and managers in the census years 1880 to 1940, is shown in table 7.

The 1940 census reported 67.5 percent of farms operated by owners, 32.2 percent by tenants, and less than 1 percent (only 5 farms) by managers. Since 1880 there has been a steady decline in the percentage of farms operated by owners, whereas the percentage operated by tenants has steadily increased. In 1940, 429 farms, or 71.6 percent of those farmed by tenants, were rented on a "share tenants and croppers" basis. In this method the tenant receives part of the crops produced (usually a third to a half), with some provision made for living privileges. Where livestock is produced, the same variations exist. When the land is rented for cash the price per acre varies in accordance with the productiveness of the soil, farm improvements and facilities, and current economic conditions.

TABLE 7.—*Percentage of farms operated by owners, tenants, and managers in Franklin County, Ind., in stated years*

Year	Percentage of farms operated by—			Year	Percentage of farms operated by—		
	Owners	Tenants	Managers		Owners	Tenants	Managers
1880	83.6	16.4	0	1920	69.4	29.9	0 7
1890	78.2	21 8	0	1930	69.0	30.3	.7
1900	77.3	21.4	1.3	1940	67.5	32.2	.3
1910	72 0	27.5	.5				

FARM INVESTMENTS AND EXPENDITURES

In 1940 the average values of all property per farm and of land per acre, including buildings, were $6,918 and $43.91, respectively, which was a decrease from those of $8,236 and $53.68 in 1930. Land and buildings represented 81.2 percent of the value of all property per farm in 1940; implements and machinery, 7.8 percent; and domestic animals, poultry, and bees, 11 percent.

In 1940 there were 701 tractors on 679 farms and 262 trucks on 246. In the regions of Wisconsin glaciation a large part of the farming operations, especially plowing and preparation of seedbeds, is accomplished by power machinery. Corn is harvested largely with mechanical pickers, and much of the small-grain and soybean crop with combines.

The total expenditure for feed for domestic animals and poultry reported by 1,427 farms in 1939 was $282,070, an average of $197.66. In the same year 1,200 farms reported the purchase of 3,406 tons of commercial fertilizer at a total cost of $94,662, averaging $78.88 a farm, and 204 farms purchased 4,741 tons of liming material, largely in the form of ground agricultural limestone, at a cost of $8,617, or an average of $42.24 a farm.

In 1939 a total of $98,927 was paid for hired labor (exclusive of household and contract construction work) by 522 farms, or an average of $189.51. Of this expenditure, $59,577 was for labor hired by the month on 198 farms and $34,357 for labor hired by the day or week on 334 farms. Most of the extra farm labor is obtained within the county or from adjacent counties. An expenditure of $167,212 for implements and machinery in 1939 was reported by 587 farms, and of $92,665 for gasoline, distillate, kerosene, and oil by 1,236 farms.

SOIL SURVEY METHODS AND DEFINITIONS

In making a soil survey the soils are examined, classified, and mapped in the field and their characteristics recorded, particularly in regard to the growth of various crops, grasses, and trees.

The soils and the underlying formations are examined systematically in many locations. Test pits are dug, borings made, and highway or railroad cuts and other exposures studied. Each exposes a series of distinct soil layers, or horizons, termed collectively the soil profile. Each horizon, as well as the underlying parent material, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The chemical reaction of the soil and its content of lime and salts are determined by simple tests.[4] Other features taken into consideration are the drainage, both internal and external, the relief, or lay of the land, and the interrelations of soil and vegetation.

The soils are classified according to their characteristics, both internal and external, with special emphasis upon the features that influence the adaptation of the land to the production of crop plants, grasses, and trees. On the basis of these characteristics the soils are grouped into classification units, the principal three of which are (1) series, (2) type, and (3) phase. Some areas that have no true soil—Riverwash and Stony and gravelly alluvium—are termed (4) miscellaneous land types.

The series is a group of soils having the same genetic horizons, similar in their important characteristics and arrangement in the profile and having similar parent material. Thus, the series comprises soils having essentially the same color, structure, natural drainage, and other important internal characteristics and the same range in relief. The texture of the upper part, including that commonly plowed, may vary within a series. The series are given geographic names taken from localities near which they were first identified. Russell, Fincastle, Cincinnati, Genesee, and Brookston are names of important soil series in Franklin County.

Within a soil series are one or more types, defined according to the texture of the upper part of the soil. Thus, the class name of this texture—as fine sandy loam, loam, silt loam, or silty clay loam—is added to the series designation to give a complete name to the soil type. Except for the texture of the surface soil, these types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific

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[4] 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, alkalinity; lower values, acidity. Indicator solutions are used to determine the chemical reaction. The presence of lime is detected by the use of a dilute solution of hydrochloric acid.

Terms that refer to reaction of soils and are commonly used in this report are defined as follows:

	pH value
Extremely acid	below 4.5
Very strongly acid	4.5–5.0
Strongly acid	5.1–5.5
Medium acid	5.6–6.0
Slightly acid	6.1–6.5
Neutral	6.6–7.3
Mildly alkaline	7.4–8.0
Strongly alkaline	8.1–9.0
Very strongly alkaline	9.1 and higher

character it is usually the unit to which agronomic data are definitely related. In comparisons of the type and phases of that type, to avoid the repetition of their complete names the type is sometimes briefly referred to as the type, the normal soil, the normal type, or the typical soil. Genesee silt loam and Genesee fine sandy loam are soil types within the Genesee series.

A soil phase is a subdivision of the type, each phase differing from the other phases in some minor feature, generally external, that may be of special practical significance. For example, within the normal range of relief of a soil type some areas may have slopes permitting the use of machinery and the growth of cultivated crops and others may not. Differences in relief, stoniness, and degree of accelerated erosion may be shown as phases. Even though no important differences may be apparent in the soil profile 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 a sloping or a steep phase. Similarly, some soils having differences in stoniness may be subdivided into phases, even though these differences are not reflected in the other characteristics of the soil or in the growth of native plants.

Aerial photographs, taken from an airplane flying at an elevation of about 13,500 feet, are used as a base in the mapping of the soils in Indiana. Each picture covers an area of about 4½ square miles, and the scale is 3.17 inches to 1 mile. The photographs are covered with sheets of cellulose acetate, a thin transparent material, on which soil boundaries, streams, roads, houses, and other features are drawn in the field. After the entire county is mapped these sheets are reduced to a scale of 2 inches to 1 mile and assembled on a base map prepared on the same scale. The assembled map is printed in colors, each soil separation having a distinguishing color, letter, and ruling designation. For example, all areas of Martinsville silt loam are designated on the map accompanying this report by the symbol Ms and are printed in gray.

SOILS

The soils of Franklin County represent a wide variation in color, natural drainage conditions, fertility, consistence, slope, and susceptibility to erosion. These characteristics are significant in determining soil productivity, and one or more of them are often limiting factors in the agricultural use of the various types and phases.

Soil types embodying different combinations of characteristics are often closely associated, a field unit often including a wide range of soil conditions. As this fact makes it difficult to apply individual systems of crop rotation, fertilization, and other soil improvements to the individual soils, more general methods of management are used.

The surface texture of the soils ranges from gravelly loam to silty clay loam, and the color from light gray in the poorly drained soils of the uplands and terraces to very dark brownish gray or nearly black in the depressional soils of the uplands and terraces and in the organic soils.

The color of the subsoil ranges from gray or mottled gray, yellow, and rust brown to dark gray, and the texture from friable sandy loam in the wind-deposited soils to heavy plastic silty clay loam in the dark depressional soils.

Natural drainage conditions range from very poor to excessive. Water erosion is potentially severe on soils having sloping to steep topography, and accelerated erosion is severe where clean-cultivated crops have been extensively grown without much thought for erosion control.

About 3 percent of the soils are dark-colored, with the surface soil relatively high in organic matter and the rest light-colored and relatively low in organic content.

The soils developed on Illinoian glacial drift and the associated terrace soils developed on old alluvium of silt and clay are strongly to very strongly acid. Those developed on Early Wisconsin glacial drift and on glaciofluvial outwash plains and terraces are in general medium acid to neutral.

The imperfectly and poorly drained soils of the Illinoian glacial drift regions, the poorly drained light-colored soils of the Early Wisconsin glacial drift regions, and the imperfectly drained soil of the old alluvial terraces have rather compact siltpans in the subsoil.

The distribution and association of the more extensive soils as well as their relative importance within geographic units are shown in figure 4. In each association the soil types and phases are listed in the order of their extent.

EXPLANATION OF FIGURE 4

Soil-association map of Franklin County, Ind., showing soil types and phases, in order of importance, in each association.

A, Cincinnati silt loam and its sloping, steep, and eroded phases, Rossmoyne, Edenton, and Avonburg silt loams.

B, Avonburg and Clermont silt loams.

C, Wilbur, Haymond, and Pekin silt loams.

D, Russell silt loam and its sloping, steep, and eroded phases, Fincastle and Cope silt loams, and Brookston silty clay loam.

E, Brookston silty clay loam, Fincastle, Cope, and Russell silt loams.

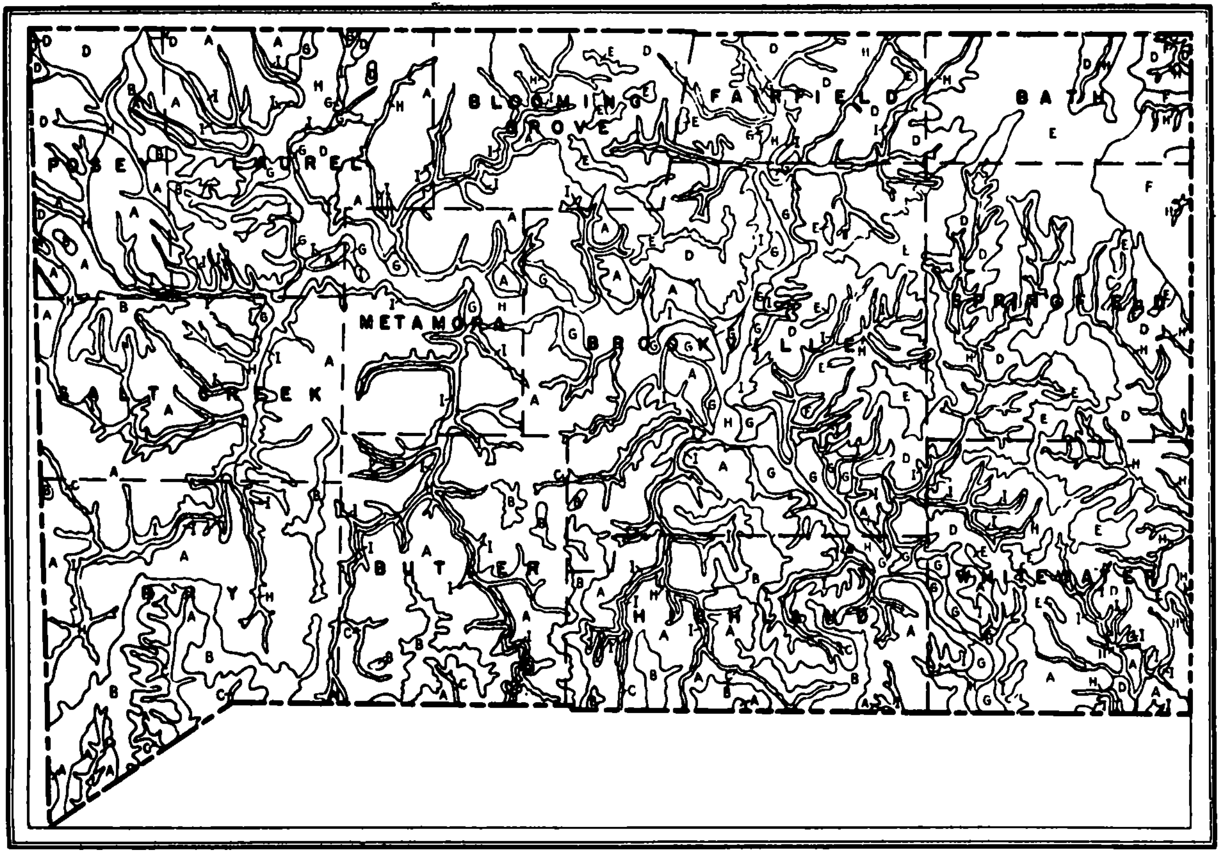
F, Wynn silt loam and gently sloping, sloping, steep, and eroded phases, Cope silt loam, and Brookston silty clay loam.

G, Fox silt loam, loam, fine sandy loam, and gravelly loam.

H, Genessee silt loam and loam, Eel silt loam, and Genesee fine sandy loam.

I, Fairmount silty clay loam, Cincinnati silt loam, steep and eroded steep phases, Hennepin clay loam, and Russell silt loam, steep and eroded steep phases.

FIGURE 4



Soil Association map; explanation on facing page.

TABLE 8.—*Key to the soils of Franklin County, Ind.*

[Major profiles (based on Indiana system of soil profile designation [1])]

Soil characteristics	Rendzinas	Gray-Brown Podzolic soils		Planosols and Semi-Planosols			Wiesenboden soils		
	VI	V	IV	III	II	I	VII	VIII	IX
Drainage	Rapid surface runoff	Good to excessive internal.	Good internal, good to excessive surface runoff.	Good to fair internal, good to slow surface runoff.	Imperfect internal, slow surface runoff.	Poor internal, very slow surface runoff.	Poor to very poor internal, very slow surface runoff to ponding.	Very poor internal, ponding.	Very poor internal, ponding.
Relief	Principally steep slopes.	Level to steep	Nearly level to steep	Nearly level to sloping	Nearly level to gently sloping.	Nearly level	Level to shallow depressions.	Level to shallow depressions.	Shallow to deep depressions.
Color:									
Surface soil	Very dark gray	Light yellowish brown	Light yellowish brown	Light yellowish brown to light brownish yellow	Light brownish gray.	Light gray to gray	Dark gray	Dark gray to very dark brownish gray.	Very dark gray to black.
Subsurface soil	Dark brownish gray to yellowish brown	Light yellowish brown to yellowish brown.	Light yellowish brown to yellowish brown.	Light brownish yellow	Brownish gray	do	do	Dark gray to dark brownish gray.	Very dark gray.
Upper subsoil	Olive yellow to yellow.	Yellowish brown to weak reddish brown.	Yellowish brown to brownish yellow.	do	Mottled gray, yellow, and rust brown.	Mottled light gray and yellow	Mottled gray, yellow, and rust brown.	Mottled gray, yellow, and rust brown.	Gray.
Lower subsoil	Olive yellow to yellowish gray.	do	do	Mottled gray, yellow, and rust brown.	do	Mottled gray, yellow, and rust brown.	do	do	Mottled gray, yellow, and rust brown.
Soils of the uplands:									
Parent material derived from—									
Early Wisconsin glacial drift (4 catenas).[2]	Hennepin		Russell	([3])	Fincastle	Delmar	Cope	Brookston	Clyde
								Washtenaw [4]	Washtenaw.[4]
		Bellefontaine							
			Wynn						
Illinoian glacial drift (2 catenas)			Cincinnati	Rossmoyne	Avonburg	Clermont			
			Edenton						
Ordovician and Silurian limestone	Fairmount								
Wind-deposited sand		Princeton							
Soils developed on glaciofluvial outwash plains and terraces:									
Parent material derived from—									
Calcareous stratified gravel and sand of Wisconsin age.		Fox						Westland	
Calcareous stratified silt and sand, with minor quantities of gravel and clay of Wisconsin age.			Martinsville						
Calcareous sand, silt, and gravel on high terraces.			Williamsburg						
Soils developed on alluvial terraces:									
Parent material derived from—									
Strongly acid stratified silt and clay			Elkinsville	Pekin	Bartle				
Alluvial soils.[5]									
Parent material derived from—									
Neutral to slightly alkaline alluvium from Early Wisconsin glacial drift regions (3 catenas).			Genesee	Eel					
			Hartman						
			Ross [6]						
Medium acid mixed alluvium from Illinoian glacial drift regions and Ordovician and Silurian limestone and calcareous shale.			Haymond	Wilbur					

[1] BUSHNELL, T. M. THE STORY OF INDIANA SOILS. Ind. Agri. Expt. Sta. Special Cir. 1, 52 pp., illus. 1944. (See p. 102, table 13, footnote 3.)

[2] Soil series entered in each line comprise a catena.

[3] Soils that key into many of the blank spaces have been mapped elsewhere in the State.

[4] Washtenaw soil consists of an accumulation of light-colored material over Brookston or Clyde soils; thus natural conditions are similar to these soils.

[5] The alluvial soils resemble those in the columns above them in color and drainage characteristics. They do not have well-defined horizons.

[6] Ross soils have dark-brown surface soils and upper subsoils.

SOIL SERIES AND THEIR RELATIONS

A key to the soil series of Franklin County is presented in table 8. The great soil groups follow the classification of soils as given in the Yearbook of Agriculture (Soils and Men) 1938.[5] The Roman numerals are based on the Indiana system of drainage-profile designation. Soil series listed in a horizontal line in the key are developed from similar parent material, differences in profile development being largely dependent on natural drainage conditions during their development. Such a grouping of soil series is called a soil catena. The soils listed under a given Roman numeral or drainage profile have similar natural drainage conditions, but differences in profile characteristics are due to the kinds of parent material on which they are developed.

Following the grouping of soils in the key, four main divisions are made of the soils of Franklin County: (1) Soils of the uplands; (2) soils developed on glaciofluvial outwash plains and terraces; (3) soils developed on alluvial terraces; and (4) alluvial soils.

SOILS OF THE UPLANDS

The soils of the uplands are grouped on the basis of the parent material into (1) soils developed on Early Wisconsin glacial drift, (2) soils developed on Illinoian glacial drift, (3) soils developed on Ordovician and Silurian limestone, and (4) soils developed on wind-deposited sand (pls. 1 and 2).

SOILS DEVELOPED ON EARLY WISCONSIN GLACIAL DRIFT

The soils developed on calcareous Early Wisconsin glacial drift include the Russell, Wynn, Bellefontaine, Hennepin, Fincastle, Delmar, Cope, Brookston, Washtenaw, and Clyde series. They occupy 31.7 percent of the area of the county, occurring on upland areas east and west of State Highway No. 1 and Whitewater River, with the exception of the larger part of the slopes, especially adjacent to the larger streams; a small area in the southeastern part; and small areas in the extreme northwestern part. As a group they are the most productive soils of the upland. The light-colored soils are medium to strongly acid and the dark-colored ones neutral to slightly acid. Free lime carbonates have been leached to an average depth of about 45 inches.

The well-drained Russell soils occur on nearly level to steep relief, and, except on the level phase, erosion is potentially severe. They have a light yellowish-brown smooth surface soil and yellowish-brown to brownish-yellow subsoil, underlain at an average depth of about 45 inches by gray and yellow calcareous glacial till.

The well-drained Wynn soils occur principally on nearly level relief, with small areas on gently undulating to steep relief. The surface and upper subsoil layers are similar to those of Russell silt loam, except that the reaction is usually somewhat less acid, and the lower subsoil, usually containing more grit and pebbles, is somewhat heavier

[5] BALDWIN, M., KELLOGG, C. E., and THORP, J. SOIL CLASSIFICATION. U. S. Dept. Agr. Yearbook (Soils and Men) 1938: 979–1001. 1938.

textured, and is usually underlain by calcareous glacial till at an average depth of about 36 inches. This, in turn, is underlain by limestone bedrock at an average depth of about 46 inches.

The well to excessively drained Bellefontaine soil occurs on undulating to sloping relief, often as kames and eskers. It has a grayish-brown to light yellowish-brown surface soil and yellowish-brown to weak reddish-brown subsoil, underlain at a depth of 36 to 45 inches by gray and yellow loose calcareous gravel and sand.

The well to excessively drained Hennepin soil occurs on very steep relief, and erosion is potentially severe. The 2- to 5-inch dark-gray to very dark-gray surface layer is underlain by calcareous glacial till.

The imperfectly drained light-colored Fincastle soils are developed principally on nearly level relief, with small areas on gently sloping relief. They have light brownish-gray to brownish-gray smooth surface and upper subsoil layers, relatively low in organic content. The mottled gray, yellow, and rust-brown lower subsoil is underlain by gray and yellow calcareous glacial till at an average depth of about 45 inches.

The poorly drained light-colored Delmar soil, occurring on nearly level relief, has a light-gray surface soil and a gray, mottled with yellow and rust-brown, subsoil, underlain at an average depth of about 45 inches by gray and yellow calcareous glacial till.

The moderately dark poorly to very poorly drained Cope soil occupies slight depressional areas and broad flats. It differs from the Brookston soil in the somewhat lighter color and lower organic content of the surface soil and upper subsoil.

The dark-colored very poorly drained Brookston soil, occupying slight depressional areas and rather broad flats, has a dark-gray to very dark brownish-gray surface soil and a mottled gray, yellow, and rust-brown subsoil, underlain at a depth of 40 to 60 inches by calcareous glacial till.

The Washtenaw soil consists of an accumulation of light-colored mineral wash from surrounding upland areas on Brookston and Clyde soils. The surface soil is light yellowish brown to brownish gray and the subsoil yellowish brown to brownish yellow, underlain by dark-gray to very dark-gray material similar to that of the normal surface layers of the above soils. The depth of the silted-in material varies from 10 to 36 inches. Natural drainage conditions are very poor.

EXPLANATION OF PLATE 1

Vertical aerial view of a part of Bath Township in the northeastern part of Franklin County, Ind.

A, Old Bath.
B, Bath.
C, Gently undulating to nearly level areas of Russell silt loam.
D, Cope silt loam (darker shaded areas).
E, Fincastle silt loam (lighter shaded areas).
F, Wooded areas, chiefly woodland pasture.
G, Cultivated fields not yet planted to corn or soybeans.
H, Fields in rotation pasture, permanent pasture, or small grain.
I, Farmstead.
J, Railroad.

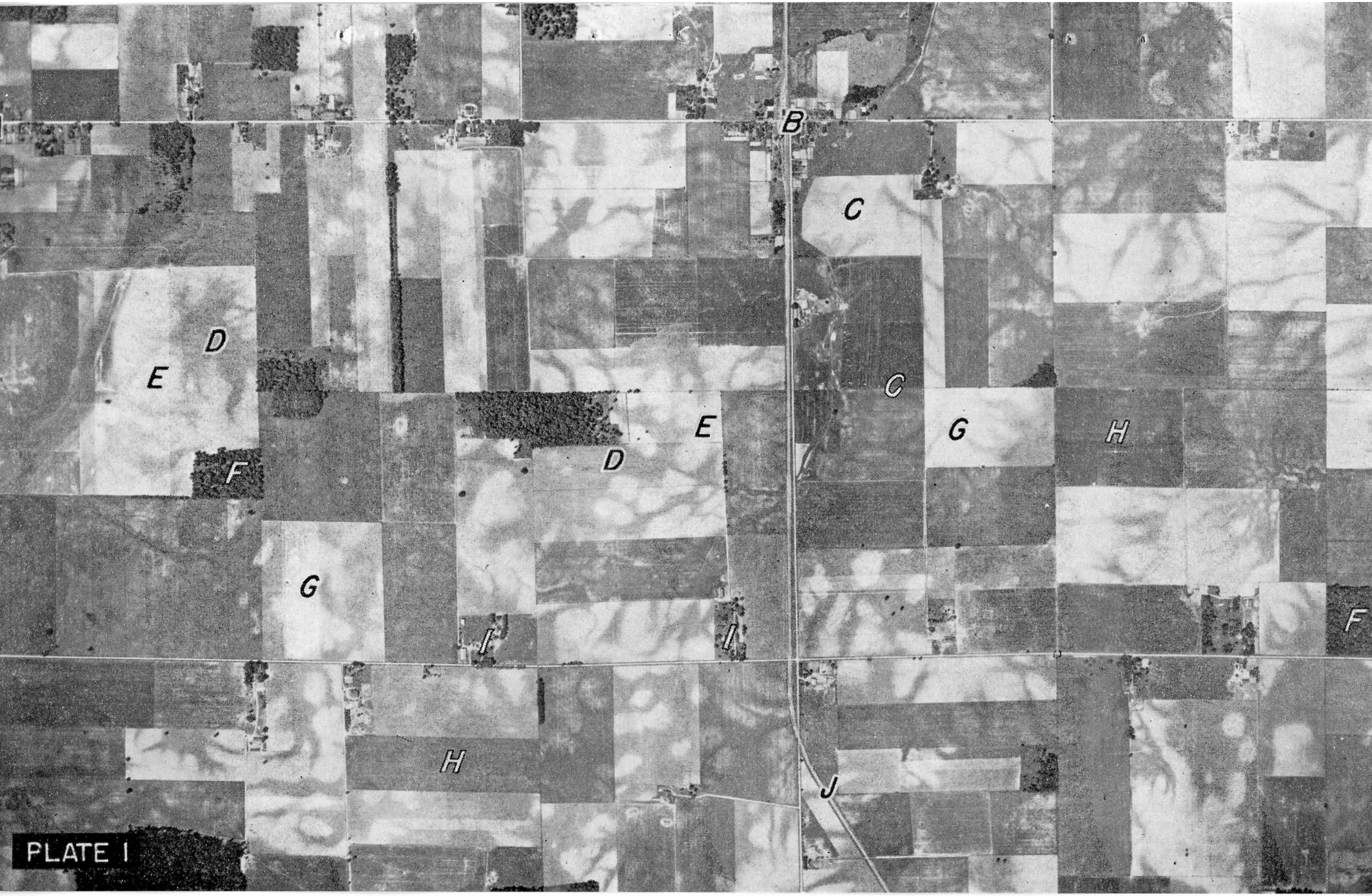


PLATE I

PLATE 2

The very dark colored very poorly drained Clyde soil, occupying the deeper depressional areas, has a very dark-gray to nearly black surface soil and upper subsoil to a depth of 16 to 18 inches, a gray subsoil, becoming mottled gray, yellow, and rust brown below a depth of 24 to 30 inches, and calcareous glacial till at a depth of 40 to 60 inches.

SOILS DEVELOPED ON ILLINOIAN GLACIAL DRIFT

The soils developed on calcareous Illinoian glacial drift include the Cincinnati, Edenton, Rossmoyne, Avonburg, and Clermont series. They occupy the upland areas west of a line drawn just west of State Highway No. 1, and west of the valley of the Whitewater River south of Brookville, except a small area in the extreme northwestern part of the county, a smaller area just east of the West Fork of Whitewater River near Laurel, and numerous slopes, especially adjacent to the valleys of the larger stream and drainageways, and also a small area in the southeastern part east of the Whitewater River. These soils, covering a total area of 42.4 percent of the county, are, in general, low in natural productivity, strong to very strongly acid, and leached of free lime carbonates to an average depth of about 120 inches (pls. 3 and 4).

The well-drained Cincinnati soils occur on undulating to steep relief, erosion is potentially severe, and the steep sloping areas are not suited to agriculture. The surface soil is grayish brown to light yellowish brown, the subsoil yellowish brown to brownish yellow, with a thin siltpan development at a depth of about 30 to 36 inches in some areas, and calcareous glacial till lies at a depth of about 120 inches.

The well-drained Edenton soils occur on sloping to steep relief. The surface and upper subsoil layers are similar to those of the Cincinnati soils, but the lower subsoil is somewhat heavier textured, calcareous till is usually absent, and bedrock of limestone and calcareous shale lies at a depth of 40 to 70 inches.

As the moderately well-drained Rossmoyne soils occupy gently undulating to nearly level relief, with small areas on sloping relief, erosion is not a serious problem, except on the sloping areas. They have grayish-brown to light brownish-yellow smooth surface soils; light brownish-yellow upper subsoils; and mottled gray, yellow, and rust-brown lower subsoils, with a siltpan development between depths of 30 and 40 inches; and at a depth of about 120 inches are underlain by calcareous glacial till.

EXPLANATION OF PLATE 2

Oblique aerial view about 2 miles northeast of Brookville, Franklin County, Ind.

A, Nearly level to sloping areas of Fincastle and Russell silt loams.
B, Wooded steep slopes of Fairmount silty clay loam.
C, Pastured gentle to steep slopes of Fairmount silty clay loam.
D, Alluvial flood plains of Genesee and Eel soils.
E, Nearly level glaciofluvial outwash terraces of Fox soils.
F, East Fork of Whitewater River, about 2 miles northeast of junction with the West Fork.
G, Nearly level to slightly depressional areas of Cope silt loam.

Developed principally on nearly level relief, with small areas on gently sloping relief, the imperfectly drained light-colored Avonburg soils are similar in natural drainage and relief to the Fincastle soils but differ in the deeper smooth grit-free subsoil, the strongly to very strongly acid surface soil and subsoil, and the depth of about 120 inches to calcareous glacial till.

The Clermont is a poorly drained light-colored soil that occupies the broader interstream flats. The relief is nearly level, and erosion is not a problem. Drainage is the first prerequisite for cropping. The smooth surface soil is light gray to gray; the smooth subsoil gray, mottled with yellow, with a heavy siltpan development at a depth of 28 to 36 inches; the somewhat friable lower subsoil layers contain some grit and pebbles in the lower part; and calcareous glacial till lies at an average depth of about 120 inches.

SOILS DEVELOPED ON ORDOVICIAN AND SILURIAN LIMESTONE

The Fairmount soils, developed on Ordovician and Silurian limestone and calcareous shale, occupy the sloping to very steep areas adjacent to the valleys of the rivers, streams, and small drainageways, principally those of the larger streams and rivers, covering a total of 12.8 percent of the area of the county.

These soils occur on sloping to very steep relief, and erosion is potentially severe. They have a very dark-gray surface soil; a dark-gray, dark brownish-gray, or olive-yellow heavy, plastic, upper subsoil; and underlying bedrock of limestone and calcareous shale at a depth of 12 to 25 inches. Varying quantities of limestone fragments are on the surface and throughout the profile.

SOILS DEVELOPED ON WIND-DEPOSITED SAND

Princeton fine sandy loam and its eroded phase, the only soils in the county developed on wind-deposited sand, occur on nearly level to rolling relief, often in dunelike areas. They are mapped in small isolated areas, principally along the bluffs of the valley of Whitewater River southeast of Brookville, and on the glaciofluvial terraces in the valley of the West Fork of Whitewater River south and east of Laurel. The surface soil is grayish brown to light yellowish brown and

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Explanation of Plate 3

Vertical aerial view of the southwestern part of Franklin County, Ind., in sections 14 and 15, and parts of 10, 11, 23, and 24, Ray Township.

A, Wooded area of Cincinnati silt loam, steep phase.

B, Eroded areas of Cincinnati silt loam on sloping and steep relief. Numerous short gullies appear in lighter shades.

C, Nearly level cultivated areas of imperfectly drained Avonburg silt loam. The parallel lines represent shallow surface drainage ditches or dead furrows.

D, Wooded areas of nearly level poorly drained Clermont silt loam.

E, Nearly level cultivated areas of Clermont silt loam. The closely spaced parallel lines are shallow surface drainage ditches or dead furrows.

F, The New York Central Railroad.

PLATE 3

PLATE 4

the subsoil yellowish brown to weak reddish brown, underlain by gray and yellow loose calcareous sand at a depth of 50 to 70 inches.

SOILS DEVELOPED ON GLACIOFLUVIAL OUTWASH PLAINS AND TERRACES

The soils developed on glaciofluvial outwash plains and terraces are grouped on the basis of the parent material into (1) soils developed on calcareous stratified gravel and sand, (2) soils developed on calcareous stratified silt and sand, with minor quantities of gravel and clay, and (3) soils developed on calcareous sand, silt, and gravel, on high terraces.

SOILS DEVELOPED ON CALCAREOUS STRATIFIED GRAVEL AND SAND

Soils developed on calcareous stratified gravel and sand include the Fox and Westland series. They occupy the terraces and outwash plains, principally as terraces in the valleys of the rivers and larger streams, comprising 2.2 percent of the county area (pls. 5 and 6).

As the well to excessively drained Fox soils occur principally on nearly level to gently undulating relief, with only a small total area on sloping relief, erosion is not a serious problem except on the sloping areas. The surface soil is light yellowish brown, the subsoil is yellowish-brown to weak reddish-brown waxy and gravelly material, and calcareous stratified gravel and sand lie at a depth of 30 to 60 inches.

The poorly to very poorly drained dark-colored Westland soil, occupying the slight depressions, old glacial drainageways, and broad flats of the terraces and outwash plains, is similar to the Brookston soil in natural drainage and relief but differs in having a waxy and gravelly clay loam subsoil that contains a considerable quantity of rounded pebbles and gravel, and in being underlain at a depth of 40 to 60 inches by loose stratified calcareous gravel and sand.

SOILS DEVELOPED ON CALCAREOUS STRATIFIED SILT AND SAND, WITH MINOR QUANTITIES OF GRAVEL AND CLAY

The soils developed on calcareous stratified silt and sand, with minor quantities of gravel and clay include the Martinsville series. They occupy about 1 percent of the area of the county, principally on terraces in the valleys of the larger streams and rivers and on the outwash plains in the eastern part. Although they are associated with and resemble somewhat the respective members of the Fox se-

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EXPLANATION OF PLATE 4

Vertical aerial view of the southwestern part of Salt Creek Township, Franklin County, Ind.

A, Relatively narrow alluvial flood plains of Genesee silt loam, adjacent to a small tributary of Salt Creek.

B, Sloping and steep areas of Cincinnati silt loam, showing in irregular-shaped white areas severe sheet and gully erosion.

C, Small areas of nearly level imperfectly drained Avonburg silt loam, showing parallel open surface drainage ditches.

D, Wooded area of Cincinnati silt loam, steep phase.

ries, the subsoil contains less gravel and rounded pebbles, and the underlying material consists predominantly of silt and sand instead of loose gravel and sand.

These well-drained soils occur principally on nearly level to undulating relief, with small areas on sloping relief, and erosion is not a problem. They have a grayish-brown to light yellowish-brown surface soil and a yellowish-brown to weak reddish-brown subsoil containing less rounded pebbles and gravel than that of the Fox soil and are underlain at a depth of 36 to 45 inches by material of predominantly calcareous stratified silt and sand.

SOILS DEVELOPED ON CALCAREOUS SAND, SILT, AND GRAVEL ON HIGH TERRACES

The soils developed on calcareous sand, silt, and gravel on high terraces are Williamsburg silt loam and its steep phase. They are often 50 feet or more above the level of the highest associated Fox soil, and the materials are older and have been exposed to soil-forming processes for a greater length of time. They are leached of free lime carbonates to an average depth of 10 to 12 feet.

These soils have a light yellowish-brown silt loam surface soil and a yellowish-brown to brownish-yellow subsoil, containing an increasing quantity of grit, sand, and gravel with depth, and are underlain at a depth of 10 to 12 feet by calcareous sand, silt, and gravel.

SOILS DEVELOPED ON ALLUVIAL TERRACES

The soils developed on alluvial terraces of the county include the Elkinsville, Pekin, and Bartle series. They are developed on strongly acid stratified silt and clay, with thin layers or lenses of fine sand in the lower substratum. They occupy about 1 percent of the county area in the valleys of the streams in regions of Illinoian glaciation, principally in the southwestern and south-central parts. They are light-colored, relatively low in organic content, and low in natural productivity.

The Elkinsville soils are well drained and occur principally on nearly level to undulating relief, with small areas on sloping relief. They have a grayish-brown to light yellowish-brown smooth surface soil and a yellowish-brown or brownish-yellow smooth subsoil, underlain by stratified silt and clay, with thin layers or lenses of fine sand. The entire profile is strongly to very strongly acid.

EXPLANATION OF PLATE 5

Vertical aerial view of sections 3, 4, 9, and 10, southeastern Brookville Township, Franklin County, Ind.

A, Whitewater River.
B, United States Highway No. 52.
C, Wooded sloping and steep areas of Fairmount silty clay loam on slopes between the upland and terraces and bottoms.
D, Beeson Branch of New York Central Railroad.
E, Alluvial flood plains of Genesee soils adjacent to the Whitewater River.
F, Glaciofluvial outwash terraces of Fox silt loam between flood plains and the upland.
G, Nearly level Avonburg and Clermont silt loams of the upland.


B
C
C
D
A
E
E
F
C
A
B
F
G
PLATE 5

PLATE 6

The Pekin soil is moderately well drained and occurs on nearly level to gently undulating relief. It has a grayish-brown to light brownish-yellow smooth surface soil; light brownish-yellow to pale-yellow smooth upper subsoil; mottled gray, yellow, and rust-brown lower subsoil, with a 12-inch siltpan development at a depth of about 30 inches; and a substratum of stratified silt and clay, with thin layers or lenses of fine sand. The entire profile is strongly to very strongly acid.

The imperfectly drained Bartle soil, occurring on nearly level relief, has a light brownish-gray or brownish-gray smooth surface soil; brownish-gray subsurface soil to a depth of about 10 to 12 inches; mottled gray, yellow, and rust-brown subsoil, with a 20- to 24-inch distinct siltpan development at a depth of about 30 inches; and a substratum of stratified silt and clay, with thin lenses or layers of fine sand. The entire profile is strongly to very strongly acid.

ALLUVIAL SOILS

The alluvial soils are grouped into (1) soils on neutral to slightly alkaline alluvium from Early Wisconsin glacial drift regions and (2) soils of medium acid mixed alluvium from Illinoian glacial drift regions and Ordovician and Silurian limestone and calcareous shale.

NEUTRAL TO SLIGHTLY ALKALINE ALLUVIAL SOILS

The soils on neutral to slightly alkaline alluvium from Early Wisconsin glacial drift regions include the Genesee, Hartman, Ross, and Eel series. They are all subject to overflow during periods of extremely high water and a large part is flooded on an average of at least once a year. They occupy 7.3 percent of the area of the county, the larger areas occurring in the flood plains of the Whitewater River and its two branches or forks, with smaller areas adjacent to the smaller streams and drainageways throughout the regions of Early Wisconsin glacial drift. This group of soils is, in general, very productive, but there is always danger to crops from floodwaters.

The well-drained Genesee soils, occurring on nearly level relief, have a grayish-brown to light yellowish-brown surface soil and a yellowish-brown to brownish-yellow subsoil. Below a depth of 36 inches the material is extremely variable in texture and composition.

The well to excessively drained Hartman soil occurs on nearly level relief. It has a grayish-brown to yellowish-brown surface soil and

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EXPLANATION OF PLATE 6

Oblique aerial view of central Franklin County, Ind., looking southeast.

A, Upland areas of Russell, Fincastle, and Cope silt loams and Brookston silty clay loam.
B, Alluvial flood plains of Genesee and Eel soils.
C, Glaciofluvial outwash terraces of Fox soils. Narrow wooded terrace border clearly shown in lower part.
D, Whitewater River.
E, Junction of the East and West Forks Whitewater River.
F, Brookville.
G, East Fork Whitewater River.
H, West Fork Whitewater River.
I, Slopes of Fairmount silty clay loam.

yellowish-brown to brownish-yellow subsoil. Boulders and gravel are numerous enough on the surface and throughout the profile to interfere seriously with cultivation.

The well-drained Ross soils differ from the Genesee in the darker color and higher organic content of the surface and subsurface layers.

The Eel soil is moderately well drained to imperfectly drained and occurs on nearly level relief or in slight depressions in temporary drainageways made by floodwaters. The surface soil is light grayish-brown to light yellowish brown, the upper subsoil is light brownish yellow, and the subsoil below a depth of 16 to 24 inches is mottled gray and yellow.

MEDIUM ACID ALLUVIAL SOILS

The soils on medium acid mixed alluvium from Illinoian glacial drift regions and Ordovician and Silurian limestone and calcareous shale include the Haymond and Wilbur series. They occupy about 1 percent of the area of the county, occurring adjacent to the small streams and drainageways in the regions of Illinoian glacial drift, principally in the southwestern and central-southern parts. Although medium to high in productivity, they are somewhat less productive than the soils on neutral to slightly alkaline alluvium.

The well-drained Haymond soil occurs on nearly level relief. It has a grayish-brown to light yellowish-brown surface soil and yellowish-brown to brownish-yellow subsoil. The surface and subsoil layers are medium acid.

The Wilbur soil is moderately well drained and occurs on nearly level relief. The surface soil is light grayish brown to light brownish yellow, and the subsoil is light brownish yellow to pale yellow to a depth of 16 to 24 inches, below which it becomes mottled gray, yellow, and rust brown. The entire profile is medium acid.

DESCRIPTIONS OF SOIL UNITS

In the following pages the soils of Franklin County are described in alphabetical order and their relation to agriculture discussed. Their location and distribution are shown on the accompanying map, and their acreage and proportionate extent are given in table 9.

TABLE 9.—*Acreage and proportionate extent of the soils mapped in Franklin County, Ind.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Avonburg silt loam	9,344	3.7	Clyde silty clay loam	64	(1)
Eroded gently sloping phase	64	(1)	Cope silt loam	4,800	1.9
Gently sloping phase	64	(1)	Delmar silt loam	128	.1
Bartle silt loam	64	(1)	Edenton silt loam	1,280	.5
Bellefontaine silt loam	64	(1)	Eroded phase	1,344	.5
Brookston silty clay loam	3,328	1.3	Eroded steep phase	576	.2
Cincinnati silt loam	18,880	7.5	Steep phase	256	.1
Eroded phase	960	.4	Eel silt loam	1,408	.5
Eroded sloping phase	34,624	13.7	Elkinsville silt loam	128	.1
Eroded steep phase	5,056	2.0	Sloping phase	64	(1)
Gullied sloping phase	3,840	1.5	Fairmount silty clay loam	17,088	6.7
Gullied steep phase	960	.4	Colluvial phase	896	.4
Sloping phase	15,360	6.1	Eroded phase	13,440	5.3
Steep phase	6,464	2.5	Severely eroded phase	512	.2
Clermont silt loam	2,944	1.2	Very steep phase	384	.2

[1] Less than 0.1 percent.

TABLE 9.—*Acreage and proportionate extent of the soils mapped in Franklin County, Ind.*—Continued

Soil type	Acres	Percent	Soil type	Acres	Percent
Fincastle silt loam	16,384	6.5	Rossmoyne silt loam	4,288	1.7
Gently sloping phase	64	([1])	Eroded phase	192	.1
Shallow phase	896	.4	Eroded sloping phase	384	2
Fox fine sandy loam	128	.1	Sloping phase	192	.1
Fox gravelly loam	832	.3	Rough gullied land (Cincinnati soil material)	2,624	1.0
Fox loam	256	.1	Russell silt loam	19,840	7.8
Eroded sloping phase	192	.1	Eroded phase	11,776	4.6
Sloping phase	128	.1	Eroded sloping phase	3,712	1.5
Fox silt loam	3,584	1.4	Eroded steep phase	3,072	1.2
Eroded phase	128	.1	Level phase	512	2
Genesee fine sandy loam	1,792	.7	Severely eroded sloping phase	4,992	2.0
High-bottom phase	192	.1	Sloping phase	2,112	.8
Genesee loam	2,368	.9	Steep phase	1,600	.6
High-bottom phase	384	.2	Stony and gravelly alluvium	1,984	8
Genesee silt loam	10,304	4.1	Washtenaw silt loam	64	([1])
High-bottom phase	960	.4	Westland silty clay loam	64	([1])
Shallow phase	320	1	Wilbur silt loam	1,216	.5
Hartman gravelly stony loam	64	([1])	Williamsburg silt loam	192	1
Haymond silt loam	320	.1	Steep phase	256	.1
Hennepin clay loam	128	.1	Wynn silt loam	1,664	.6
Martinsville loam	128	1	Eroded gently sloping phase	1,920	.7
Martinsville silt loam	1,152	.4	Eroded sloping phase	384	.2
Eroded sloping phase	320	1	Eroded steep phase	384	.2
Pekin silt loam	64	([1])	Gently sloping phase	256	.1
Princeton fine sandy loam	64	([1])	Severely eroded sloping phase	1,792	.7
Eroded phase	128	.1	Sloping phase	320	.1
Riverwash	448	2	Steep phase	192	.1
Ross silty clay loam	256	.1			
High-bottom phase	448	.2	Total	252,800	100.0

[1] Less than 0.1 percent.

Avonburg silt loam.—This is an imperfectly drained member of the soil catena that also includes the Cincinnati, Rossmoyne, and Clermont series. It is developed on Illinoian glacial drift.

A total of 9,344 acres is mapped, the larger areas in Ray, southern Butler, and Highland Townships. It occupies the interstream flats intermediate between the Rossmoyne or Cincinnati soils and Clermont silt loam. It forms a large part of region *B*, as shown in figure 4, the soil association map of the county. As the relief is nearly level, usually less than 2 percent, erosion is unimportant. Surface drainage is slow and internal drainage imperfect. The native vegetation consists chiefly of white and pin oaks, sweetgum, and sour gum, with smaller quantities of beech, maple, and elm.

The following is a profile description in cultivated areas:

0 to 7 inches, light brownish-gray to brownish-gray friable smooth fine- to medium-granular silt loam, relatively low in organic content. (In undisturbed wooded areas the surface 2 to 3 inches is dark brownish gray and relatively high in organic content.) Crawfish mounds are numerous on the surface, and numerous crawfish casts of gray silty material extend through this layer into that below. Reaction, strongly to very strongly acid.

7 to 10 inches, light brownish-gray to brownish-gray friable coarse-granular heavy silt loam to silty clay loam, with an occasional light-yellow mottling. This layer is permeable to moisture movement and plant roots Reaction, strongly to very strongly acid.

10 to 30 inches, mottled gray, yellow, and rust-brown smooth silty clay loam, breaking into ¼- to ½-inch subangular aggregates that are firm but not hard when moist, are rather distinctly developed, and separate easily when disturbed. A few small rust-brown iron concretions are present. Reaction, strongly to very strongly acid.

30 to 50 inches, mottled gray, yellow, and rust-brown compact silty clay loam, breaking into columns having a vertical length three or four times that of the horizontal and usually a 2- or 3-inch capping of light-gray silty material. It is impermeable to moisture movements and plant roots. Reaction, strongly to very strongly acid.

50 to 120 inches, mottled gray, yellow, and rust-brown silty clay loam that is more friable than the above layer and breaks into subangular pieces that are easily broken down into coarse granules when moist. A small quantity of grit, pebbles, and rock fragments is in the upper part, increasing with depth. Reaction, strongly acid in the upper part and only slightly acid in the lower.

120 inches +, gray and yellow compact calcareous glacial till composed of unassorted silt, clay, sand, and rock fragments. This represents the parent soil material.

Variations in the profile characteristics are in texture and thickness of layers (except the texture of the surface layer) and in depth to calcareous till. The depth to and thickness of the heavy siltpan layer is variable within short distances.

The common rotation of crops includes corn, wheat or rye, and a clover or timothy mixture or timothy alone. Where this soil forms a part of a field unit that also includes the Rossmoyne and Cincinnati soils, it is cropped about the same as the associated soils. Where field units are composed entirely or largely of it, the rotation probably includes a somewhat higher percentage of soybeans and corn. In order to obtain better crop yields it is essential that adequate artificial drainage be installed. This is accomplished by the installation of tile drains about 2 rods apart, or by the use of dead furrows 1 to 2 rods apart. The furrows act as shallow open ditches or drainageways that collect the excessive surface water and in some cases divert it to the drainageways.

Corn, probably the most important crop grown, usually follows hay in the rotation. The quantity and analysis of commercial fertilizer applied under corn are extremely variable but usually range from 50 to 100 pounds an acre. Corn yields of 25 to 30 bushels an acre under present management practices can be increased to 45 or 50 bushels by installing adequate artificial drainage and using liberal quantities of commercial fertilizer.

Wheat, probably the second most important crop, usually follows corn and soybeans in the rotation. A rather general practice is to apply 100 to 200 pounds of commercial fertilizer an acre under wheat, which yields 12 to 15 bushels an acre. Rye occasionally takes the place of wheat in the rotation, yields averaging about 12 bushels an acre with the use of very little, if any, fertilizer. The soil is not well adapted to growing oats, and only a few small areas are used for them.

Hay crops include either a mixture of timothy and clover, with some lespedeza and redtop, or timothy or clover grown alone. If clover is to be grown successfully, it is essential to install adequate artificial drainage and apply sufficient lime to the soil to correct acidity. Clover is sometimes seriously damaged by heaving of the plants and may be occasionally drowned out.

Avonburg silt loam, eroded gently sloping phase.—Accelerated erosion has removed over 25 percent of the surface soil of this phase, which occurs on slopes of 2 to 8 percent. It is very inextensive, occupying only 64 acres in small isolated areas in the southwestern part of the county, usually in association with the gently sloping phase.

Depending on the degree of erosion, the 6- or 7-inch surface layer varies from light brownish-gray smooth friable silt loam to brownish-gray or mottled gray, yellow, and rust-brown slightly plastic silty clay loam. The rest of the profile is essentially the same as that of the type, and the crops grown are about the same as on that soil, but yields are usually less. Both organic content and fertility level are low and tilth conditions are poor.

Avonburg silt loam, gently sloping phase.—Very little or no appreciable accelerated erosion has developed on this phase, which occurs on slopes of 2 to 8 percent on the broad upland areas in Highland Township in the south-central part of the county, principally adjacent to drainageways that have developed since the areas were cleared of timber, usually between areas of the Rossmoyne or Cincinnati soils and Avonburg silt loam. Only 64 acres are mapped. The profile characteristics are essentially the same as those of the type, but this phase is somewhat susceptible to injury from accelerated erosion because of the gently sloping relief. Crops grown and yields obtained are about the same as on the type.

Bartle silt loam.—Developed on acid alluvial terraces, this light-colored soil is the imperfectly drained member of the catena that also includes the Elkinsville and Pekin series. A total of only 64 acres occurs in rather small isolated areas closely associated with Elkinsville and Pekin silt loams, principally along Little Laughery Creek, Ray Township. It is usually only a few feet above the alluvial overflow bottoms. Artificial drainage is necessary for successful cropping, as both internal and external drainage conditions are imperfect. This is accomplished with tile drains or by the use of dead furrows or shallow open ditches.

Following is a profile description in cultivated areas:

0 to 7 inches, light brownish-gray to brownish-gray smooth friable medium-granular silt loam, low in organic content. Reaction, strongly to very strongly acid.

7 to 12 inches, brownish-gray smooth friable heavy silt loam with faint yellow mottlings in the lower part. The material breaks out into small subangular aggregates that can be easily broken down into coarse granules. Reaction, strongly to very strongly acid.

12 to 30 inches, mottled gray, yellow, and rust-brown smooth silty clay loam, breaking into ¼- to ½-inch subangular aggregates. It is free of grit and pebbles. Reaction, strongly to very strongly acid.

30 inches +, highly mottled and blotched gray, yellow, and rust-brown silty clay loam containing thin lenses or layers of very fine sand. Reaction, strongly acid.

Variations in the profile characteristics are in texture and thickness of the layers, except the texture of the surface layer.

The crop rotation in use is about the same as that on the associated Elkinsville and Pekin soils. It is very important that this soil be artificially drained sufficiently to allow cropping. The soil is naturally low in organic matter and plant nutrients, and the reaction is such that applications of 3 to 5 tons of lime an acre are necessary to neutralize the acidity.

Corn usually follows hay in the rotation, yielding about 30 bushels an acre under present management practices. Wheat usually follows corn or soybeans, yielding 12 to 15 bushels an acre. As this soil is not well adapted to growing oats, only a small acreage is used for this crop. Hay crops include either clover or timothy alone or a mixture of these.

The soil is usually cold and wet in spring, and the planting of spring-sown crops is occasionally delayed to such an extent that crop yields are materially reduced. Wheat and other small grains are occasionally drowned out, and both small grains and clover are occasionally severely damaged by heaving.

Bellefontaine silt loam.—Developed on Early Wisconsin glacial drift, this soil is associated principally with Russell silt loam but, unlike that soil, is characterized by a substratum of calcareous gravel and sand at a depth of 3 or 4 feet. It occurs on knolls and kames in the regions of Early Wisconsin glaciation, principally along the valley of the East Fork of Whitewater River in the northern part of the county. A total of only 64 acres is mapped.

Both internal and external drainage conditions are good to excessive. Its position on knolls and ridges, usually at a higher elevation than the surrounding areas, encourages rapid surface runoff. The porous nature of the underlying material contributed to the somewhat excessive internal drainage. Native vegetation consisted chiefly of white and red oaks and hickory, with some walnut, maple, elm, and other associated species.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown smooth friable medium-granular silt loam, relatively low in organic content. (In undisturbed wooded areas the surface 2 or 3 inches is dark yellowish brown to brownish gray and relatively high in organic content.) Reaction, medium acid.

7 to 12 inches, yellowish-brown to brownish-yellow friable heavy silt loam to silty clay loam that is coarse granular in structure. Reaction, medium acid.

12 to 18 inches, brownish-yellow silty clay loam, breaking into ½- to ¾-inch subangular aggregates. Reaction, medium to strongly acid.

18 to 40 inches, yellowish-brown to weak reddish-brown waxy and gravelly clay loam, breaking into irregular-sized angular pieces. This material is plastic when moist and hard when dry. Reaction, medium acid.

40 to 45 inches, dark yellowish-brown waxy and gravelly clay loam, breaking into irregular-sized pieces. There is an abrupt change from the above layer to this material, and tongues or lenses of this layer extend into the underlying material. Reaction, neutral to slightly acid.

45 inches +, gray and yellow loose stratified calcareous gravel and sand. Cross bedding is usually prominent.

Variations in the profile characteristics are in texture and thickness of the layers and in depth to calcareous gravel and sand. The subsoil in areas mapped about 1½ miles southeast of Fairfield east of the East Fork of Whitewater River is not so waxy or gravelly as normal but is more like the subsoil of Russell silt loam, and the depth to loose gravel and sand is somewhat greater. Areas mapped in the southwestern part of Springfield Township and in the northeastern part of Whitewater Township do not have the typical waxy subsoil, but the depth to calcareous gravel and sand is normal. Small isolated areas having moderately accelerated sheet erosion are included with this soil. Here a part of the normal surface soil has been removed, and the present 6- to 8-inch surface layer includes a part of the normal subsoil. In these included areas the organic content is very low and tilth conditions are poor.

Management practices and crops grown on this soil are similar to those on the associated Russell silt loam, which include the common rotation of corn, wheat, and hay. The larger cultivated areas usually have a somewhat general cropping system that includes corn, wheat, and alfalfa.

Corn usually follows hay in the rotation, yielding 25 to 35 bushels an acre under present management practices. It is not so well adapted to this soil as to Russell silt loam, because of the droughty nature of the substratum, and in seasons of abnormally low moisture conditions yields are low. Wheat usually follows corn, yielding 12 to 20 bushels an acre. Commercial fertilizer at the rate of 100 to 150 pounds or more an acre is commonly used under wheat, and some barnyard manure is used as a top dressing, although this is not a common practice. Owing to low moisture conditions during the growing season, this soil is not adapted to growing oats, and rather low yields are obtained. Alfalfa is well adapted, good stands being obtained after the application of sufficient lime to the soil (1 to 3 tons an acre). Clover and other hay crops are not so well adapted as is alfalfa.

A good rotation system for this soil is a 4- to 5-year rotation of corn, wheat, and 2 to 3 years of alfalfa, which will aid in maintaining and increasing the organic and nitrogen content and help control erosion. Manure and other organic matter should be applied when available and sufficient commercial fertilizer used under corn and wheat to allow a surplus for the alfalfa.

A few small forest areas that occur on slopes of 12 to about 30 percent are included with Bellefontaine silt loam on the soil map. With the exception of the somewhat thinner layers and less depth to loose calcareous gravel and sand, the profile characteristics of this inclusion are essentially the same as those of the type. Also included are several small areas on 12- to 30-percent slopes on which 25 percent or more of the surface soil or all of it and part of the subsoil have been removed by accelerated erosion. In these areas the surface soil is variable and includes part of the original subsoil, the organic content is extremely low, and tilth conditions are poor. Areas of this inclusion have been cleared of timber and at present are either in permanent bluegrass pasture or have a cover of poverty grass, quackgrass, and briers. A few small areas having a slope of over 30 percent are also included, the larger of which occur adjacent to the valley of the East Fork of Whitewater River in the northern part of the county.

Brookston silty clay loam.—This dark-colored very poorly drained soil occupies the slight depressional areas and rather extensive flats in the regions of Early Wisconsin glacial drift, often occurring in close association with the Cope and Fincastle soils and also at the breaks of small drainageways in association with Russell and Wynn silt loams. A total of 3,328 acres is mapped.

Both internal and external drainage conditions are naturally poor, but most areas have been artificially drained sufficiently to permit cropping. Native vegetation consisted of water-tolerant trees, chiefly maple, elm, ash, and gum, and marsh grasses.

Following is a profile description in cultivated areas:

0 to 7 inches, dark-gray to very dark brownish-gray silty clay loam, relatively high in organic content. Reaction, neutral to slightly acid.

7 to 14 inches, dark-gray silty clay loam to clay loam, with some light-yellow or rust-brown mottlings in the lower part of the horizon. The

organic content is relatively high. The material breaks out into irregular-sized angular pieces that are hard when dry but easily broken down when moist. Roots have no difficulty in penetrating this layer. Reaction, neutral.

14 to 48 inches, mottled gray, yellow, and rust-brown plastic gritty clay loam to sandy clay, containing an occasional boulder and various-sized rock fragments. It breaks into large angular pieces that become hard when dry. Reaction, neutral.

48 inches +, mottled gray, yellow, and rust-brown clay loam to sandy clay calcareous glacial till, composed of unassorted silt, clay, sand, and rock fragments. This represents the parent soil material.

Variations in the profile characteristics are in the texture and thickness of the layers and in the depth to calcareous till. A few small areas in the southeastern part of Bath and northeastern part of Springfield Townships, associated with Wynn silt loam and the shallow phase of Fincastle silt loam, are underlain by limestone bedrock at a depth of 50 to 80 inches.

The greater part of this type is cleared of forest and either under cultivation or in permanent bluegrass pasture. Because of its occurrence in close association with the light-colored soils of the Early Wisconsin glacial drift region and with Cope silt loam, management practices and rotations are essentially the same as on those soils. The common rotation is one that includes corn, wheat or oats, and hay, with an occasional crop of soybeans and other field crops. Where this soil makes up a large part or all of a field unit, the rotation system may be altered to include corn, soybeans, wheat or oats, and 1 year or more of alfalfa. Corn is occasionally grown for two or more consecutive years on these areas. Although the fertilizer requirement and plant-nutrient content are somewhat different than on the associated soils, it is very difficult to treat an area of this soil in a different manner unless it constitutes a large part of a field unit.

Although corn usually follows hay in the rotation, it may follow soybeans or be grown where fall-sown small grains have failed. It is commonly fertilized with 50 to 150 pounds or more of fertilizer an acre. Under present management practices corn yields 50 to 55 bushels an acre, but under better practices and with favorable weather conditions yields of 60 bushels or more are not uncommon.

Wheat yields range from 15 to 25 bushels an acre, but there is some damage to wheat and other fall-sown small grains from heaving. It is a common practice to use 100 to 150 pounds of commercial fertilizer an acre under wheat. Very little fertilizer is used under oats, yields of which vary from 20 to 50 bushels an acre, often depending largely on weather conditions during the growing season. Because of the high nitrogen and organic content of the soil some damage also results from lodging of the grain.

This soil is very well adapted to growing soybeans, which yield 20 to 30 bushels an acre, with higher yields not uncommon. They are grown for both grain and hay, but the recent increase in soybean acreage has been largely for grain. Excellent stands of both alfalfa and clover can be secured without the use of lime, and hay yields are usually high. There is, however, some damage from winterkilling. Many farmers grow a mixture of alfalfa, clover, alsike, and timothy. Special crops, as sweet corn and tomatoes, are well suited to this soil but only a small acreage is grown.

Cincinnati silt loam.—This well-drained soil is similar to Russell silt loam in natural drainage conditions but differs in the high acidity of the surface soil and subsoil and in the greater depth to calcareous till. It occurs in association with soils developed on the Illinoian glacial drift, and Fairmount silty clay loam often occurs on the adjacent steep areas. A total of 18,880 acres is mapped. It is one of the dominant soils in region *A* (fig. 4). The relief ranges from 2 to 8 percent, and very little if any appreciable accelerated erosion occurs. Surface drainage is good and runoff excessive on the more sloping areas. The soil has developed under a cover of deciduous trees, including red, black, and white oaks, hickory, and maple, with some tuliptree (locally called tulip poplar or yellow-poplar), ash, elm, and other associated species.

Following is a profile description in cultivated areas:

0 to 7 inches, light yellowish-brown smooth friable silt loam, composed of firm but not hard medium-sized granules. The organic content is relatively low. (In undisturbed wooded areas the surface 2 to 3 inches is dark yellowish brown to dark brownish gray and relatively high in organic content.) Reaction, strongly to very strongly acid.

7 to 12 inches, yellowish-brown to brownish-yellow friable coarse-granular heavy silt loam to silty clay loam, breaking into coarse granules that are easily crushed when moist and hard when dry. This layer is permeable to moisture movements and plant roots Reaction, strongly to very strongly acid.

12 to 20 inches, yellowish-brown to brownish-yellow silty clay loam, breaking into ¼- to ¾-inch subangular aggregates. There is a thin coating of gray colloidal material on many of the cleavage faces. This layer is permeable to moisture movement and plant roots. Reaction, strongly to very strongly acid.

20 to 40 inches, brownish-yellow silty clay loam, breaking into ¾- to 1½-inch subangular aggregates that are easily broken down when moist and hard when dry. The material is permeable to moisture movement and plant roots. A few pebbles of quartz and other exotic rocks are present in the lower part of this layer. Some areas have a rather compact layer about 12 inches thick, occurring at a depth of 30 to 36 inches. When this layer is present the material is somewhat impermeable to moisture movement and plant roots. Reaction, strongly acid.

40 to 120 inches, brownish-yellow (with streaks of light yellow, gray, and rust brown in the lower part) silty clay loam, somewhat more friable than the above layer and breaking into subangular aggregates that are easily broken down into coarse granules. Pebbles and rock fragments are numerous in the lower part. Reaction, strongly acid in the upper part and slightly acid in the lower.

120 inches +, gray and yellow compact glacial till, composed of unassorted silt, clay, sand, and rock fragments.

Variations from the above profile characteristics are in the texture and thickness of the layers and the depth of calcareous till. Some areas in the central-western and southwestern parts of the county, having a heavier and more plastic lower subsoil and heavier textured calcareous till than normal, are so intimately associated with areas having a normal profile that separation is infeasible.

The rotation practiced includes corn, wheat or rye, and hay, with an occasional crop of soybeans, tobacco, barley, oats, and vegetables. As this soil is normally low in organic content and plant nutrients, constant replenishment is necessary to maintain and improve productivity. This is best accomplished by the liberal use of barnyard manure, plowing under of all available crop residue, liming to correct acidity, and by the liberal use of commercial fertilizer. In order to preserve the valuable surface soil and prevent loss of plant nutrients by accelerated erosion, clean-cultivated crops should not occur too often in the rotation system—probably not more than once every 4 or 5 years—and a cover crop should always be present during winter and spring.

Under current management practices, including the use of some barnyard manure and some commercial fertilizer, corn yields 25 to 35 bushels an acre. These yields can be increased to 45 bushels or more under the better practices. The use of commercial fertilizer under corn is rather general in the southwestern part of the county but somewhat limited in other parts.

Wheat, probably the second most important crop grown, usually follows corn in the rotation. A larger percentage of farmers use commercial fertilizer with wheat than with any other crop grown on this soil. The quantity and analyses commonly used are 50 to 150 pounds or more an acre of 2–12–6.[6] Wheat yields vary considerably, probably averaging 12 to 15 bushels an acre under present management practices. Rye occasionally takes the place of wheat in the rotation, and some farmers turn it under in spring before planting corn. Acre yields average 10 to 15 bushels with the use of very little commercial fertilizer. Oats, not well adapted to this soil, are very inextensively grown and are rarely fertilized. They yield 20 to 30 bushels an acre.

Hay crops include a mixture of timothy and clover with some redtop and lespedeza, also some clover or timothy alone. Because of the strong acidity of the surface soil and subsoil, good stands of clover are difficult to maintain without the liberal use of lime in some form.[7] In recent years a large quantity of ground limestone has been applied to this soil, and very good crops of clover have been obtained. Only two or three small areas of alfalfa were observed on this soil during the mapping season (1938). Owing to the high acidity of the surface soil and subsoil, it is doubtful whether alfalfa can be successfully grown over a period of years. A few small areas are seeded to lespedeza and fair to good stands obtained. Because of its tolerance to high acidity, it should become more popular and more generally used on this and the associated strongly acid soils.

Included with this type on the soil map are a few small areas of Parke silt loam, which would have been mapped separately if the total extent had been larger. These areas occur in the central part of section 23, Laurel Township, adjacent to Federal Highway No. 52. Surface runoff is good to excessive, and internal drainage is somewhat excessive, owing to the presence of the loose sand and gravel substratum. In undisturbed wooded areas this inclusion has the following profile characteristics:

0 to 3 inches, dark yellowish-brown smooth friable silt loam, relatively high in organic content and having a thin accumulated layer of partly decayed leaves and other forest litter. Reaction, medium to strongly acid.

3 to 7 inches, yellowish-brown friable silt loam, relatively low in organic content. It breaks into medium-sized firm but not hard granular aggregates. Reaction, medium to strongly acid. When cultivated, this and the above layer are mixed together, resulting in a light yellowish-brown friable silt loam surface soil, relatively low in organic content.

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

[7] Lime recommendations for the various soils are given in table 12 and the sections on Estimated Yields and Productivity Ratings and Management of the Soils of Franklin County.

7 to 12 inches, yellowish-brown to brownish-yellow coarse-granular heavy silt loam to silty clay loam. Reaction, strongly to very strongly acid.
12 to 18 inches, yellowish-brown to brownish-yellow silty clay loam, breaking into ⅛- to ¾-inch subangular aggregates. Reaction, strongly to very strongly acid.
18 to 35 inches, brownish-yellow heavy silty clay loam, breaking into ¾- to 1½-inch subangular aggregates. It is plastic and sticky when moist and hard when dry. Reaction, strongly to very strongly acid.
35 to 55 inches, brownish-yellow or weak reddish-brown gritty silty clay loam, breaking into small angular aggregates that are waxy and plastic when moist and hard when dry. The quantity of sand and gravel increases with depth in this layer and numerous rust-brown to nearly black blotches and spots are present. Reaction, strongly acid.
55 inches +, weak reddish-brown or brownish-yellow stratified sand, with a small quantity of gravel. Enough clay and silt are present to make the material slightly cohesive. Reaction, medium to strongly acid.

Variations in the profile characteristics of Parke silt loam are in the texture and thickness of the layers. This inclusion is at present under a forest cover. Where it is cropped in other areas of the State, the cropping system usually includes corn, wheat, and a mixture of clover and timothy. It is somewhat droughty and low in organic content and occurs on a relief that subjects cultivated areas to potential damage from accelerated erosion.

Cincinnati silt loam, eroded phase.—This phase occurs in association with the other phases of Cincinnati silt loam in the regions of Illinoian glaciation, as shown in the soil association map (fig. 4). A total of 960 acres is mapped. It occupies slopes of 2 to 8 percent, and more than 25 percent of the surface soil and part of the subsoil have been removed from a large part of the areas by accelerated erosion.

Depending upon the degree of accelerated erosion, the 6- or 7-inch surface layer varies from light yellowish-brown smooth friable silt loam to yellowish-brown or brownish-yellow heavy silt loam to light silty clay loam. A few small gullies or rills only a few inches deep are present on numerous areas, but they are neither deep nor extensive enough to interfere with cultivation. The rest of the profile is similar to that of the type.

Tilth conditions are poor and organic-matter content is extremely low. The presence of the heavier textured subsoil in the plow soil, or 6-inch surface layer, encourages accelerated erosion and materially reduces crop yields. A large part of the phase is cultivated to crops common to this area, including corn, wheat, and mixed hay, but yields are substantially lower than on the type. A few areas are idle and sustain growths of broomsedge, poverty grass, briers, and sassafras.

Included with this phase are a few small areas of Parke silt loam, eroded phase, which would have been shown separately if the total extent had been greater. These included areas occur on slopes of 3 to 25 percent, in sections 10 and 15, Ray Township, along the west county line, and 25 percent or more of the surface soil has been removed by accelerated erosion.

Depending upon the degree of accelerated erosion, the 6- or 7-inch surface layer varies from light yellowish-brown friable silt loam to brownish-yellow or yellowish-brown silty clay loam. Tilth conditions are poor and the organic content and fertility level low. The rest of the profile is similar to that of the normal type. The cropping system is similar to that on the associated Cincinnati soils and includes principally corn, wheat, and timothy or clover. Because of the droughty nature of this soil crops suffer somewhat in periods of drought, and crop yields are somewhat lower than on the eroded phase of Cincinnati silt loam.

Cincinnati silt loam, eroded sloping phase.—Occurring on 8- to 25-percent slopes, this soil has lost 25 percent or more of the surface soil and part of the subsoil from a large part of the areas by accelerated erosion. The total area mapped is 34,624 acres. This phase has all been cleared and cultivated, but at present a large part is abandoned and allowed to remain idle, with the result that erosion has proceeded unabated. These areas support a growth of broomsedge, briers, sumac, and sassafras, with a little bluegrass.

The 6- or 7-inch surface layer is extremely variable, depending on the degree of accelerated erosion. It varies from light yellowish-brown smooth friable silt loam to yellowish-brown or brownish-yellow heavy silt loam to silty clay loam, extremely low in organic content. Tilth conditions are poor, and the fertility level is low. A few small gullies a few inches deep are present on numerous areas, but they are neither deep nor extensive enough to interfere with cultivation. The rest of the profile is similar to that of Cincinnati silt loam, except that the subsoil layers are somewhat thinner.

The cultivated areas of this phase are used for about the same crops as the type—corn, wheat or rye, and a hay mixture that includes timothy, redtop, and clover. Crop yields are somewhat variable but materially lower than on that soil. Special care is essential on this phase in order to arrest erosion and maintain and improve fertility and crop yields.

Cincinnati silt loam, eroded steep phase.—By accelerated erosion this phase has lost more than 25 percent of the surface soil and part of the subsoil. It occupies a total of 5,056 acres, on slopes greater than 25 percent in small isolated areas associated with the steep and other phases of the type. Depending on the degree of accelerated erosion, the 6-inch surface layer varies from light yellowish-brown smooth friable silt loam to yellowish-brown or brownish-yellow heavy silt loam to silty clay loam, extremely low in organic content. The rest of the profile is similar to that of the normal type, except that the subsoil layer is considerably thinner and the depth to calcareous till is less.

Although all this phase had been brought under cultivation in the past, only a few small areas are cultivated at present and crop yields are extremely low. The greater part of it is abandoned for agricultural use and supports a growth of broomsedge, poverty grass, briers, and various weeds, with scattered patches of sumac and sassafras. This phase is too steep for cropping to the general farm crops, and its best use is for forest or permanent pasture. To establish good pastures, it is necessary to apply sufficient lime (3 to 4 tons an acre) to this soil, together with sufficient plant nutrients in the form of commercial fertilizer.

Cincinnati silt loam, gullied sloping phase.—Under present economic conditions this soil is nonagricultural and probably it should be reforested. It occurs on slopes of 8 to 25 percent. Gullies more than 3 feet deep are numerous over a large part of the area, and the intergully areas have lost more than 75 percent of the surface soil and part of the subsoil by accelerated erosion. A total of 3,840 acres is mapped. Practically all areas were cultivated in the past but at present are idle and support a growth of poverty grass, briers, various weeds, and scattered patches of sassafras and sumac.

Cincinnati silt loam, gullied steep phase.—Numerous gullies, many of which are several feet deep, have developed on this phase, which occurs on slopes of more than 25 percent. The intergully areas are severely sheet eroded. Being unsuitable for the economic production of the general farm crops of the region, all this soil is abandoned and at present supports a sparse growth of weeds, briers, bromegrass, and shrubs. It should be reforested. A total of 960 acres is mapped.

Cincinnati silt loam, sloping phase.—This phase is similar to the type in profile characteristics, but differs in having somewhat thinner layers. It occurs on slopes of 8 to about 25 percent, and little if any appreciable accelerated erosion has developed. A total area of 15,360 acres is mapped, practically all of which is under forest cover. As erosion is potentially severe on the cultivated areas, it is necessary to use a cropping system that includes a predominance of hay and other close-growing crops in order to preserve the surface soil and to prevent lowering the productivity. Yields may be expected to be somewhat less than on the typical soil, as surface runoff is greater and moisture conditions are less favorable for crop growth.

Cincinnati silt loam, steep phase.—Including those areas of the type on which little if any appreciable accelerated erosion has developed, this steep phase has a slope greater than 25 percent. It is similar to the normal soil in profile characteristics, except the various layers are considerably thinner and the depth to calcareous till is less. Because of rapid runoff and potential erosion, it is not suited to cropping, and practically all areas are either under a forest cover or have recently been cleared. A total of 6,464 acres is mapped.

Clermont silt loam.—This poorly drained light-colored soil developed on Illinoian glacial drift. It covers a total of 2,944 acres, the larger areas occurring in sections 8, 14, 16, 17, and 22 of Ray Township, sections 32 and 34 of Highland Township, and section 12 of Butler Township, with smaller areas principally in the southern and central-southern parts of the county. The relief is nearly level, and both internal and external drainage are poor. To permit successful cropping artificial drainage is necessary, two methods of which are used on this soil—(1) shallow open ditches or dead furrows and (2) tile ditches or drainage. The open ditches are usually about 2 rods apart, extending the length of the field or area and occasionally connecting with the natural drainageways. Tile drains are placed about 2 rods apart and at a relatively shallow depth (well below plow depth). Native vegetation consisted chiefly of sweetgum, sour gum, and pin oak.

Following is a profile description in cultivated areas:

0 to 7 inches, light-gray to gray friable granular silt loam, slightly mottled and streaked with yellow or rust brown. Numerous small firm rounded iron concretions are on the surface and throughout this layer, and numerous crawfish mounds, a few inches high, are present. Locally, this soil is known as crawfish land, buckshot land, or slash land. Reaction, strongly to very strongly acid.

7 to 28 inches, light-gray mottled and blotched with yellow and rust-brown smooth friable silt loam to heavy silt loam, breaking into small subangular aggregates that can be easily crushed into fine granules when moist. There is a tendency in some areas for the material to have platy structure, and the numerous crawfish casts or holes are filled with light-gray silty material. Reaction, strongly to very strongly acid.

28 to 54 inches, light-gray silty clay loam to silty clay with pale-yellow mottlings and rust-brown blotches and streaks. The material breaks into vertical columns with a 4- to 10-inch vertical and a 1½ to 3-inch horizontal dimension. Rounded caps or tops of light-gray silty material occur on the tops of the columns in many areas. Reaction, strongly to very strongly acid.

54 to 120 inches, gray silty clay loam with rather wide streaks of pale yellow and rust brown. It is somewhat friable, and the upper part contains some grit and a few small pebbles and stones, principally quartz, which increase in quantity with depth Reaction, strongly to very strongly acid in the upper part and slightly acid in the lower.

120 inches +, gray and yellow compact calcareous till composed of unassorted silt, clay, sand, and rock fragments. This represents the parent soil material.

Variations in the profile characteristics are in the texture and thickness of the various layers (except the texture of the surface layer) and the depth to calcareous till. The depth to the heavy siltpan layer varies from 28 to 36 inches, and this layer extends to a depth of 48 to 60 inches. The depth to calcareous till varies from 96 to 180 inches and probably averages about 120 inches.

The common rotation used consists of corn, wheat, and hay crops, including a mixture of timothy and clover, or timothy grown alone. This is varied to include soybeans and other field crops and an occasional crop of tomatoes. This soil is very cold and wet in spring, and the planting of crops is often delayed to such an extent that yields are materially reduced. To secure good crop yields it is necessary that adequate artificial drainage be installed and that good management practices and proper rotation systems be used.

Corn usually follows hay in the rotation, yielding about 25 bushels an acre under present management practices. Commercial fertilizer at the rate of 50 to 150 pounds or more an acre is usually used under corn on this soil. Under the better practices, including the turning under of all available organic matter, the use of sufficient lime to correct soil acidity (3 to 4 tons an acre), growing clover and other legumes that will tolerate the strongly acid condition of the subsoil and the high moisture conditions, corn yields may be increased to 40 bushels or more an acre.

As this soil is not well adapted to growing wheat and other small grains, crop failures are not uncommon. Severe damage is occasionally caused in winter and early spring by heaving or drowning out.

Soybeans tolerate the excessive moisture conditions on this soil, yields probably averaging about 15 bushels an acre. Yields can be materially increased by applying sufficient lime to correct soil acidity.

Hay crops usually include a mixture of timothy and clover or timothy grown alone, with some lespedeza or redtop. To grow clover successfully it is necessary to apply sufficient lime to neutralize the soil acidity. Timothy tolerates the wet condition of the soil during winter and early spring, and good stands are obtained.

Clyde silty clay loam.—Occupying the deeper depressional areas in the regions of Early Wisconsin glaciation, this dark-colored very poorly drained soil is the most poorly drained member of the catena to which it belongs. It occurs in small isolated areas closely associated with Brookston silty clay loam and Cope silt loam. A total of only 64 acres is mapped. Natural drainage conditions are very poor, but most of the soil has been artificially drained sufficiently to allow cropping. In seasons of abnormally high rainfall, however, crops are occasionally drowned out or the areas are not cropped. The native vegetation consisted of marsh grasses and water-loving trees. A few areas have a growth of sycamore (buttonwood) and marsh grasses.

Following is a profile description in cultivated areas:

0 to 7 inches, very dark-gray to nearly black silty clay loam, relatively high in organic matter. Reaction, neutral.

7 to 18 inches, dark-gray to very dark-gray gritty silty clay loam to clay loam, relatively high in organic matter. An occasional large boulder is present and the content of sand and fine gravel is variable. The material breaks into angular pieces that become hard when dry. Reaction, neutral.

18 to 28 inches, light-gray to gray (with light-yellow or rust-brown mottlings in the lower part), heavy plastic clay loam or sandy clay, usually containing much grit and rock fragments. Reaction, neutral.

28 to 50 inches, mottled gray, yellow, and rust-brown clay loam to sandy clay that breaks into large angular pieces. It is plastic when moist and very hard when dry. Reaction, neutral.

50 inches +, mottled gray, yellow, and rust-brown compact calcareous glacial till, consisting of unassorted silt, clay, sand, and rock fragments.

Some areas vary from the above profile characteristics in texture and thickness of the layers and depth to calcareous till.

Management practices and rotations are necessarily similar to those on the associated Brookston and Cope soils. The rotation usually includes corn, wheat or oats, and hay crops. It is necessary to install artificial drainage on this soil to permit cropping. In seasons of abnormally high rainfall it is not uncommon for crops to be drowned out or for the soil to be too wet to permit the planting of corn, oats, and other crops in spring.

An area located about one-fourth mile east of the village of Old Bath is an included area that is more nearly like the Abington soils. Here the surface 8 inches is very dark-gray to nearly black friable silt loam to silty clay loam, very high in organic content, in a few spots approaching muck in character. Below this to a depth of about 22 inches is light-gray gritty and gravelly silty clay loam to clay loam, underlain by gray gravelly and sandy clay loam that is less coherent with depth. A thin layer of marl-like material is present in the upper part of this layer in a few places, but this layer is not continuous.

One small area of Carlisle silty muck in the northwestern part of section 11, Springfield Township, is included with Clyde silty clay loam on the soil map, owing to small extent. The surface 6 to 8 inches is very dark-gray to black granular silty muck, high in organic content.

This is underlain by very dark-gray to black somewhat granular silty mucky material that grades at a depth of about 12 inches into olive-yellow soft macerated peaty material.

The included area is cropped about the same as the associated Clyde and Brookston soils. It is high in organic matter and nitrogen content but deficient in phosphate and very deficient in potash.

In seasons of normal or somewhat restricted rainfall corn yields equal or exceed those on Brookston silty clay loam, but the average yields over a 10-year period are considerably less than on that soil. Corn yields about 50 bushels an acre and wheat 18 to 20 bushels. There is often considerable damage to wheat and other fall-sown small grains from drowning out. Oats are not well adapted to this soil and are occasionally drowned out in spring and early summer, and both fall-sown small grains and oats are damaged from lodging of the grain. Soybeans are well-adapted and yield 20 to 25 bushels or more an acre when drainage is adequate. Good stands of alfalfa and clover can be obtained without liming the soil, but these crops are occasionally severely damaged during winter and early spring by drowning out or heaving.

Cope silt loam.—A moderately dark-colored poorly to very poorly drained member of the soil catena of which it is a part, this soil is developed on Early Wisconsin glacial drift. It is similar to the Brookston soil, but the color is not so dark, the organic content of the surface and subsurface layers is less, and the dark-colored layers are thinner.

This soil occupies the shallow depressional areas and flats in the regions of calcareous Early Wisconsin drift soils, usually occurring in irregular-shaped areas closely associated with the Brookston and Fincastle soils. A total of 4,800 acres is mapped, principally in the northern part of Springfield Township and in Bath Township. Natural drainage conditions are poor, but most areas have been artificially drained sufficiently to permit cropping. The native vegetation consisted principally of red maple, elm, ash, white and red oaks, and hackberry.

Following is a profile description in cultivated areas:

0 to 7 inches, dark brownish-gray friable silt loam, relatively high in organic content. Reaction, neutral to slightly acid.

7 to 14 inches, dark-gray silty clay loam, relatively high in organic content. A few small pebbles and an occasional boulder are present. Reaction, neutral to slightly acid.

14 to 55 inches, mottled gray, yellow, and rust-brown gritty silty clay to sandy clay, containing much grit and numerous small angular rock fragments. It breaks into irregular-sized pieces that are plastic when moist and hard when dry. Reaction, neutral.

55 inches +, gray and yellow compact calcareous glacial till composed of unassorted silt clay, sand, and rock fragments.

Variations in the profile characteristics are in texture and thickness of layers and depth to calcareous till. Small areas in the northeastern part of the county, associated with Wynn silt loam and the shallow phase of Fincastle silt loam, have limestone bedrock at an average depth of about 75 inches.

The cropping system used is governed somewhat by the extent of the associated soils but, in general, includes corn, wheat or oats, and hay crops. Soybeans are increasing in importance in the rotation and usually follow corn or occasionally small grains. Where this soil comprises all or most of a field unit, it is often cropped to corn for two or more consecutive years. It is relatively high in organic and nitrogen content but somewhat deficient in phosphate and potash. Adequate artificial drainage is probably the first prerequisite for the successful cropping of this soil.

Corn yields vary somewhat with seasonal conditions and management, averaging about 55 bushels an acre under the present management, but yields of 70 bushels or more are not uncommon under better management practices and with favorable weather conditions. Corn is usually fertilized about the same as on the associated soils, except in fields that consist entirely or largely of this type. Here less fertilizer is occasionally used, or fertilizers relatively high in phosphorus and potash are used.

Wheat usually follows corn or soybeans in the rotation. It is a common practice to apply 100 to 150 pounds or more an acre of commercial fertilizer under wheat, which yields 18 to 22 bushels an acre. Oats occasionally take the place of wheat in the rotation, yielding 30 to 50 bushels an acre. Small grains are occassionally injured by heaving and lodging of the grain.

Excellent stands of clover and alfalfa can be obtained without the use of lime. They are, however, occasionally injured by heaving, and in periods of extremely high rainfall small areas may be drowned out. Soybeans are well adapted to this soil and yield 20 to 25 bushels an acre.

Delmar silt loam.—This light-colored poorly drained soil is developed on Early Wisconsin glacial drift. It covers only 128 acres in small isolated areas associated with Fincastle, Brookston, and other soils in the Early Wisconsin glacial drift regions. The relief is nearly level, and surface and subsoil drainage are naturally poor. Native vegetation consisted chiefly of elm, ash, sycamore, and white oak.

Following is a profile description in cultivated areas:

0 to 7 inches, light-gray to gray smooth friable medium-granular silt loam, relatively low in organic content. (In undisturbed wooded areas the surface 2 or 3 inches is dark gray and relatively high in organic content.) Numerous small rounded pale-yellow or rust-brown iron concretions occur on the surface and throughout the layer. Reaction, medium acid.

7 to 10 inches, light-gray to gray friable smooth heavy silt loam to silty clay loam, containing numerous small rounded iron concretions. It is composed of medium-sized firm but not hard granules. Reaction, medium to strongly acid.

10 to 18 inches, mottled gray, yellow, and rust-brown silty clay loam, containing very little grit or pebbles. It breaks into small subangular aggregates that may be easily broken down when moist into coarse granules. It is permeable to moisture movements and plant roots. Reaction, medium to strongly acid.

18 to 36 inches, mottled gray, yellow, and rust-brown plastic heavy silty clay loam, usually breaking into 1- to 1½-inch subangular aggregates but in some areas tending to have ill-defined columnar structure. Here the length of the vertical axis of the columns is 3 to 4 times that of the horizontal. The upper part of the layer usually contains very little grit or pebbles, but the lower part contains varying quantities of grit, pebbles, and rock fragments. This layer is somewhat impervious to moisture movement and plant roots. Reaction, strongly to medium acid.

36 to 45 inches, mottled gray, yellow, and rust-brown silty clay loam that is somewhat more friable and less impervious to moisture movement

and plant roots than the above layer. It breaks into medium-sized subangular aggregates and contains numerous small rock fragments and an occasional boulder. Reaction, medium to slightly acid.

45 inches +, gray and yellow compact calcareous glacial till, composed of unassorted silt, clay, and rock fragments. This represents the parent soil material.

Variations in the profile characteristics are in texture and thickness of layers and depth to calcareous till.

Management and rotation systems are about the same as on the associated Fincastle, Cope, and Brookston soils. It is necessary to drain this soil artificially to allow cropping.

Corn yields 20 to 30 bushels an acre, depending upon the adequacy of the artificial drainage and the state of fertility. In sufficiently artificially drained areas where the fertility has been increased by the addition of crop residue and commercial fertilizer and the acidity corrected by the addition of lime (2 to 3 tons an acre), yields average 40 bushels or more an acre.

This soil is not well adapted to growing small grains, including wheat, rye, and oats. There is considerable damage to wheat and rye from winterkilling, and the planting of oats is often delayed in spring, because the soil dries out very slowly, causing the crop to suffer from lack of moisture in summer. Wheat and rye yield 12 to 15 bushels an acre and oats 20 to 40, probably averaging about 30.

Hay crops include a mixture of clover, timothy, alsike, and alfalfa or clover or alfalfa grown alone. Timothy is probably better adapted than either alfalfa or clover to this soil. To grow successfully clover and alfalfa it is necessary to install adequate artificial drainage and to apply sufficient lime to correct soil acidity. Serious damage to these crops by winterkilling or heaving is not uncommon.

Edenton silt loam.—Usually in relatively small isolated areas, principally adjacent to the drainageways, a total of 1,280 acres of this well to excessively drained soil is mapped. Developed on Illinoian glacial drift, it is underlain by limestone at a depth of 40 to 80 inches. It occurs on sloping areas in the regions of Illinoian glaciation, usually in a position intermediate between areas of Cincinnati silt loam and Fairmount silty clay loam. The surface runoff is good to somewhat excessive, and internal drainage is good in the upper part of the profile and somewhat restricted in the lower part, especially where bedrock occurs at the shallower depths. Native vegetation consisted principally of white and red oaks, hickory, and maple.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown smooth friable silt loam, relatively low in organic content. (In undisturbed wooded areas the surface 2 or 3 inches is dark yellowish brown and relatively high in organic content.) Reaction, strongly to very strongly acid.

7 to 12 inches, yellowish-brown to brownish-yellow friable coarse-granular heavy silt loam to silty clay loam, breaking into coarse granules or small subangular aggregates that are firm but not hard and are rather distinctly developed. Reaction, strongly to very strongly acid.

12 to 18 inches, yellowish-brown to brownish-yellow silty clay loam, breaking into about ¾-inch subangular aggregates. Reaction, strongly to very strongly acid.

18 to 32 inches, yellowish-brown to brownish-yellow heavy silty clay loam, containing some grit and an occasional small rounded pebble. It breaks into ¾- to 1½-inch subangular aggregates. Reaction, strongly acid.

32 to 48 inches, mottled yellow, gray, and pale-olive silty clay to clay, containing numerous spots and blotches of dark brown. It breaks into irregular-sized and irregular-shaped pieces that are plastic when moist, sticky when wet, and hard when dry. Reaction, medium to slightly acid.

48 inches +, bedrock of limestone and shale.

Variations in the profile characteristics are in texture and thickness of layers and depth to limestone bedrock. Included are small areas, having a slope of less than 8 percent, where the depth to bedrock is usually greater than normal.

Practically all areas are in forest. A few small isolated included areas with a slope of less than 8 percent are under cultivation to corn, wheat, and hay crops. Crop yields are about the same as on the associated Cincinnati silt loam. Accelerated erosion is potentially severe, and when this soil is brought under cultivation good management practices are necessary to maintain and increase productivity and to control erosion.

Edenton silt loam, eroded phase.—Associated with Cincinnati silt loam and Fairmount silty clay loam, this phase occurs in the region of Illinoian glaciation. It is found on slopes of 8 to 25 percent, on which 25 percent or more of the surface soil or all of the surface soil and part of the subsoil have been removed by accelerated erosion. It covers a total of 1,344 acres, the larger areas occurring in the southeastern part of the county in the vicinity of and north of South Gate. Included are a few small isolated areas, having a slope of 2 to 8 percent, on which 25 to 75 percent of the surface soil has been removed by accelerated erosion.

The 6- or 7-inch surface layer varies from light yellowish-brown friable silt loam to brownish-yellow or yellowish-brown silty clay loam, depending on the degree of accelerated erosion. The inclusion of some of the subsoil in the surface material has lowered the tilth conditions, and areas of this soil usually become somewhat cloddy, making the preparation of good seedbeds difficult. The rest of the profile is similar to that of the type. All this eroded phase has been cleared of timber and brought under cultivation. Only a few areas of it are cultivated at present, however, and it is largely in low-grade pasture, consisting chiefly of broomsedge, poverty oatgrass, sassafras, and sumac. The cultivated areas are used for corn, wheat, and an occasional crop of tobacco. Crop yields are about equal to those obtained on the eroded sloping phase of Cincinnati silt loam.

Edenton silt loam, eroded steep phase.—Mapped on a total of only 576 acres, this phase occurs on slopes of more than 25 percent, on which 25 percent or more of the surface soil or all of the surface soil and a part of the subsoil have been removed by accelerated erosion. It occurs in the region of Illinoian glaciation, often in a position intermediate between areas of Cincinnati silt loam and Fairmount silty clay loam.

The 6- or 7-inch surface layer varies from light yellowish-brown heavy silt loam to yellowish-brown or brownish-yellow heavy silty clay loam, depending on the degree of accelerated erosion. The organic content is extremely low, and tilth conditions are poor. The rest of the profile is essentially the same as that of the type, except that the layers are thinner and the depth to limestone bedrock is considerably less. Areas of this phase were cleared of timber and brought under cultivation or used for pasture in the past, but they have been taken out of cultivation and now support a growth of broomsedge, poverty oatgrass, briers, sassafras, and sumac. The soil is essentially nonarable and best suited to forestry.

Edenton silt loam, steep phase.—This phase occurs on slopes of more than 25 percent, and little if any appreciable accelerated erosion has developed. The soil profile is similar to that of the type, except for the thinner layers and considerably less depth to limestone and shale. Owing to the steep sloping conditions and susceptibility to erosion, all areas of this phase are in forest and will probably remain so. A total of only 256 acres is mapped.

Eel silt loam.—This is a moderately well-drained to imperfectly drained soil on neutral to slightly alkaline alluvium washed from regions of Early Wisconsin glacial drift and glaciofluvial outwash plains and terraces. A total of 1,408 acres is mapped, principally along the smaller drainageways in the Early Wisconsin glaciated regions and in temporary channels made by floodwaters. The elevation is usually a few feet lower than that of the associated Genesee soils. Native vegetation consisted chiefly of sycamore, elm, ash, and Carolina poplar.

Following is a profile description in cultivated areas:

0 to 7 inches, light grayish-brown to light brownish-yellow friable granular silt loam. The organic content is variable but usually relatively low. Reaction, neutral.

7 to 20 inches, light brownish-yellow friable coarse granular heavy silt loam to silty clay loam having a somewhat platy structure An occasional thin layer or lense of fine sand is present. Reaction, neutral.

20 inches +, mottled gray and yellow silty clay loam to sand and gravel. There is a wide variation in the composition of this material, and numerous depositional horizons can be distinguished. Below a depth of 40 inches the material is often gravel and sand. Reaction, neutral to calcareous.

Variations in the profile characteristics are in color, texture, and thickness of the layers.

Less than 50 percent of this soil is cultivated. As drainage is fair to imperfect, damage to crops from flooding and excessive moisture is usually greater than on the associated Genesee soils. Corn is the principal crop grown, and yields average about 50 bushels an acre. Because of the danger from flooding and drowning out, wheat and oats are not so extensively grown as on the Genesee soils, except where it is closely associated with them. Alfalfa is well suited but is occasionally severely damaged by flooding. More than 50 percent of the soil is in permanent bluegrass or woodland pasture, the small areas adjacent to the small drainageways probably being best suited to this use. A few areas are in woodland consisting principally of ash, elm, sycamore, and Carolina poplar.

Elkinsville silt loam.—This light-colored soil is the well-drained member of the catena that also includes the Pekin, Bartle, and Peoga [8] series. Developed on acid alluvial terraces of 3 percent or less, erosion is not a problem. A total of 128 acres is mapped on the alluvial ter-

[8] The Peoga series does not occur in this county.

races in the regions of Illinoian glaciation, along the various branches of Salt and Little Laughery Creeks, principally in Ray Township. These terraces, probably formerly alluvial flood plains, are now 2 to 6 feet or more above the present alluvial soils, owing to stream cutting and lowering of the stream channel. Surface runoff is not rapid, and internal drainage is good. The native vegetation consisted chiefly of oak, hickory, and maple, with lesser quantities of associated species.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown smooth friable silt loam, low in organic content. Reaction, medium to strongly acid.

7 to 12 inches, yellowish-brown to brownish-yellow smooth friable coarse granular heavy silt loam, permeable to moisture movement and to plant roots. Reaction, strongly to very strongly acid.

12 to 18 inches, yellowish-brown to brownish-yellow smooth heavy silty clay loam, breaking into ¼- to ½-inch subangular aggregates that can be easily crushed when moist into coarse granules. It is permeable to moisture movement and to plant roots. Reaction, strongly to very strongly acid.

18 to 30 inches, brownish-yellow smooth silty clay, breaking into ½- to 1½-inch subangular aggregates. This layer is permeable to moisture movement and to plant roots. Reaction, strongly to very strongly acid.

30 to 50 inches, brownish-yellow silty clay to heavy silty clay loam, breaking into irregular sized and shaped pieces. A thin coating of gray colloidal clay is usually on the cleavage or breakage faces, giving the material a slightly mottled appearance in place, but this gray color disappears when the material is crushed. There is little grit or pebbles present, and old depositional horizons are usually noticeable Reaction, strongly to very strongly acid.

50 inches +, gray, yellow, and brown silt loam to silty clay loam, with thin layers or lenses of fine sand. Reaction, strongly acid.

Except for the texture of the surface layer, variations in the profile characteristics are in texture and thickness of the various layers.

The common rotation system includes corn, wheat, and clover or timothy, with an occasional crop of soybeans. This soil is naturally low in organic matter and plant nutrients, and the acidity of both surface and subsoil is high. To secure good crop yields on this soil, it is essential to plow under all available organic matter, to use the proper quality and quantity of commercial fertilizer under crops, and to apply sufficient lime (3 to 4 tons an acre) on the soil to correct acidity. Sufficient liming is not only essential for obtaining good stands of clover, which in turn aids in increasing corn, wheat, and other crop yields, but also increases soybean yields. Neither drainage nor erosion are serious factors, although erosion does become a problem on the included sloping areas.

Corn usually follows hay crops in the rotation or may be planted on areas where fall-sown small grains have failed. It is usually fertilized with 50 to 100 pounds or more an acre of commercial fertilizer. With favorable weather conditions yields of about 35 bushels an acre can be increased to 40 bushels or more under the better management practices.

Wheat follows corn or soybeans in the rotation, yielding about 15 bushels an acre. It is a rather general practice to use 100 to 150 pounds of commercial fertilizer an acre under wheat, and a few farmers top-dress wheat with barnyard manure. Although oats are not so well adapted as wheat to this soil they are grown on a few areas, and yields are relatively low. Soybeans, more extensively grown than formerly, usually follow corn in the rotation, yielding about 15 bushels an acre.

The hay crops in common use include clover, timothy, or a mixture of these. Hay yields can be increased by rather liberal applications of commercial fertilizer, and to insure good stands of clover it is necessary to apply sufficient lime to correct soil acidity.

Included with this soil in mapping are a few small areas, having a slope of 3 to 8 percent, on which only slight accelerated erosion has developed. Also included are a few small areas, having a 3- to 8-percent slope, on which 25 percent or more of the surface soil has been removed by accelerated erosion. The 6- or 7-inch surface layer of the latter inclusion is yellowish-brown or brownish-yellow heavy silt loam to silty clay loam, very low in organic content.

Elkinsville silt loam, sloping phase.—Occurring on slopes of 8 to 25 percent, accelerated erosion is variable on this phase. A total of only 64 acres is mapped, principally on the slopes between areas of the type and the acid alluvial soils. The profile is essentially the same as that of the normal type, except that the layers are somewhat thinner and the 6- or 7-inch surface layer is yellowish-brown to brownish-yellow heavy silt loam to silty clay loam. Less than 30 percent of this phase is cultivated, and crop yields are materially lower than on the type, owing to the slope, less favorable moisture conditions, and the low organic and plant-nutrient content. A few areas are in forest and the rest in low-grade pasture, consisting chiefly of broomsedge, poverty oatgrass, sassafras, and briers.

Fairmount silty clay loam.—This type is developed on Ordovician and Silurian limestone and shale. It is well to excessively drained on slopes of about 12 to 55 percent. There is little accelerated erosion, however, as practically all areas are at present in forest with small isolated ones in permanent bluegrass pasture. A total of 17,088 acres is mapped, principally on slopes adjacent to the larger stream valleys in the regions where Illinoian drift occurs on the uplands. Surface runoff is rapid and internal drainage fair to slow. Native vegetation consisted chiefly of white, black, and red oaks and hickory, with some elm and sycamore on the lower slopes.

Following is a profile description in wooded areas:

0 to 2 inches, very dark-gray to very dark brownish-gray moderately friable heavy silt loam to silty clay loam, relatively high in organic content. There is usually a thin accumulated layer of partly decayed forest litter on the above material. Reaction, neutral to slightly alkaline.

2 to 8 inches, dark brownish-gray silty clay loam, breaking into ¼- to ½-inch angular aggregates. Fragments of limestone occur throughout the layer. Reaction, neutral to slightly alkaline.

8 to 12 inches, grayish-yellow heavy silty clay loam to silty clay, breaking into medium-sized blocky aggregates. Reaction, neutral to slightly alkaline.

12 to 18 inches, brownish-yellow or olive-yellow silty clay to clay, breaking into angular blocky aggregates that have shiny cleavage or breakage faces. It is plastic when moist, very sticky when wet, and hard when dry. Reaction, neutral.

18 inches +, partly weathered limestone bedrock.

Variations in the profile characteristics are in thickness of the layers and depth to limestone bedrock. The quantity of partly weathered limestone fragments on the surface and throughout the profile is variable.

Because of the sloping condition this soil is subject to severe accelerated erosion under cultivation, resulting in serious loss if good management practices are not exercised. Yields of corn are fair to good for a few years after the land is cleared, but usually decrease because of improper rotation and management practices. Alfalfa is well adapted to this soil, and excellent stands can be secured without the use of lime. There is, however, considerable loss from heaving of the plants during winter and early spring. Tobacco is well adapted, producing good yields for the first 2 or 3 years of cropping. After this, however, the yields decrease rapidly largely because of the loss of surface soil by accelerated erosion. Excellent stands of bluegrass can be obtained and, where properly managed, the livestock-carrying capacity an acre is relatively high. The steeper areas are not well adapted to cropping but are probably better suited to permanent pasture or forest.

Fairmount silty clay loam, colluvial phase.—Often in fan-shaped areas, this phase, consisting of material washed and slumped down from the above slopes of the type, occurs in a position intermediate between that soil and the glaciofluvial terraces or alluvial bottoms. It has no definite profile, and limestone and shale fragments occur on the surface and throughout the material in various quantities. Tobacco and alfalfa are grown in areas where the rock fragments are less numerous or have been removed, the yields averaging about the same or slightly higher than on Fairmount silty clay loam. Where rock fragments are too numerous to permit cultivation, the land is used for permanent bluegrass pasture. A total of 896 acres is mapped.

Fairmount silty clay loam, eroded phase.—Occurring on slopes of 12 to 55 percent, this phase has lost 25 to 75 percent of the surface soil by accelerated erosion. It occurs in association with the type adjacent to the valleys and drainageways, principally the larger streams and rivers. A total of 13,440 acres is mapped.

The 6- or 7-inch surface layer is variable, usually dark brownish-gray silty clay loam to brownish-yellow plastic silty clay. Limestone and shale fragments occur on the surface and throughout the layer. The rest of the profile is similar to that of the typical soil.

Cultivated areas are used principally for tobacco or alfalfa, with small areas in corn. Because of its heavy texture this soil is difficult to work, and corn yields are somewhat lower than on the uneroded typical soil. Most of the tobacco produced in the county is grown on this phase. It is commonly fertilized rather liberally and yields about 900 pounds an acre. Light burley is the kind most commonly grown, with smaller quantities of dark burley. Alfalfa is well adapted, although good stands are occasionally difficult to obtain owing to the heavy texture of the surface soil and to injury from heaving. A large part is in bluegrass pasture.

Fairmount silty clay loam, severely eroded phase.—By accelerated erosion this phase has lost 75 percent or more of the surface soil or all the surface soil and part of the subsoil. It occurs on slopes of 12 to 55 percent. The 6- or 7-inch surface layer over a large part of the areas is brownish-yellow or olive-yellow plastic silty clay, relatively low in organic content. Limestone and shale rock fragments occur on the surface and throughout this layer. The rest of the profile is similar to that of the type. Surface drainage is excessive and internal drainage fair to restricted. A considerable part of this phase was cleared and brought under cultivation 50 or 60 years ago, cultivated for a few years, abandoned, and allowed to reforest. These areas now sustain a growth of various-sized trees and brush, with an understory of briers and some bluegrass. The rest is in pasture, consisting of bluegrass together with various weeds, briers, and small shrubs, with a few small areas cropped to tobacco or corn, yields of which are low. A total of 512 acres is mapped.

Fairmount silty clay loam, very steep phase.—Although this phase occurs on slopes of more than 55 percent it has little appreciable accelerated erosion, as it is practically all in forest, with only a few small areas in bluegrass pasture. A total of 384 acres is mapped, principally along the valleys of the larger streams in association with other phases of the type.

Profile characteristics are similar to those of the typical soil, except that the layers are considerably thinner and the depth to bedrock averages about 12 inches. As the relief is too steep for cultivated crops and a good stand of bluegrass pasture on some of the steeper areas difficult to maintain, the best use for this phase is forest.

Included with this phase are a few small areas of Fairmount silty clay loam, having a gradient of 55 percent or more, on which 25 percent or more of the surface soil or all the surface soil and part of the subsoil have been removed by accelerated erosion. These areas are in pasture, consisting of small quantities of bluegrass, with various shrubs, briers, and weeds.

Fincastle silt loam.—This light-colored imperfectly drained soil is developed on Early Wisconsin glacial drift. The parent material is unassorted glacial till deposited by the Early Wisconsin glacier. The depth to free-lime carbonates is 36 to 60 inches and averages about 45.

This soil covers a total of 16,384 acres, often intermediate between areas of Russell silt loam and the Cope or Brookston soils. Owing to the nearly level to gently undulating relief, external drainage is slow in most areas and internal drainage imperfect, making it necessary to drain this soil artificially to insure good crop yields. This is usually accomplished with tile drainage. Most areas have been artificially drained sufficiently for cultivation, but some need more adequate drainage. The native vegetation consisted principally of beech, sugar maple, elm, white, black, and pin oaks.

Following is a profile description in cultivated areas:

0 to 7 inches, light brownish-gray to brownish-gray smooth friable medium-granular silt loam, relatively low in organic content. (In undisturbed wooded areas the 2- to 3-inch surface layer is dark brownish-gray and relatively high in organic content.) Reaction, medium.

7 to 10 inches, light brownish-gray smooth friable heavy silt loam to silty clay loam composed of firm but not hard medium to coarse granules, with very little grit and pebbles present. A few light-yellow mottlings may be present. Reaction, medium to strongly acid.

10 to 16 inches, mottled gray, yellow, and rust-brown smooth silty clay loam, breaking into ¼- to ¾-inch subangular aggregates and containing only a small quantity of grit and pebbles. It is permeable to moisture movement and to plant roots. Reaction, medium to strongly acid.

16 to 35 inches, mottled gray, yellow, and rust-brown heavy plastic silty clay loam, breaking into ¾- to 1½-inch subangular aggregates. This layer is somewhat impermeable to moisture movement and to plant roots. Reaction, strongly to medium acid.

35 to 46 inches, mottled gray, yellow, and rust-brown silty clay loam, containing increasing quantities of grit, pebbles, and rock fragments with depth. The material is more friable than the above layer and not so impermeable to moisture movement and to plant roots. Reaction, medium to slightly acid.

46 inches +, gray and yellow compact calcareous glacial till composed of unassorted silt, clay, sand, and rock fragments, representing the parent soil material.

Variations in the profile characteristics are in texture and thickness of layers and depth to calcareous till. Where Fincastle silt loam grades into Brookston silty clay loam, the surface soil is somewhat darker and slightly heavier textured.

This soil is largely in cultivation or bluegrass pasture. As it is often closely associated with Cope silt loam and Brookston silty clay loam, the management and crop rotations are influenced somewhat by the extent of those soils. The rotation system is usually similar to that practiced on Russell silt loam and includes principally corn, wheat or oats, and hay crops. Soybeans, rye, and other field crops are fitted into the rotation system, and a few areas of tomatoes and tobacco are grown.

Corn usually follows hay crops in the rotation but may be grown where fall-sown small grains have failed. It is commonly fertilized with 50 to 150 pounds of commercial fertilizer an acre. Yields are extremely variable, depending upon drainage conditions, fertility level, the quantity and quality of commercial fertilizer used, and seasonal conditions. Average yields of 40 bushels an acre under present management practices may be increased to 50 bushels or more under good practices, which involve establishing adequate artificial drainage, turning under all available organic matter, using sufficient commercial fertilizer, and applying sufficient lime (1 to 3 tons an acre) to the soil to correct acidity.

Wheat usually follows corn in the rotation, yielding 18 to 20 bushels an acre. It is a common practice to apply 100 to 150 pounds of commercial fertilizer an acre under wheat, a few areas also receiving a top dressing of barnyard manure. Wheat and other small grains are not so well adapted to this soil as to Russell silt loam and are occasionally seriously damaged by heaving. Oats, occasionally grown in the place of wheat in the rotation, yield 20 to 50 bushels an acre and average about 35. Very little commercial fertilizer is used under oats.

Hay crops include a mixture of clover, timothy, alsike, and alfalfa or clover or alfalfa grown alone. It is necessary to apply sufficient lime to correct soil acidity before good stands of clover or alfalfa can be obtained. Injury to both clover and alfalfa from heaving is occasionally severe. The acreage in soybeans has increased in recent years. They are usually grown after corn or small grains, and yields range from 15 to 25 bushels an acre, with larger yields obtained under better management practices and good weather conditions.

Fincastle silt loam, gently sloping phase.—Little or no appreciable accelerated erosion is present on this soil, which occurs on slopes of 3 to 12 percent. Small areas are north of Scipio, closely associated with the type. A total of only 64 acres is mapped. This phase is similar to the typical soil in profile characteristics, but the layers are usually slightly thinner and depth to calcareous till is usually somewhat less. Owing to slope conditions, it is somewhat subject to accelerated erosion under cultivation, and greater care should be exercised in the rotation system than on the typical soil. Crops grown and yields obtained are about the same as on that soil.

Fincastle silt loam, shallow phase.—Covering a total of 896 acres, this phase occurs on slopes of less than 3 percent, with little or no appreciable accelerated erosion. Small areas are mapped in the northeastern part of the county, in association with Wynn silt loam. The surface and upper subsoil layers are similar to those of the type, but the lower subsoil is usually slightly heavier textured. The 6- to 12-inch underlying calcareous till rests on limestone bedrock at an average depth of about 42 inches. Included with this phase are a few small areas in which the calcareous till layer is absent and the heavy plastic silty clay lower subsoil lies directly on limestone bedrock. The crop rotation system and crop yields are about the same as on the typical soil.

Fox fine sandy loam.—This soil occurs on nearly level to gently undulating relief with a slope of less than 3 percent, and erosion is not a problem. The larger areas of the 128 acres mapped occur in sections 4 and 9 of Brookville Township and section 21 of Laurel Township.

In cultivated areas the 6- to 8-inch surface layer is light yellowish-brown single-grained fine sandy loam, relatively low in organic content. The subsoil to a depth of about 20 inches is yellowish-brown or brownish-yellow loam to sandy loam, containing a few pebbles and larger stones. The rest of the profile is similar to that of Fox silt loam, except for the slightly greater depth to calcareous gravel and sand and the larger quantity of sand in the substratum.

Practically all this soil is cultivated to general crops, as corn, wheat, and clover or alfalfa, but yields are considerably lower than on Fox silt loam. As the lighter textured surface soil and upper subsoil make this soil somewhat droughty, crop yields are reduced in periods of drought.

Fox gravelly loam.—Intermediate between areas of Fox loam or Fox silt loam and the sweet alluvial soils and occasionally as the sloping area between terraces of Fox soils that occur at different levels, this soil covers a total area of 832 acres on slopes of more than 30 percent. The 4- or 5-inch surface layer of dark-brown to brown gravelly loam to gravelly sandy loam is underlain by a few inches of gravelly clay that is plastic when moist. Below this is loose calcareous gravel and sand. In numerous small areas the surface layer is loose calcareous gravel, without the normal surface and upper subsoil layers. This soil is partly in woodland, consisting chiefly of red, white, and yellow oak trees, and the cleared areas now support a growth of briers, weeds, and shrubs. Its best use is for forest, as it is essentially a nonagricultural soil.

Fox loam.—In association with Fox silt loam this soil occurs on the glaciofluvial outwash plains and terraces. Its profile characteristics are similar to those of the silt loam, except that the texture of the surface soil is loam instead of silt loam and that of the upper subsoil is somewhat lighter. It occupies a total area of 256 acres, the larger areas occurring along the Whitewater River south of Brookville, along the West Fork of the Whitewater River, northwest of Metamora and west of Brookville and along Big Cedar Creek north of Cedar Grove. The gradient is less than 3 percent, and accelerated erosion is not a problem.

The crop rotation is essentially the same as that on the associated silt loam—corn, wheat, and alfalfa or clover, with an occasional crop of soybeans and vegetables. In years of normal moisture conditions crop yields are about equal to or slightly lower, but in years of abnormally low moisture supply crops are more severely damaged than on that soil.

Included with this soil on the map are small areas having a slope of 3 to 12 percent on which little accelerated erosion occurs, also small areas of the same gradient on which 25 percent or more of the surface soil or all of the surface soil and part of the subsoil have been removed by accelerated erosion. The included areas that have a gradient of 3 to 12 percent are largely under cultivation to the general farm crops, but yields are lower than those obtained on typical Fox loam. They are probably better adapted to alfalfa than to the general farm crops.

Fox loam, eroded sloping phase.—Occurring on slopes of 12 to 30 percent, this phase has lost 25 percent or more of the surface soil by accelerated erosion. A total of 192 acres is mapped between areas of Fox loam or Fox silt loam and the sweet alluvial soils, or as the sloping areas between the various benches or terraces of Fox soils. The areas are long and rather narrow and difficult to crop in a manner different from the associated soils. The soil profile is similar to that of the typical soil, except that the 6- or 7-inch surface layer is yellowish-brown or brownish-yellow heavy loam to silty clay loam, extremely low in organic content. The characteristics of the surface soil are variable but are usually such as to affect adversely tilth conditions and lower crop yields. This phase is probably better suited to alfalfa than to the general system of cropping.

Fox loam, sloping phase.—Occurring as sloping areas between Fox loam or Fox silt loam and sweet alluvial soils, this phase has a gradient of 12 to 30 percent on which little or no accelerated erosion has developed. A total of only 128 acres is mapped, principally in the valley of the Whitewater River. Except for considerably thinner layers and less depth to loose calcareous gravel and sand, the profile characteristics are similar to those of the type. All this phase is under a forest cover, predominantly oak and hickory. Owing to the sloping relief it is probably best suited to forest, permanent bluegrass pasture, or alfalfa.

Fox silt loam.—This well to excessively drained soil, developed on glaciofluvial outwash plains and terraces of Wisconsin age, is a member of the soil catena that includes the Homer, Westland, and Abington series. (The Homer and Abington soils do not occur in this county.) The underlying material is loose stratified gravel and sand.

A total of 3,584 acres is mapped, principally in the valleys of the streams and drainageways in the regions of Early Wisconsin glaciation, usually intermediate between areas of alluvial and upland soils.

The relief is nearly level to gently undulating, usually less than 3 percent, on which very little accelerated erosion has developed. Surface runoff is not a problem except on the gently sloping areas, where some care is needed to prevent erosion. Because of the porous nature of the substratum, internal drainage is good to slightly excessive. Native vegetation consisted chiefly of black and red oak, maple, walnut, hackberry, and ash trees.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable medium-granular silt loam, relatively low in organic matter. (In undisturbed wooded areas the 2- to 3-inch surface layer is dark brownish-gray and relatively high in organic matter.) Reaction, medium to slightly acid.

7 to 12 inches, light yellowish-brown to yellowish-brown heavy silt loam to silty clay loam, breaking into coarse granules or into small subangular aggregates. This layer is permeable to moisture movement and to plant roots. Reaction, medium acid.

12 to 20 inches, yellowish-brown silty clay loam, breaking into ¼- to ¾-inch subangular aggregates and containing some small glacial gravel. Reaction, medium acid.

20 to 40 inches, yellowish-brown to weak reddish-brown waxy and gravelly plastic clay loam, breaking into irregular-sized angular pieces. It is plastic when moist, sticky when wet, hard when dry, and slightly impermeable to moisture movement and to plant roots. Reaction, medium acid.

40 to 45 inches, dark yellowish-brown to dark brownish-gray waxy and gravelly heavy clay loam, breaking into large angular pieces. There is an abrupt change from the above layer to this material and from this to the underlying material. Tongues or lenses of this material extend into the underlying layer. Reaction, slightly acid to neutral.

45 inches +, gray and light-yellow loose calcareous stratified gravel and sand.

Variations in the profile characteristics are in texture and thickness of the layers, depth to calcareous gravel and sand, and acidity of the surface soil and subsoil. A few small areas just west and south of Fairfield have a darker colored surface soil than normal and a slightly acid to neutral subsoil, probably due to the influence of the adjacent limestone slopes. A few of the higher terraces along the east side of the Whitewater River have a stronger acidity reaction than normal but are otherwise similar to the normal soil.

The common rotation is corn, wheat, and clover or alfalfa. Some soybeans and other field crops are grown, and a few areas are used for vegetables, fruit, and other specialized crops. Corn usually receives acre applications of 50 to 150 pounds of commercial fertilizer and yields 30 to 40 bushels an acre. Owing to the somewhat droughty nature of the soil, yields are materially reduced in years of abnormally low moisture conditions. Wheat is better adapted than oats and constitutes a large part of the small grains grown. A common practice is to use 100 to 150 pounds or more of commercial fertilizer an acre under wheat, and a few areas receive a top dressing of barnyard manure. Yields average about 20 bushels an acre. Alfalfa is better adapted than other legumes, and at present a large percentage of the hay grown is either alfalfa alone or a mixture of alfalfa and clover, with some timothy. Good stands of alfalfa have been obtained without the use of lime, but stands are improved when ground limestone (1 to 2 tons an acre) is applied to the soil. Vegetables and small fruits are grown on a few small areas for commercial use, and yields are fair to good. A few areas are in forest—chiefly the various varieties of oak—a large part of which is on the gently sloping areas (3 to 12 percent gradient).

Fox silt loam, eroded phase.—Occurring on slopes of 3 to 12 percent, this phase has lost 25 percent or more of the surface soil, or all of the surface soil and part of the subsoil by accelerated erosion. The 6- or 7-inch surface layer varies from yellowish-brown moderately heavy silt loam to yellowish-brown or brownish-yellow silty clay loam, extremely low in organic content. The rest of the profile is similar to that of the typical soil except that the depth to calcareous gravel and sand is usually less. A total of 128 acres is mapped.

This phase is cultivated to the general farm crops—corn, soybeans, wheat, and alfalfa—but yields are considerably lower than on the typical soil. Growing a cover crop of wheat and other small grains and using a rotation that includes more alfalfa and less clean-cultivated crops will aid in preventing further losses from erosion and help to maintain and improve crop yields. A few areas are allowed to remain in alfalfa for 4 years or more.

Genesee fine sandy loam.—Occurring on alluvial areas throughout the region of Early Wisconsin glaciation, principally along the Whitewater River and the East and West Forks of Whitewater River, and less extensively along the larger tributaries, this well-drained soil occupies a total area of 1,792 acres.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown to brown fine sandy loam, usually relatively low in organic content. Reaction, neutral to slightly alkaline.

7 to 20 inches, yellowish-brown to brownish-yellow fine sandy loam to loamy sand. Reaction, neutral to slightly alkaline.

20 inches +, yellowish-brown or brownish-yellow sand and gravel, often occurring in depositional layers or horizons and containing varying quantities of leaves, twigs, branches, and other debris. Reaction, neutral to alkaline.

Most of this soil is cropped to corn, wheat, and clover or alfalfa, with a few areas used for melons and cucumbers. It is somewhat droughty and crop yields, especially of corn and small grains, are materially lower than on Genesee silt loam. Special crops, as melons and cucumbers, are well adapted, returning fair to good yields.

Included with this type on the map are small areas of Genesee loamy sand, which would have been mapped separately if they had been of sufficient extent. Here the 6- to 8-inch surface layer of light yellowish-brown to brown incoherent loamy sand, extremely low in organic content, is underlain by yellowish-brown to brownish-yellow loamy sand to sand containing enough silt to make the material feebly coherent. Loose coarse sand and gravel occurs below a depth of 24 inches. The larger areas of this inclusion are along the West Fork of the Whitewater River in sections 4 and 33, about 4½ miles west of Brookville, and in section 32, west of New Trenton.

Being extremely droughty, these included areas are not well adapted to cropping. Corn, wheat, and clover or alfalfa are grown, but yields are extremely low. A few areas are in low-grade pasture, with a scattered growth of willows.

Genesee fine sandy loam, high-bottom phase.—This phase, having essentially the same profile characteristics as the normal type, occurs on a slightly higher elevation in the alluvial plains in association with the typical soil and other Genesee soils. It occupies a total of 192 acres, the larger areas occurring in the northern part of section 14, northwest of Cedar Grove, and in the southern part of section 18, east of Cedar Grove. Although this phase is not so frequently flooded as is the normal type, no apparent differences in the cropping system are used. Crops grown and yields obtained are about the same as on that soil.

Included with this phase on the map are a few very small areas of Genesee loamy sand, high-bottom phase, in which the surface soil is yellowish-brown loamy sand.

Genesee loam.—Occupying a total area of 2,368 acres along the rivers and drainageways throughout the region of Early Wisconsin glaciation in association with the other Genesee soils and Eel silt loam, this soil is similar to Genesee silt loam in profile characteristics, except that the 7-inch surface layer has a loam texture and the subsoil usually contains more sand. The surface and subsoil layers are neutral to slightly alkaline, although a few areas on the east side of the East Fork of the Whitewater River are calcareous on the surface. Management practices and crops grown are about the same as on Genesee silt loam, and crop yields about the same or slightly lower.

Genesee loam, high-bottom phase.—Profile characteristics of this phase are essentially the same as those of the typical soil, but the elevation is slightly higher, usually somewhat removed from the stream channel; thus damage to crops from overflow is not so great as on areas of that soil. The total extent is 384 acres. The rotation system and crops grown are about the same as on the typical soil, except that more wheat and hay are grown. Crop yields are about the same as on the high-bottom phase of Genesee silt loam.

Genesee silt loam.—This well-drained soil is developed on sweet alluvium from regions of Early Wisconsin glacial drift and glaciofluvial outwash plains and terraces. It occupies a total of 10,304 areas on the flood plains of the rivers and streams, the larger areas occurring adjacent to the Whitewater River and its East and West Forks. The areas are often rather extensive, and a number of field units are composed largely or entirely of this soil. Although drainage is good, all areas are overflowed during periods of extremely high water, and a large part is flooded an average of at least once a year. Native vegetation consisted chiefly of sycamore, elm, Carolina poplar, and ash.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable medium-granular silt loam. The organic content is variable but usually relatively low. Reaction, neutral to slightly alkaline.

7 to 30 inches, yellowish-brown to brownish-yellow friable medium- to coarse-granular heavy silt loam, having in some places thin layers of fine sandy material. Reaction, neutral to slightly alkaline.

30 inches +, yellowish-brown to brownish-yellow silty clay loam to sand. The texture is extremely variable, and depositional layers may be easily recognized. Partly decomposed twigs, branches, leaves, and other debris may occur in various depositional layers.

Variations in the profile characteristics are in texture and thickness of the various layers, except the surface texture. Where this soil grades into Ross silty clay loam, the surface is somewhat darker than normal.

More than 90 percent of this soil has been cleared of forest and is under cultivation. It is one of the most productive soils in the county for corn, for which a large part is used. No lime is required to grow successfully alfalfa, clover, and other legumes. Flooding is a potential danger of damage to all crops grown; however, most of the floods occur late in winter or early in spring, and the rotation system is usually adjusted to take this into consideration. Although the rotations are variable, probably the most common one is corn for two or more consecutive years, wheat, and a hay crop consisting either of alfalfa or clover alone, or a mixture of these with timothy and alsike. Some farmers grow corn for several consecutive years and a few grow corn and soybeans in rotation, with an intercrop of sweetclover. On some areas the rotation used is corn for two or more consecutive years followed by wheat, in which an intercrop of sweetclover is planted to be plowed up the following spring and the land planted to corn.

The organic and plant-nutrient content, although somewhat variable in different areas of this soil, is usually such that a well-balanced commercial fertilizer is needed for corn and wheat to obtain the higher yields.

Corn is usually fertilized with 50 to 150 pounds or more of commercial fertilizer an acre, and acre yields average about 55 bushels. Under good management practices and with good weather conditions, yields of 70 bushels or more are not uncommon. Common practice is to use 100 to 150 pounds or more of commercial fertilizer an acre under wheat, yields of which average about 20 bushels. Although wheat and other fall-sown small grains are occasionally severely damaged by floodwaters, the frequency of this damage is not such as to discourage the growing of wheat, except on a few low-lying areas. Oats, a minor crop, yield about 40 bushels an acre under good management practices and with favorable weather conditions. Soybeans are well adapted and are often grown on areas where wheat or hay crops have been drowned out by floodwaters, acre yields of 20 to 25 bushels or more being obtained. Hay crops are predominantly either clover or alfalfa grown alone or a mixture of these with timothy and alsike. Excellent stands and yields of alfalfa and clover are obtained without the use of lime, but there is always potential danger of serious damage from floodwaters. Sweet corn, field peas, and other special crops are well adapted but are grown on only a few areas.

Genesee silt loam, high-bottom phase.—Mapped on a total of 960 acres on the flood plains of the rivers and drainageways throughout the regions of Early Wisconsin glaciation, this soil is associated with the Genesee and Eel soils and, in some places, with Ross silty clay loam. The profile characteristics are essentially the same as those of the typical soil, but the elevation is slightly higher. The rotation system is similar to that on the typical soil except that more wheat and clover or alfalfa are grown, and, because of the slightly higher position of this soil, crop damage from flooding is not so serious. Crop yields are about the same as on the normal type.

Genesee silt loam, shallow phase.—This phase covers a total of 320 acres along the smaller streams and drainageways, principally in the regions of Illinoian till, where limestone outcrops along the slopes.

The 6- or 7-inch surface layer is grayish-brown to light yellowish-brown friable medium-granular silt loam, relatively low in organic content, underlain by yellowish-brown to brownish-yellow heavy silt loam. The depth to limestone bedrock is 8 to 30 inches and averages about 15 inches. The entire profile is neutral to slightly alkaline, and limestone rock fragments are on the surface and throughout the profile in numerous areas. Practically all areas are in woodland pasture, with varying quantities of sycamore, ash, Carolina poplar, and elm, and an undergrowth of bluegrass, or in permanent bluegrass pasture. Owing to its shallow depth to bedrock and its occurrence in long and narrow areas, often cut by small drainageways from the uplands, this phase is not suited to cropping but is better adapted to permanent bluegrass pasture.

Hartman gravelly stony loam.—Developed on the alluvial flood plains in the regions of Early Wisconsin glaciation, this is a well to excessively drained nearly level soil. It covers only 64 acres, principally in small areas along Little and Big Cedar Creeks, associated with the Genesee soils.

A profile description in a cultivated area is as follows:

0 to 7 inches, grayish-brown to light yellowish-brown to brown loam, containing a large quantity of limestone fragments and rounded boulders and gravel. Reaction, neutral to slightly alkaline.

7 inches +, yellowish-brown to brownish-yellow gravelly loam to silt loam, containing numerous large stones.

The content of boulders and rock fragments on and in the soil is sufficient to interfere seriously with cultivation. Attempts are made to crop some areas to corn and wheat, but yields are extremely low. As fair to good stands of alfalfa may be obtained, this is probably the best use for this soil.

Mapped with this soil are a few areas consisting almost entirely of boulders, gravel, and sand.

Haymond silt loam.—This light-colored soil on mixed alluvium washed from regions of Illinoian glaciation and limestone slopes is the well-drained member of the catena that also includes the Wilbur series. It occurs in rather long narrow areas adjacent to the drainageways, in association with the Wilbur soil of the flood plains and occasionally with Elkinsville, Pekin, and Bartle soils of the acid alluvial terraces. A total of 320 acres is mapped principally adjacent to Little Laughery Creek and other drainageways in the southwestern part of the county. Although the relief is nearly level and drainage good, most areas are subject to overflow.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown to brown friable medium-granular silt loam, relatively low in organic content. Reaction, medium acid.

7 to 24 inches, yellowish-brown to brownish-yellow friable silt loam to silty clay loam, containing an occasional thin lense or layer of fine sand. Reaction, medium acid.

24 inches +, yellowish-brown to brownish-yellow heavy silt loam to plastic silty clay loam, showing old depositional layers of varying thickness. Reaction, medium acid.

Variations in the profile characteristics are in texture of the subsoil layers and thickness of the various depositional layers.

Owing to its occurrence in narrow areas, often dissected by drainageways from the surrounding uplands, and to the difficulty of cropping the necessarily small field units, this soil is largely used for permanent pasture or forest. Cultivated areas are cropped to corn, wheat, and clover or timothy, with a few areas in vegetables, largely for home consumption. Corn usually follows hay crops in the rotation and yields 30 to 40 bushels an acre. Wheat is more generally fertilized than corn and yields about 15 bushels an acre. The better stands and yields of hay crops, consisting of clover or a mixture of clover and timothy, are obtained after the soil has been limed. Although it is not necessary to apply lime for growing clover, stands and yields may be materially increased by its use (1 or 2 tons an acre). Some damage results from floodwaters, but this is not great. Owing to the usually low organic and plant-nutrient content of this soil, crop yields may be materially increased under the better management practices, which involve plowing under all available organic matter and applying liberal quantities of commercial fertilizer.

Hennepin clay loam.—Principally adjacent to the larger streams in the regions of Early Wisconsin glaciation and closely associated with the steep phases of Russell silt loam, this soil, occurring on slopes of more than 55 percent, covers a total of only 128 acres. The 2- to 5-inch dark-gray to dark brownish-gray friable clay loam surface layer, relatively high in organic content, is underlain by calcareous glacial till similar to that underlying the Russell soils. Because of the steep relief and susceptibility to accelerated erosion, this type is essentially nonagricultural and should remain in forest. A few small areas have been cleared but no attempt has been made to cultivate them.

Martinsville loam.—Erosion is not a problem in management of this well- to extensively drained light-colored soil since it occurs on slopes of less than 3 percent. Except for the texture of the surface soil and upper subsoil, the profile characteristics are similar to the silt loam. Only 128 acres are mapped, principally in section 34, Laurel Township, with a few small areas on the glaciofluvial outwash plains and terraces in the valley of the Whitewater River. Management practices and crops grown are similar to those on the associated Martinsville silt loam and the Fox soils, and crop yields are only slightly lower than on the silt loam.

Martinsville silt loam.—Developed on glaciofluvial outwash plains and terraces underlain by silt and sand with some gravel and clay, this light-colored soil is the well-drained member of the catena that also includes the Whitaker and Mahalasville series. (The Whitaker and Mahalasville soils are not extensive enough in this county to be separated on the map.) A total area of 1,152 acres is mapped. The relief is nearly level to gently undulating, less than 3 percent gradient. Surface runoff is not rapid, except on the included steeper areas, and internal drainage is good. Native vegetation consisted of a mixed growth of hardwood trees, principally white and red oaks, beech, ash, elm, maple, walnut, and hickory.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable medium-granular silt loam, relatively low in organic content. Reaction, slightly to medium acid.

7 to 12 inches, light yellowish-brown to yellowish-brown coarse-granular heavy loam to silty clay loam, breaking into firm but not hard coarse granules. It is permeable to moisture movement and plant roots. Reaction, slightly to medium acid.
12 to 18 inches, yellowish-brown or brownish-yellow silty clay loam, breaking into ¼- to ½-inch subangular aggregates. It is permeable to moisture movement and plant roots. Reaction, slightly to medium acid.
18 to 45 inches, yellowish-brown to weak reddish-brown gritty clay loam to silty clay loam, breaking into ½- to 1½-inch subangular aggregates, and containing a few small rounded pebbles and gravel, especially in the lower part. Reaction, medium to slightly acid.
45 inches +, gray and yellow calcareous stratified silt and fine sand, with small quantities of clay and gravel.

Variations in the profile characteristics are in texture and thickness of the layers and depth to the underlying calcareous material. Where bordering areas of the Fox soils, the subsoil usually contains more grit, pebbles, and gravel than normal.

This soil is cropped about the same as the associated areas of Fox soils, the rotation consisting of corn, wheat, and clover or alfalfa, with an occasional crop of soybeans and other field crops. It is not so droughty as those soils and crop yields are, in general, slightly higher.

Corn usually follows hay in the rotation and yields about 40 bushels or more an acre. Wheat is commonly fertilized with 100 to 150 pounds an acre of commercial fertilizer and yields about 20 bushels. Although fair to good stands of clover and alfalfa have been obtained without liming the soil they can be improved by using sufficient lime to correct soil acidity.

Mapped with this soil are small areas having a slope of 3 to 12 percent that would have been separated as a sloping phase if they had been of sufficient extent. Also included are small areas of an imperfectly drained soil, principally in the northern part of section 34, Laurel Township, which, if more extensive, would have been mapped as Whitaker silt loam. Here the 6- or 7-inch surface layer is brownish-gray smooth friable silt loam, relatively low in organic content, and the subsoil to a depth of about 10 inches is brownish-gray coarse-granular heavy silt loam, underlain by mottled gray, yellow, and rust-brown silty clay loam, breaking into medium-sized subangular aggregates. Calcareous stratified silt and sand lie at a depth of 45 to 55 inches.

Martinsville silt loam, eroded sloping phase.—Occurring on 12- to 30-percent slopes, this phase has lost 25 percent or more of the surface soil from part of its areas by accelerated erosion. It covers a total area of 320 acres on narrow slopes between the silt loam or loam and the sweet alluvial soils. Except for the considerably thinner layers and slighter depth to the calcareous silt and sand it is similar to the loam in profile characteristics. Practically all of it has been cleared of its original forest cover, but at present only a few small areas are under cultivation. The present cover consists chiefly of briers, shrubs, and weeds, with a small percentage of bluegrass.

Included with this phase are a few small areas having a slope of more than 30 percent.

Pekin silt loam.—This light-colored moderately well-drained soil is developed on acid alluvial terraces. It covers a total of 64 acres on nearly level relief in the regions of Illinoian glaciation, principally in Ray Township, in association with Elkinsville and Bartle silt loams. Surface runoff is not rapid, and internal drainage is good in the upper part of the profile but somewhat restricted in the lower.

Following is a profile description in cultivated areas:

0 to 7 inches, light grayish-brown to light brownish-yellow smooth friable medium-granular silt loam, low in organic content. Reaction, strongly acid.

7 to 12 inches, light brownish-yellow to pale-yellow friable coarse-granular silt loam. Reaction, strongly to very strongly acid.

12 to 17 inches, light brownish-yellow to pale-yellow silty clay loam, breaking into ¼- to 1½-inch subangular aggregates. Reaction, strongly to very strongly acid.

17 to 50 inches, mottled gray, yellow, and rust-brown silty clay loam, breaking into 1- to 1½-inch subangular aggregates. The mottling becomes more intense in the lower part, and pockets, streaks, or blotches of rust brown or gray are numerous. Reaction, strongly to very strongly acid.

50 inches +, mottled and blotched gray, yellow, and rust-brown silt loam to silty clay loam, containing thin lenses or layers of very fine sand. Reaction, strongly acid.

Owing to its close association with Elkinsville and Bartle silt loams, the crop rotation on this soil is necessarily about the same as on those soils. This, in general, consists of corn, wheat, and hay crops, with occasionally soybeans and other field crops. As the soil is very deficient in organic matter and plant nutrients, it is necessary to plow under all available organic matter and plant residue and to apply liberal quantities of commercial fertilizer, not only for corn and wheat but also either directly or indirectly with soybeans and hay crops, to obtain good crop yields. It is essential to apply sufficient lime (3 or 4 tons an acre) to correct soil acidity and to maintain good stands of clover. Drainage is not a problem.

Corn usually follows hay crops in the rotation and yields about 35 bushels an acre under present management practices. Wheat follows corn or soybeans and averages about 15 bushels. Oats are not well adapted and are grown on only a small total acreage. Soybeans are occasionally grown and usually follow corn, yielding about 15 bushels an acre. Hay crops include either timothy or clover grown alone or a mixture of these.

Princeton fine sandy loam.—This soil is developed on wind-blown material of Wisconsin glacial age. The relief is undulating to sloping with very little surface runoff, and internal drainage is excessive. It covers only 64 acres in small isolated areas, principally on the east side of the West Fork of the Whitewater River, about 1 mile south of Laurel, and in the southwestern part of section 2, southeastern Brookville Township. Native vegetation consisted chiefly of oak.

Following is a profile description in cultivated areas:

0 to 7 inches, light grayish-brown to light yellowish-brown fine sandy loam, relatively low in organic content. Reaction, medium acid.

7 to 12 inches, light yellowish-brown to yellowish-brown fine sandy loam. Reaction, medium acid.

12 to 36 inches, yellowish-brown to weak reddish-brown friable sandy clay loam. Reaction, medium acid.

36 inches +, brownish-yellow loose fine sand to sand. Reaction, medium to slightly acid in upper part of the material, becoming calcareous at an average depth of about 70 inches.

Variations in the profile characteristics are in texture and thickness of layers and depth to calcareous sand.

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This soil is cropped to corn, wheat, and clover, although it is droughty and not well adapted to these crops; but, because of its occurrence in small isolated areas in association with the upland soils of Wisconsin glaciation and with the Fox soils, it is cropped about the same as those soils. It is better adapted to alfalfa and special crops, as melons and cucumbers, but the areas are usually too small for crop specialization.

Princeton fine sandy loam, eroded phase.—This phase occurs on undulating to sloping relief, with an average slope of 8 to 30 percent. It is similar to the type except that the 6- or 7-inch surface layer is brownish yellow to yellowish brown and includes some of the upper subsoil, and the organic and plant-nutrient content is lower. A total of 128 acres is mapped in relatively small isolated areas in the regions of Wisconsin glaciation, principally in the eastern part of the valley of the Whitewater River, the larger areas occurring in the southwestern part of section 28, and in the southeastern part of section 29, southeast of Brookville. This phase is partly in bluegrass pasture and partly cultivated to general crops. It is better adapted to alfalfa and such special crops as melons and cucumbers, but, because of its occurrence in small isolated areas, very little if any of these crops are grown. Pasture is of a medium to low quality, and crop yields are lower than on the typical soil.

Riverwash.—Consisting of a mixture of gravel, boulders, and sand, this type occurs as small islands in the Whitewater River system or between the present channel and an abandoned channel, usually only a few feet above water level in the normal river stage. These areas, totaling 448 acres, which are not stable and may disappear with the next floods, support a scant growth of small trees and weeds and are not suited to agriculture.

Ross silty clay loam.—This well-drained dark-colored soil differs from the Genesee soils principally in the darker color and higher organic content of the surface and upper subsoil layers. It occurs on alluvium washed from regions of Early Wisconsin glacial drift and glaciofluvial outwash plains and terraces. A total of only 256 acres occurs in small areas on the flood plains of the rivers and streams, principally in sections 3 and 31, Laurel Township, and in the valley of Pipe Creek, usually adjacent to sloping areas of the Fox or Fairmount soils. The dark color of the surface and upper subsoil layers is due, in part, to the high lime content in the wash from these soils. The relief is nearly level, and drainage conditions are good.

Following is a profile description in cultivated areas:

0 to 7 inches, dark-brown silty clay loam, relatively high in organic content. Reaction, neutral.

7 to 15 inches, dark-brown to dark yellowish-brown heavy silty clay loam to silty clay, breaking into angular irregular-sized pieces, tough and plastic when moist and hard when dry. Reaction, neutral.

15 inches +, brown or yellowish-brown plastic silty clay loam to silty clay, with thin layers of silt or fine sand below a depth of about 36 inches.

Variations in the profile characteristics are in color, texture, and thickness of the layers. A few partly weathered limestone fragments are on and in the profile in the areas adjacent to limestone slopes. In a few areas gravel and sand occur below a depth of 48 inches.

Although this soil, usually occurring well back from the stream channel, is flooded in periods of extremely high water, the frequency of the flooding is not so great as on the associated Genesee soils adjacent to the stream channel. The organic content of the surface and upper subsoil layers is higher than in those soils, but the heavier texture makes tilth conditions less favorable. The soil tends to puddle, and clods usually form when tillage operations are performed under unfavorable moisture conditions. It is cropped about the same as the associated Genesee soils, and crop yields are about the same as on Genesee silt loam. It is not so well adapted as those soils to growing wheat and other small grains, because of some damage from heaving caused by the heavier textured surface soil. Alfalfa is well adapted and is grown on many areas for several consecutive years.

Ross silty clay loam, high-bottom phase.—Although the profile characteristics of this phase are essentially the same as those of the type, the elevation is slightly higher; thus flooding is less frequent. A total area of 448 acres is mapped. Crops grown and yields obtained are about the same as on the typical soil.

Rossmoyne silt loam.—This moderately well-drained soil is developed on Illinoian glacial drift. It covers a total of 4,288 acres, occurring as small local flats on the narrow ridges, and usually in a position intermediate between the well-drained Cincinnati soils and the imperfectly drained Avonburg silt loam on the broader flats. The relief is undulating to nearly level (less than 8-percent gradient), thus erosion is not a problem. External drainage is good but not excessive, and internal drainage is good in the upper part and somewhat restricted in the lower. The native vegetation consisted chiefly of white, red, and black oaks, hickory, and maple trees, with small quantities of tuliptree, ash, and elm.

Following is a profile description in cultivated areas:

0 to 7 inches, light grayish-brown to light yellowish-brown smooth friable silt loam, low in organic content, composed of fine to medium distinctly developed granules. (In undisturbed wooded areas the 2- or 3-inch surface layer is dark yellowish-brown to dark brownish-gray smooth friable silt loam, relatively high in organic content.) Reaction, strongly to very strongly acid.

7 to 14 inches, light brownish-yellow friable smooth heavy silt loam, breaking into coarse-granular aggregates, soft when moist and hard when dry. In undisturbed wooded areas there is no sharp change between this layer and that above, but in cultivated areas a distinct plow line is noticeable. This layer is permeable to moisture movement and plant roots. Reaction, strongly to very strongly acid

14 to 18 inches, light-yellow to light brownish-yellow smooth friable silty clay loam, breaking into ¼- to ½-inch subangular aggregates, easily crushed when moist but hard when dry. Reaction, strongly to very strongly acid.

18 to 30 inches, mottled yellow and gray, with streaks and blotches of rust-brown, smooth silty clay loam, breaking into ½- to 1½-inch subangular particles, having a thin coating of gray colloidal clay on the cleavage or breakage faces and along old root and worm channels. Reaction, strongly to very strongly acid.

30 to 36 inches, mottled gray, yellow, and rust-brown heavy silty clay loam to silty clay, breaking into 1- to 2-inch subangular aggregates showing a tendency toward columnar or blocky structure in many areas. Reaction, strongly to very strongly acid.

36 to 120 inches, mottled gray, yellow, and rust-brown somewhat friable silty clay loam, having no definite breakage and usually falling apart into

irregularly sized and shaped pieces. It is more friable than the above subsoil layers. The upper part contains very little grit or pebbles but becomes gritty with depth, and varying quantities of pebbles and small rounded stones are present. Reaction, strongly to very strongly acid in the upper part and slightly acid in the lower.

120 inches +, gray and yellow unassorted and unconsolidated compact glacial till, composed of silt, clay, sand, and rock fragments. This represents the parent material.

Variations in the profile characteristics are in thickness and texture (except the surface texture) of the layers and depth to calcareous till. The presence of the compact somewhat impervious layer at a depth of 30 to 36 inches is erratic. Where areas of this soil lie adjacent to the Russell, Fincastle, and other soils developed on Early Wisconsin glacial drift, the depth to calcareous till is somewhat less than normal and the subsoil contains more grit and rock fragments.

This soil is cultivated to the general crops common to the regions of Illinoian glaciation, the usual rotation being corn, wheat or rye, and hay crops. As erosion is not a serious problem, a larger area is used for corn and other clean-cultivated crops than on Cincinnati silt loam. To maintain and increase productivity, it is important to use good management practices, which involve turning under all available organic matter, including crop residue, applying sufficient lime (3 to 4 tons an acre) to correct acidity, using sufficient commercial fertilizer of proper analyses, and growing more hay and small grains and less corn and other clean-cultivated crops.

Corn, which usually follows hay crops in the rotation, is usually fertilized with some commercial fertilizer, the larger applications being used in the southwestern part of the county. Yields of 20 to 30 bushels an acre under present management practices may be increased to 35 bushels or more under the better practices. Wheat, probably the second most important crop, follows corn or soybeans in the rotation and is more generally fertilized than any other crop, the quantity of fertilizer varying from 100 to 150 pounds or more an acre. Some rye is grown, but it is seldom fertilized. Oats, not so well adapted as wheat or rye, are grown on a relatively small acreage, with the use of very little or no fertilizer. Wheat and rye yield 10 to 15 bushels an acre and oats 20 to 30. Hay crops usually include a mixture of timothy and clover, with some lespedeza and redtop. Good stands of clover can be maintained if sufficient lime is applied to correct the acidity. Alfalfa is not adapted because of the strong acidity of the surface and subsoil layers. Timothy is better adapted than either clover or alfalfa, unless the soil is properly limed and fertilized before sowing clover. Lespedeza may be successfully grown and will probably replace other hay crops in the future. Special crops, as tomatoes and tobacco, are grown on a few areas, but the acreage is never large.

Rossmoyne silt loam, eroded phase.—More than 25 percent of the surface soil of this phase has been lost by accelerated erosion. Its total extent (192 acres) occurs on slopes of less than 8 percent. The 6- to 8-inch surface layer is variable, depending on the quantity of normal surface soil removed, and usually contains enough of the heavy-textured upper subsoil to lower tilth conditions and reduce fertility. About the same crops are grown as on the type, but yields are somewhat lower. With a proper cropping system and proper management practices, which involve growing more hay crops, especially clover, and more small grains and less clean-cultivated crops; plowing under all available crop residue; and using liberal quantities of commercial fertilizer, it is possible to maintain and improve the fertility level and increase crop yields.

Rossmoyne silt loam, eroded sloping phase.—Occurring on 8- to 25-percent slopes, this phase has lost more than 25 percent of the surface soil by accelerated erosion over a large part of its total extent (384 acres). Depending on the degree of accelerated erosion, the 6- to 8-inch surface layer varies from light yellowish-brown to light-yellow or light brownish-yellow friable silt loam to silty clay loam, and it has a very low organic content, low fertility level, and poor tilth conditions. The rest of the profile is similar to the type, except that the various subsoil layers are thinner. The crops grown are corn, wheat, and hay, with an occasional crop of soybeans, oats, and special field crops. The slope conditions and the past cropping methods have been largely responsible for the eroded condition of this phase. By using a long crop rotation system, which includes a winter cover crop at all times, and restricting the use of clean-cultivated crops, the fertility level and crop yields may be maintained and increased.

Rossmoyne silt loam, sloping phase.—A total of 192 acres of this phase occupies 8- to 25-percent slopes, on which little or no appreciable accelerated erosion occurs. Except for somewhat thinner layers, it is similar to the typical soil in profile characteristics. As erosion is somewhat of a problem on this phase when cultivated, good management practices are essential to maintain tilth conditions and fertility level. Practically all areas at present are in forest or have been recently converted into pasture, which accounts for the lack of erosion.

Rough gullied land (Cincinnati soil material).—In its total area of 2,624 acres, this phase includes areas having a slope of 8 percent or more on which a network of gullies, many of which are more than 20 feet deep, has developed. The very small severely sheet eroded intergully areas have been practically destroyed for agricultural use under present economic conditions. A few attempts to plow in the gullies and reclaim the land proved very unsatisfactory, as the heavy-textured subsoil is exposed, forming part or all of the plow soil, tilth conditions are very poor, and the organic and plant nutrient content is extremely low. Attempts were made in a few instances to establish a system of small dams across the larger gullies and plant the silted-in areas above the dams to trees, principally black locust, with unsatisfactory results. The high acidity and low organic content of the material, together with the inability to sufficiently reduce accelerated erosion, accounts for the failure to secure a good tree growth.

Russell silt loam.—This well-drained soil is developed on Early Wisconsin glacial drift. It differs from Cincinnati silt loam in having less acid surface and subsoil layers and calcareous till at an average depth of about 45 inches instead of about 120 inches as in that type. The parent or underlying material of unconsolidated silt, clay, sand, and rock fragments is very ununiform in composition and may vary greatly within a short distance, causing local variations in the profile, both in color and texture of the various layers. This is a major soil type in region D, as shown on the soil association map (fig. 4), covering a total area of 19,840 acres throughout the regions of Early Wisconsin glaciation. It occurs on slopes of 3 to 12 percent, with little or no appreciable accelerated erosion. External drainage is good to somewhat excessive and internal drainage good, except in the lower subsoil in a few areas. The native vegetation consisted of a dense growth of deciduous trees, chiefly white oak, hickory, ash, elm, maple, and poplar, with some sycamore and beech.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown smooth friable granular silt loam, relatively low in organic content. (In undisturbed wooded areas the 2- or 3-inch surface layer is dark yellowish-brown to dark brownish-gray friable silt loam, relatively high in organic content.) Reaction, medium acid.

7 to 10 inches, light yellowish-brown to brownish-yellow friable heavy silt loam, usually free of grit and pebbles, breaking into coarse granules or small subangular aggregates, easily crushed when moist. This layer is permeable to moisture movement and plant roots. Reaction, medium to strongly acid.

10 to 18 inches, brownish-yellow to yellowish-brown silty clay loam, breaking into ¼- to ½-inch subangular aggregates, easily crushed into coarse granules when moist but hard when dry. The material is permeable to moisture movement and plant roots. Reaction, medium to strongly acid.

18 to 36 inches, brownish-yellow to yellowish-brown compact silty clay loam, breaking into ½- to 1½-inch subangular aggregates, having a thin coating of gray colloidal clay on many of the cleavage faces, giving a somewhat mottled appearance in place, but the gray color disappears when the material is crushed. It is permeable to moisture movement and plant roots. Reaction, medium to strongly acid.

36 to 45 inches, brownish-yellow silty clay loam, less compact and more friable than the above layer, breaking into irregular-sized subangular pieces and containing a considerable quantity of grit and small rock fragments. Reaction, medium to slightly acid.

45 inches +, gray and yellow compact calcareous glacial till, composed of unassorted silt, clay, sand, and rock fragments.

Variations in the profile characteristics are in texture and thickness of the layers, and the depth to calcareous till—about 36 to 60 inches. Where this soil is mapped adjacent to areas of Cincinnati silt loam, the depth to calcareous till is usually greater than normal, and the lower subsoil usually contains less grit and rock fragments.

In general, the crop rotation consists of corn, wheat or oats, and clover, timothy, or alfalfa, or a mixture of these. An occasional crop of tobacco, rye, and vegetables is grown, and soybeans are increasing in importance in the rotation. Constant replenishment of the naturally low organic content is necessary to maintain and increase crop yields.

Corn usually follows hay crops in the rotation or it may be grown where fall-sown small grains have been winterkilled. Where this soil is associated with the larger areas of Cope, Brookston, and Clyde soils, especially in Bath and north Springfield Townships, it receives more barnyard manure and other organic matter than that in other parts of the county. A general practice is to use 50 to 150 pounds or more of commercial fertilizer an acre for corn. Average acre yields of about 40 bushels under present management practices may be increased to 50 bushels or more under good practices and with favorable weather conditions. The soil is excellent for growing wheat, fertilization of which is probably more general than of any other crop grown, and yields average about 18 bushels an acre. Very little commercial fertilizer is used for rye, which occasionally takes the place of wheat in the rotation. Few areas are fertilized for oats, which usually follow corn or soybeans in the rotation, but a few farmers apply rather heavy applications of commercial fertilizer at the time of seeding oats, more for indirect fertilization of clover and alfalfa than for benefits derived from increased oat yields. Yields of 25 to 45 bushels an acre are largely limited by weather conditions during the growing season.

Hay crops consist of a mixture of clover, alfalfa, timothy, and alsike with some bromegrass, or clover or alfalfa grown alone. Good stands of alfalfa and clover can be secured if sufficient lime (2 to 3 tons an acre) is applied, and on improperly managed areas it is also important to apply phosphate and potash fertilizers to assure good stands of hay crops. This is usually best accomplished by applying relatively large quantities of fertilizer at the time of seeding small grains, which usually precede hay crops. Soybeans, increasing in importance, usually follow corn or small grains in the rotation, yielding 15 to 25 bushels an acre. Under good management practices and with proper weather conditions during the growing season, higher yields are obtained. A small acreage is used for special vegetable crops, as tomatoes and potatoes, and for tobacco.

Russell silt loam, eroded phase.—In association with the type and its other phases, this phase covers a total of 11,776 acres in regions of Early Wisconsin glaciation. It occupies 3- to 12-percent slopes from which more than 25 percent of the surface soil and part of the subsoil have been removed by accelerated erosion over a large part of its extent. Depending upon the degree of accelerated erosion the 6- or 7-inch surface layer varies from light yellowish-brown smooth friable silt loam to yellowish-brown or brownish-yellow silty clay loam. In a few small areas the lower subsoil is exposed. The organic content is extremely low and tilth conditions are poor, owing to the inclusion of a large part of the subsoil with the cultivated or present surface soil. The rest of the profile is similar to the typical soil.

The rotation system used is similar to that on the type, but crop yields are materially lower and good stands of clover and alfalfa are more difficult to obtain. A good management program is essential to maintain and increase production and to prevent future loss of surface soil and plant nutrients by accelerated erosion.

Russell silt loam, eroded sloping phase.—Occurring on 12- to 30-percent slopes, this phase has lost more than 25 percent of the surface soil and part of the subsoil by accelerated erosion over a large part of its extent. It covers a total of 3,712 acres in the regions of Early Wisconsin glaciation, associated with the type and its other phases. Depending upon the degree of accelerated erosion, the 6- or 7-inch surface layer varies from light yellowish-brown smooth friable silt loam to brownish-yellow or yellowish-brown silty clay loam. The organic content is extremely low, tilth conditions are poor, and the fertility level is low. The rest of the profile is similar to the typical soil, except that the subsoil layers are somewhat thinner.

A large part of this phase is cultivated to about the same crops as the type, but yields are materially lower. Under careful management practices, comprising a long crop rotation, winter cover crop, and the growing of legumes, less seriously eroded areas may be continued in agricultural production. The more seriously eroded areas would probably be better suited to permanent pasture or possibly to forest. After correcting soil acidity and applying sufficient quantities of commercial fertilizer, good permanent bluegrass pastures can be established and maintained.

Russell silt loam, eroded steep phase.—Occurring on 30- to 55-percent slopes, a large part of this phase has lost 25 percent or more of the surface soil, or all of the surface soil and part of the subsoil by accelerated erosion. It covers a total area of 3,072 acres, principally adjacent to the streams and drainageways in the Early Wisconsin glaciated areas. Depending upon the degree of accelerated erosion, the 6- or 7-inch surface layer varies from yellowish-brown to brownish-yellow heavy silt loam to silty clay loam. The organic content is extremely low, tilth conditions are very poor, and the fertility level is low. The rest of the profile is similar to the typical soil, except for the considerably thinner layers and less depth to calcareous till.

Areas of this phase were cleared and cultivated in the past. At present, however, only a few small areas are cultivated, the phase being largely in permanent pasture. Because of slope conditions and susceptibility to erosion, its best use is for permanent pasture or forest.

Included in mapping are numerous small areas on which gullies more than 3 feet deep occur.

Russell silt loam, level phase.—This phase occurs on slopes of less than 3 percent, having little or no appreciable accelerated erosion. A total of 512 acres is mapped, principally in the northeastern part of Bath Township. The profile is similar to the type except for the somewhat thicker layers and the usually slightly greater average depth to calcareous till. It is cropped about the same as that soil, but slightly higher yields are obtained. Internal drainage is good, and, because of the small extent of the areas, external drainage does not become a management problem.

Mapped with this phase are a few small areas that would have been mapped separately as a terrace phase if the total extent had been greater. This inclusion has essentially the same profile characteristics as the type except for the slightly thicker layers and its occurrence on a terrace or benchlike position on smooth to nearly level topography with a slope of less than 3 percent. It occurs north and northwest of Cedar Grove in a position intermediate between the upland areas of Early Wisconsin glacial drift and the outwash plain and terrace areas of the Fox and associated soils. The crops grown are similar to those on the typical soil, with yields about the same or slightly higher. Drainage conditions are good, and accelerated erosion is not a problem because of the nearly level relief.

Russell silt loam, severely eroded sloping phase.—A total area of 4,992 acres of this phase is mapped. It occurs on 12- to 30-percent slopes, from which 75 percent or more of the surface soil, or all the surface soil and part of the subsoil have been removed by accelerated erosion. Depending upon the degree of accelerated erosion, the 6- or 7-inch surface layer varies from yellowish-brown to brownish-yellow smooth heavy silt loam to silty clay loam. The organic content is extremely low, tilth conditions are poor, and the fertility level is low. With the exception of thinner subsoil layers and less depth to calcareous till, the rest of the profile is similar to the typical soil. Most of this phase is cultivated at present, with the rotation system about the same as on the type, but yields are very low. A few areas are in fair to poor bluegrass pasture.

Included are numerous small areas on which gullies more than 3 feet deep occur. The intergully areas are severely sheet-eroded.

Russell silt loam, sloping phase.—The 2,112 acres of this phase occur on slopes of 12 to 30 percent, on which very little or no appreciable accelerated erosion has developed. The profile is similar to the type, except for the somewhat thinner layers and less depth to calcareous till. The slope conditions are such that erosion is potentially severe, and improper rotation and management practices soon result in loss of surface soil. Except for a few small areas, this phase is in forest or permanent bluegrass pasture. The cultivated areas are cropped about the same as the typical soil, but, owing to the more rapid runoff of surface water and less favorable moisture relations, yields are somewhat lower. Fair to good permanent bluegrass pasture could be materially improved by applying sufficient lime to correct soil acidity and using rather liberal applications of a commercial fertilizer relatively high in phosphate.

Russell silt loam, steep phase.—This phase occurs on slopes of 30 to 55 percent, with very little or no appreciable accelerated erosion. A total of 1,600 acres is mapped throughout the regions of Early Wisconsin glaciation, especially adjacent to the streams and drainageways. Except for the considerably thinner layers and less depth to calcareous till, the profile is similar to the typical soil. Because of the steep relief and susceptibility to accelerated erosion when cleared, this phase is unsuited to agriculture and at present is in forest or permanent bluegrass pasture. Areas of this slope that were cleared and cultivated in the past are mapped as the eroded steep phase.

Stony and gravelly alluvium.—This land type is a variable mixture of gravel, stones, and sand, with small quantities of silt and clay. A total of 1,984 acres is mapped on alluvial flood plains of Whitewater River and its larger tributaries in the region of Early Wisconsin glaciation, adjacent to the river channel and where the swift floodwaters have cut through from one bend of the river to another. Where small areas occur closely associated with larger areas of the Genesee soils, the same crops are grown as on those soils, but yields are extremely low. Alfalfa produces fair yields. As this type is not adapted to agriculture a large part is idle and supports a growth of weeds and brush.

Washtenaw silt loam.—This accumulation of light-colored material has washed from the surrounding upland areas over the darker colored Brookston and Clyde soils. It covers a total of only 64 acres in depressional areas surrounded by Russell and, in some cases, Fincastle soils, the larger areas occurring in sections 16 and 21 of Blooming Grove Township, with smaller isolated ones throughout the Early Wisconsin glacial drift regions. Natural drainage is very poor, and present drainage conditions are extremely variable. Some inadequately drained areas, because of their occurrence in small pocketlike positions, are extremely difficult to drain artificially.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to dark yellowish-brown friable medium-granular silt loam. The organic content is variable and usually somewhat higher than the surface soil of the associated light-colored Fincastle and Russell soils and lower than that of the Cope and Brookston soils. Reaction, slightly acid to neutral.

7 to 15 inches, dark yellowish-brown to dark brownish-yellow heavy silt loam, having a platy or laminated structure. Reaction, slightly acid to neutral.

15 to 55 inches, mottled gray, yellow, and rust-brown silty clay loam, breaking into irregular-sized angular pieces. Reaction, neutral.

55 inches +, gray and yellow compact calcareous glacial till, composed of unassorted silt, clay, sand, and rock fragments.

Variations in the profile characteristics are in the texture and thickness of the layers, especially the thickness of the silted-in material, which varies from 12 to 36 inches or more. Where it attains the greater thickness the lower part is mottled gray, yellow, and rust brown.

The crops grown are about the same as on the associated soils, the usual rotation consisting of corn, wheat or oats, and hay crops, with some soybeans. Where drainage is adequate, crop yields are similar to those obtained on Cope silt loam. It is not uncommon for crops to be "drowned-out" on areas of this soil, especially fall-sown small grains and hay crops. A few small areas are at present in permanent bluegrass pasture.

Westland silty clay loam.—Developed on glaciofluvial outwash plains and terraces, this soil is the dark-colored poor to very poorly drained member of the catena that also includes the Fox, Homer, and Abington series. (The Homer and Abington series do not occur in this county). It is inextensively mapped, covering only 64 acres in slight depressional areas in association with Fox and Martinsville soils, the larger areas occurring in section 3 in the southern part of Brookville Township; in the southeastern part of section 32, Whitewater Township; and in the northwestern part of section 21, Brookville Township. Natural drainage is very poor, but most areas have been artificially drained sufficiently for cropping. Native vegetation consisted chiefly of red maple, elm, and ash trees, and marsh grasses.

Following is a profile description in cultivated areas:

0 to 7 inches, dark-gray to very dark brownish-gray silty clay loam, relatively high in organic content. Reaction, neutral.

7 to 16 inches, dark-gray to dark brownish-gray plastic silty clay loam, having a few light-yellow or rust-brown mottlings in the lower part. The organic content is relatively high and the reaction neutral. The material is permeable to moisture movement and plant roots. Numerous small glacial gravels and an occasional boulder are present.

16 to 50 inches, mottled gray, yellow, and rust-brown waxy and gravelly clay loam, breaking into large angular pieces, plastic when moist, sticky when wet, and hard when dry. Rather numerous rounded pebbles

and gravel occur in the upper part and increase with depth, and an occasional large stone or boulder is present. Reaction, neutral.

50 inches +, gray and light-yellow calcareous stratified gravel and sand.

Variations in the profile characteristics are in the texture and thickness of the layers and depth to calcareous gravel and sand. In a part of the area mapped in section 3, south Brookville Township, which would have been separated as Abington silty clay loam if sufficiently extensive, the 6- or 8-inch surface layer is very dark-gray to nearly black silty clay loam, extremely high in organic content; the subsoil to a depth of about 18 inches is dark-gray to very dark-gray silty clay loam to clay loam, underlain by gray gravelly clay loam containing a thin layer of gray marl in some places. Gray loose calcareous gravel and sand lie at a depth of about 48 inches.

Owing to the occurrence of this soil in relatively long and narrow areas, closely associated with Fox silt loam, crop rotations are essentially the same as on that soil. Under present management practices corn yields about 50 bushels an acre, with 55 bushels or more not uncommon in seasons of favorable weather conditions. Wheat yields about 20 to 22 bushels an acre, but it may be occasionally drowned out or damaged by lodging of the grain. Good stands of alfalfa and clover may be obtained without liming, but some damage to these crops results from heaving and drowning out.

Wilbur silt loam.—Moderately well drained, this member of the catena that also includes the Haymond series is a mixture of alluvium from Illinoian glacial drift areas and limestone slopes. It is somewhat less well drained than Haymond silt loam, with restricted drainage conditions in the lower part of the subsoil. It covers a total of 1,216 acres along the drainageways in the southwestern and south-central parts of the county and is the principal alluvial soil mapped along Little Laughery Creek and its tributaries. Native vegetation consisted principally of elm, ash, and swamp oak trees.

Following is a profile description in cultivated areas:

0 to 7 inches, light grayish-brown to light brownish-yellow smooth medium-granular friable silt loam, relatively low in organic content. Reaction, medium acid.

7 to 15 inches, light brownish-yellow to pale-yellow heavy silt loam to silty clay loam. Reaction, medium acid.

15 inches +, mottled gray, yellow, and rust-brown loam to silty clay loam, somewhat variable in texture, with noticeable layers or horizons of varying thickness. Partly decayed tree branches, twigs, and other organic debris are usually present throughout. Reaction, medium acid.

Variations in the profile characteristics are in the texture of the subsoil and the thickness of the depositional layers.

A larger part of this than of the associated Haymond silt loam is cultivated, and field units are usually larger. The common rotation consists of corn, wheat, and clover or timothy, with some soybeans. Vegetables for home consumption are grown on small areas.

It is a more common practice to use fertilizer with wheat than with corn. Under the better management practices, which involve plowing under all available organic matter, using liberal applications of commercial fertilizer, and applying 1 to 2 tons of lime an acre to correct acidity, average corn and wheat yields of about 30 bushels and 15 bushels an acre, respectively, may be materially increased. Average soybean yields of about 20 bushels an acre may be substantially increased by direct or indirect fertilization and by correcting soil acidity. Although clover may be grown without using lime, the better stands and yields are obtained on areas where acidity has been corrected by its use. About 40 to 50 percent of this soil is at present in permanent bluegrass pasture or forest.

Mapped with this soil are several small areas of Wakeland silt loam which would have been shown separately if the total extent were greater. This inclusion is an imperfectly drained light-colored soil on mixed alluvium from areas of Illinoian glaciation and limestone slopes. It occurs in small areas on the alluvial flood plains in the southwestern and south-central parts of the county, usually well back from the larger stream channels and often adjacent to low acid terrace areas. Where possible, areas of this soil should be artificially drained. Native vegetation consisted chiefly of ash, elm, and sycamore trees.

Following is a profile description in cultivated areas:

0 to 7 inches, brownish-gray to light brownish-gray medium-granular friable silt loam, relatively low in organic content. Reaction, medium acid.

7 to 20 inches, mottled gray and yellow friable silt loam to silty clay loam, with numerous rust-brown spots and blotches. Reaction, medium acid.

20 inches +, mottled gray, yellow, and rust-brown loam to silty clay loam that is variable, with noticeable old depositional layers or horizons of various thickness. Reaction, medium acid.

Variations in the profile characteristics are in the texture of the subsoil and thickness of the depositional layers.

The few small areas of the inclusion are at present either in permanent bluegrass pasture or have a scattered tree growth of ash, elm, and sycamore, with an undergrowth of bluegrass. For better crop production, it is necessary to drain this soil artificially. Tile drains are probably extremely difficult to use on most areas, but it is possible to use dead furrows or shallow ditches for artificial drainage. As the soil is naturally low in organic matter and plant nutrients, these elements should be supplied to obtain good crop yields. Although clover may be grown without using lime, better yields are obtained after soil acidity has been corrected by its use.

Williamsburg silt loam.—Developed on high terraces, probably of Early Wisconsin age, this light-colored soil is well to excessively drained. A total of 192 acres is mapped, principally on the high terraces and benches along the lower part of Salt Creek, and on the north side of the West Fork of Whitewater River, north, east, and west of Metamora. These terraces, often 50 feet or more above the adjacent flood plains, are the highest in the region. The relief is nearly level to gently undulating, with a gradient of less than 3 percent. Surface runoff is good but not excessive and internal drainage good.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable medium-granular silt loam, relatively low in organic content. Reaction, medium acid.

7 to 12 inches, yellowish-brown coarse-granular friable heavy silt loam, with some evidence of platy structure. Reaction, medium to strongly acid.

12 to 17 inches, yellowish-brown to brownish-yellow silty clay loam, breaking into ¼- to ¾-inch subangular aggregates, usually free of pebbles. It is permeable to moisture movement and plant roots. Reaction, medium to strongly acid.

17 to 50 inches, yellowish-brown to brownish-yellow gritty heavy silty clay loam, breaking into 1- to 2-inch subangular aggregates, slightly plastic when moist and hard when dry. A thin coating of gray very fine sand in on some of the cleavage faces, and a few blotches and pockets of gray silty material occur in the lower part of the layer. Reaction, medium to strongly acid.

50 to 120 inches, alternate layers or beds of gray and yellow fine sand and silt, varying from ⅛-inch to more than 1 foot thick. Reaction, strongly to medium acid in the upper part and slightly acid in the lower.

120 inches +, gray and yellow calcareous stratified sand, silt, and gravel.

Variations in the profile characteristics are in the thickness and texture (except the surface texture) of the various layers and the depth to calcareous material.

The cropping system consists of corn, wheat and clover and/or timothy. Corn yields about 35 bushels an acre and wheat about 15 to 18 bushels. Most farmers use commercial fertilizer for wheat, but corn is not generally fertilized. To maintain good stands of clover, it is necessary to apply sufficient lime to this soil to correct acidity.

Williamsburg silt loam, steep phase.—Except for thinner layers and considerably less depth to calcareous stratified material, the profile characteristics of this phase, which occurs on slopes of more than 25 percent, are similar to those of the typical soil. Of the total area of 256 acres mapped, only a few small areas are cultivated, the larger part either being in forest or supporting a growth of briers, shrubs, weeds, and bluegrass. It is probably better adapted to bluegrass pasture and forest than to cultivated crops.

Included are a few small areas from which 25 percent or more of the surface soil has been removed by accelerated erosion. Here the 6- or 7-inch surface layer is yellowish-brown or brownish-yellow silty clay loam.

Wynn silt loam.—Underlain by limestone bedrock at a depth of 30 to 60 inches, this is a well-drained light-colored soil developed from Early Wisconsin glacial drift. It occurs in the northeastern and east-central parts of the county, principally in east Bath Township and in northeast Springfield Township. A total area of 1,664 acres is mapped. The relief is nearly level—less than 3 percent—and, largely because of the somewhat porous and fragmentary character of the underlying limestone bedrock, internal drainage conditions are good. Native vegetation consisted chiefly of maple, ash, elm, and white and red oak trees.

Following is a profile description in cultivated areas:

0 to 7 inches, grayish-brown to light yellowish-brown friable smooth medium-granular silt loam, relatively low in organic content. (In undisturbed wooded areas the 2- or 3-inch surface layer is dark brownish gray and relatively high in organic content.) Reaction, slightly to medium acid.

7 to 12 inches, yellowish-brown to brownish-yellow friable granular silt loam, breaking into coarse granular aggregates. Reaction, slightly to medium acid.

12 to 18 inches, yellowish-brown to brownish-yellow silty clay loam, breaking into ¼- to ½-inch subangular aggregates. Reaction, slightly to medium acid.

18 to 30 inches, brownish-yellow heavy silty clay loam, breaking into ¾- to 1¾-inch subangular aggregates. It contains some grit and a few small pebbles, especially in the lower part. Reaction, slightly to medium acid.

30 to 40 inches, brownish-yellow heavy silty clay loam to clay loam, containing numerous small pebbles and rock fragments. Reaction, slightly acid.

40 to 46 inches, gray and yellow calcareous glacial till composed of unassorted silt, clay, sand, and rock fragments.
46 inches +, limestone bedrock.

Variations in the profile charactertistics are in the thickness of the layers and the depth to calcareous till and to limestone bedrock. In general, the depths to calcareous till and to bedrock are somewhat greater in the western part of the region where this soil grades into Russell silt loam.

The rotation system in general use on this soil consists of corn, wheat, and hay crops, with an occasional crop of soybeans. Although the relatively shallow depth to limestone does not seriously affect crop yields in seasons of normal or excessive rainfall, they are somewhat reduced in seasons of low rainfall. This is especially true of corn. Erosion control is not a factor, owing to the nearly level relief.

Corn, usually following hay crops in the rotation, is commonly fertilized with 60 to 150 pounds of commercial fertilizer an acre, and yields average about 40 bushels. Wheat is well adapted and under present management practices yields about 18 to 20 bushels an acre. Most farmers use 100 to 150 pounds or more of commercial fertilizer an acre for wheat, and a few farmers top-dress it with barnyard manure. Oats, not so well adapted as wheat, are a minor crop, usually taking the place of wheat in the rotation. Hay crops consist of a mixture of clover, alfalfa, timothy, and alsike, or clover or alfalfa grown alone. Although good stands of clover and alfalfa have been obtained without the use of lime, they may be improved by applying sufficient lime to correct soil acidity. Soybeans are increasing in importance and usually follow corn in the rotation, yielding 18 to 22 bushels an acre,

Included are several areas where the calcareous till layer is absent. Here the lower subsoil is more plastic than normal, and the depth to underlying bedrock varies from 20 to 30 inches.

Wynn silt loam, eroded gently sloping phase.—Occurring on slopes of 3 to 12 percent, this phase has lost 25 percent or more of the surface soil or all the surface soil and part of the subsoil by accelerated erosion. A total of 1,920 acres is mapped in the northeastern and east-central parts of the county in association with the typical soil and its other phases. The 6- or 7-inch surface layer varies from light yellowish-brown smooth friable silt loam to yellowish-brown or brownish-yellow silty clay loam. The organic content is low and tilth conditions are usually poor, owing to the inclusion of the heavy-textured normal subsoil with the surface soil. The rest of the profile is similar to the typical soil. Crops grown are about the same as on that soil, but yields are materially lower. To control erosion and increase crop yields it is essential to use good management practices, which involve the use of a rotation system that includes less clean-cultivated crops and more close-growing crops, as small grains and hay. A few areas are in permanent bluegrass pasture.

Wynn silt loam, eroded sloping phase.—On its slopes of 12 to 30 percent, this phase has lost 25 to 75 percent of the surface soil by accelerated erosion over a large part of its extent. A total of only 384 acres is mapped in the northeastern and east-central parts of the county, principally adjacent to the drainageways, associated with the other phases of the typical soil. The 6- or 7-inch surface layer varies from light yellowish-brown friable smooth granular silt loam to yellowish-brown or brownish-yellow silty clay loam. The organic content is lower and tilth conditions are poorer than on the typical soil. Except for the somewhat thinner layers and somewhat less depth to bedrock, the rest of the profile is similar to that soil. This phase is largely cultivated to the general crops of the region, but yields are materially lower than on the normal type. Owing to the sloping conditions and loss of organic matter and plant nutrients by accelerated erosion, this phase is not so well adapted to the rotation system used on that type. One which involves plowing under all available organic matter and includes less clean-cultivated crops—corn and more hay, especially alfalfa and clovers—will aid in preventing further damage by erosion and will maintain and increase crop yields. A few areas are in permanent bluegrass pasture of fair quality.

Wynn silt loam, eroded steep phase.—Occurring on slopes of 30 percent or more, this phase has lost 25 percent or more of the surface soil, or all the surface soil and part of the subsoil by accelerated erosion over a large part of its extent. A total of only 384 acres is mapped in the northeastern and east-central parts of the county, principally adjacent to the drainageways. The 6- or 7-inch surface layer is yellowish-brown or brownish-yellow silty clay loam, very low in organic content. Except for the considerably thinner layers and the average depth of only about 20 inches to bedrock the rest of the profile is similar to the typical soil. This phase has been cleared and is at present in pastures consisting predominantly of various weeds and briers with only a small percentage of bluegrass. It is probably best adapted to forest or permanent pasture.

Wynn silt loam, gently sloping phase.—A total area of 256 acres of this phase is mapped in the northeastern and east-central parts of the county in association with the typical soil and its other phases. It occurs on slopes of 3 to 12 percent and has very little appreciable accelerated erosion. The profile is similar to the typical soil, and, in general, depth to bedrock is about the same. Management practices and crops grown are about the same as on the normal type, and yields are about the same or slightly less. Owing to the gently sloping conditions, this type is more likely to be affected by accelerated erosion than is the normal, especially under bad management practices, and good management is required to prevent loss of the surface soil and plant nutrients. A few areas are in permanent bluegrass pasture or forest.

Wynn silt loam, severely eroded sloping phase.—On its 12- to 30-percent slopes this phase has lost 75 percent or more of the surface soil or all the surface soil and part of the subsoil by accelerated erosion over a large part of its extent. Depending upon the degree of erosion, the 6- or 7-inch surface layer is variable but usually brownish-yellow or yellowish-brown silty clay loam. The organic content is extremely low and tilth conditions are very poor, owing to the presence of large quantities of the normal subsoil in the surface layers. Except for the considerably thinner layers and less depth to the underlying bedrock, the rest of the profile is similar to the normal type. A total area of

1,792 acres is mapped in the northeastern and east-central parts of the county, principally adjacent to the drainageways. All this phase has been cleared and cultivated, but only a few areas are at present in cultivation, and crop yields are low. Most of the soil is in pasture consisting of a sparse growth of Kentucky bluegrass, briers, and various weeds.

Included are several small areas on which gullies that extend down to the underlying bedrock occur. Here the intergully areas are usually severely sheet eroded.

Wynn silt loam, sloping phase.—This phase is mapped in the northeastern and east-central parts of the county, associated with the normal type and its other phases. It has a total area of 320 acres. It occurs on 12- to 30-percent slopes on which little or no accelerated erosion has developed. The soil profile is essentially the same as the normal type, except that the layers are somewhat thinner and depth to bedrock is somewhat less.

Most of this phase is at present in forest, with a few small areas in good bluegrass pasture. It is likely to become eroded under cultivation, and the cultivated areas on this slope range are mapped as the eroded sloping phase.

Wynn silt loam, steep phase.—Little or no appreciable accelerated erosion has developed on this phase, which occurs on slopes of more than 30 percent. The profile is similar to the typical soil in number and arrangement of layers, but the thickness of the layers is considerably less and the average depth to bedrock about 20 inches. It covers a total area of 192 acres, all in forest to which it is probably best suited.

ESTIMATED YIELDS AND PRODUCTIVITY RATINGS

In table 10 the soils are listed alphabetically and estimated average acre yields of the principal crops are given for each soil under both common and better farming practices.

The estimates are based primarily on interviews with farmers, the county agent, members of the Purdue University Agricultural Experiment Station, direct observation by members of the soil survey party, and results obtained on experimental farms by the experiment station. They are presented only as estimates of the average production over a period of years, according to the two broadly defined types of management. They may not apply directly to specific tracts of land for any particular year, as the soils shown on the map may vary somewhat from place to place, management practices differ slightly from farm to farm, and climatic conditions fluctuate from year to year. On the other hand, these estimates are as accurate as may be obtained without further detailed and lengthy investigations, and they serve to bring out the relative productivity of the soils mapped.

In order to compare directly the yields obtained in this county with those obtained in other parts of the country, yield figures have been converted in table 11 to indexes based on standard yields.

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TABLE 10.—*Estimated average acre yields of the principal crops on each soil in Franklin County, Ind.*

[Yields in columns A indicate the average crop obtained under prevailing practices, which include crop rotations, some erosion control practices, and the use of some legumes, commercial fertilizers, lime, and barnyard and green manures; those in columns B indicate the average crop obtained with improved methods of management, which include the more intensive use of the prevailing practices. Absence of a yield figure indicates that the crop is not commonly grown]

Soil [1]	Corn		Wheat		Oats		Soybeans		Mixed hay		Red clover		Alfalfa	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu-*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Avonburg silt loam.														
Drained	25	45	12	20	20	30	15	20	1.0	1.8	0.6	1.4	----	----
Undrained	10	----	7	----	10	----	10	----	.6	----	----	----	----	----
Eroded gently sloping phase	20	40	10	17	15	25	12	15	.8	1.5	.4	.8	----	----
Gently sloping phase	25	45	12	20	20	30	15	20	1.0	1.8	.6	1 4	----	----
Bartle silt loam:														
Drained	25	45	12	20	20	30	15	20	1.0	1.8	.6	1.0	----	----
Undrained	10	----	7	----	15	----	10	----	.6	----	----	----	----	----
Bellefontaine silt loam	30	40	12	20	17	25	15	20	1.2	1.8	1.0	1.5	2 5	3.6
Brookston silty clay loam:														
Drained	50	60	18	25	37	47	22	25	2.2	2 5	1.8	2.0	3 0	3 8
Undrained	25	----	5	----	15	----	12	----	1.6	----	1.4	----	2.0	----
Cincinnati silt loam	25	35	12	20	25	35	12	20	1 0	1 5	.6	1.2	----	----
Eroded phase	20	30	8	15	20	30	10	15	.4	1 0	.4	.8	----	----
Eroded sloping phase	15	25	6	10	12	15	8	12	.3	.8	.2	8	----	----
Eroded steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Gullied sloping phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Gullied steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sloping phase	20	30	8	15	15	20	10	15	.4	1 0	.2	1.0	----	----
Steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Clermont silt loam:														
Drained	25	40	10	15	20	25	10	15	1.0	1.6	.6	1.2	----	----
Undrained	10	----	5	----	10	----	10	----	.6	----	----	----	----	----
Clyde silty clay loam														
Drained	45	55	15	20	30	45	22	25	2.0	2.2	1 6	2.0	2.8	3.6
Undrained	10	----	5	----	10	----	10	----	1.0	----	1.0	----	1.0	----
Cope silt loam.														
Drained	50	60	18	25	37	47	22	25	2 2	2.5	1 8	2.0	3.0	3.8
Undrained	25	----	5	----	15	----	12	----	1 6	----	1 4	----	2.0	----
Delmar silt loam.														
Drained	25	40	10	15	20	25	10	15	1.0	1.6	.8	1 4	1.6	2.4
Undrained	15	----	5	----	10	----	7	----	.4	----	.4	----	.8	----
Edenton silt loam	25	35	12	17	15	20	10	15	.4	1.0	.2	1.0	----	----
Eroded phase	15	25	6	10	12	15	8	12	.4	1.0	.2	.8	----	----
Eroded steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----

[1] The terms "drained" and "undrained" have reference to artificial drainage.

TABLE 10.—*Estimated average acre yields of the principal crops on each soil in Franklin County, Ind.*—Continued

[Yields in columns A indicate the average crop obtained under prevailing practices, which include crop rotations, some erosion control practices, and the use of some legumes, commercial fertilizers, lime, and barnyard and green manures; those in columns B indicate the average crop obtained with improved methods of management, which include the more intensive use of the prevailing practices. Absence of a yield figure indicates that the crop is not commonly grown.]

Soil [1]	Corn		Wheat		Oats		Soybeans		Mixed hay		Red clover		Alfalfa	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Eel silt loam:	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu*	*Bu.*	*Bu*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Drained	50	60	15	18	30	35	22	25	2.2	2.5	1.8	2.0	3.0	3.6
Undrained	40		10		20		20		1.4		1.4		2.6	
Elkinsville silt loam	25	35	12	20	25	35	12	20	.8	1.5	.6	1.2		
Sloping phase	15	25	8	12			10	15	.6	1.0	.4	1.0		
Fairmount silty clay loam	20	30					12	17	1.0	1.5	1.0	1.0	2.0	3.0
Colluvial phase	25	35					17	22	1.5	2.0	1.5	2.0	2.8	3.6
Eroded phase	15	25					10	15					1.5	2.0
Severely eroded phase													1.2	1.6
Very steep phase														
Fincastle silt loam:														
Drained	35	45	15	20	30	40	20	25	1.8	2.2	1.4	1.8	2.4	3.2
Undrained	20		10		20		12		1.5		1.0		1.8	
Gently sloping phase	35	45	15	20	30	40	20	25	1.8	2.2	1.4	1.8	2.4	3.2
Shallow phase:														
Drained	35	42	15	20	30	40	20	25	1.8	2.2	1.4	1.8	2.4	3.2
Undrained	20		10		20		12		1.5		1.0		1.8	
Fox fine sandy loam	25	35	12	15	20	25	12	15	1.0	1.4	6	1.2	2.0	3.0
Fox gravelly loam														
Fox loam	30	40	19	22	25	30	15	20	1.4	2.0	1.0	1.6	2.8	3.6
Eroded sloping phase									8	1.2	.6	1.0	1.6	2.8
Sloping phase									1.0	1.5	8	1.2	2.2	3.4
Fox silt loam	35	45	20	25	25	30	17	20	1.6	2.0	1.0	1.6	2.8	3.6
Eroded phase	25	35	12	17	20	25	12	15	1.4	1.8	.8	1.4	2.4	3.4
Genesee fine sandy loam	35	40	12	18	25	30	18	20	1.2	1.5	.8	1.2	2.4	3.2
High-bottom phase	35	40	12	18	25	30	18	20	1.2	1.5	.8	1.2	2.4	3.2
Genesee loam	50	55	20	22	40	45	22	25	2.2	2.5	2.0	2.2	3.6	3.8
High-bottom phase	50	55	20	22	40	45	22	25	2.2	2.5	2.0	2.2	3.6	3.8
Genesee silt loam	55	60	20	22	40	45	22	25	2.2	2.5	2.0	2.2	3.6	3.8
High-bottom phase	55	60	20	22	40	45	22	25	2.2	2.5	2.0	2.2	3.6	3.8
Shallow phase									1.4	1.6	1.2	1.4	3.2	3.6
Hartman gravelly stony loam									1.0	1.4	1.0	1.4	2.0	2.4
Haymond silt loam	35	45	15	20	20	30	17	22	1.6	2.0	1.2	2.0	1.6	3.0
Hennepin clay loam														
Martinsville loam	30	40	17	22	22	32	15	20	1.8	2.2	1.2	1.8	2.8	3.6

Martinsville silt loam	35	45	20	25	25	35	17	20	1.8	2.2	1.2	1.8	2.8	3.8
Eroded sloping phase	----	----	----	----	----	----	----	----	1.0	1.5	----	----	2.0	2.8
Pekin silt loam	25	40	12	20	25	35	12	20	.8	1.5	.6	1.4	----	----
Princeton fine sandy loam	20	30	10	15	----	----	12	15	.5	1.0	.4	.6	2.0	3.2
Eroded phase	15	25	7	10	----	----	8	10	.4	.8	3	.5	1.6	2.8
Riverwash	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Ross silty clay loam	45	55	17	20	30	35	22	25	2.2	2.4	1.8	2.0	3.0	3.6
High-bottom phase	45	55	17	20	30	35	22	25	2.2	2.4	1.8	2.0	2.5	3.5
Rossmoyne silt loam	25	35	12	20	25	35	12	20	1.0	1.5	.6	1.2	----	----
Eroded phase	20	30	10	15	20	30	10	15	.6	1.2	.4	1.0	----	----
Eroded sloping phase	20	30	10	15	20	30	10	15	.6	1.2	4	1.0	----	----
Sloping phase	25	35	12	17	25	35	12	20	1.0	1.5	.6	1.2	----	----
Rough gullied land (Cincinnati soil material)	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Russell silt loam	35	45	17	25	35	45	17	22	1.8	2.2	1.2	1.8	2.4	3.6
Eroded phase	30	40	12	17	25	35	15	20	1.2	1.6	.8	1.4	1.8	2.8
Eroded sloping phase	25	35	10	15	20	30	12	15	1.0	1.6	6	1.2	1.6	2.6
Eroded steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Level phase	35	45	17	25	35	45	17	22	1.8	2.2	1.2	1.8	2.4	3.6
Severely eroded sloping phase	20	30	8	12	----	----	10	12	.6	1.0	.4	1.0	1.2	2.0
Sloping phase	30	40	15	20	25	35	15	20	1.6	2.0	1.0	1.6	2.0	3.0
Steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Stony and gravelly alluvium	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Washtenaw silt loam:														
Drained	45	55	15	22	30	40	17	22	1.8	2.2	1.6	1.8	2.4	3.2
Undrained	10	----	5	----	10	----	10	----	1.0	----	1.0	----	1.2	----
Westland silty clay loam.														
Drained	50	55	17	22	35	45	22	25	2.0	2.2	1.6	2.0	2.8	3.8
Undrained	25	----	5	----	15	----	12	----	1.4	----	1.2	----	1.6	----
Wilbur silt loam	35	45	15	20	20	30	17	22	1.6	2.0	1.2	2.0	1.6	3.0
Williamsburg silt loam	25	35	12	20	20	30	12	20	1.0	1.5	6	1.2	1.4	2.5
Steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Wynn silt loam	35	45	17	25	35	45	17	22	1.8	2.2	1.2	1.8	2.4	3.6
Eroded gently sloping phase	32	40	15	20	30	40	15	20	1.5	1.8	1.0	1.5	2.0	3.2
Eroded sloping phase	25	37	10	15	20	27	10	15	1.0	1.5	6	1.2	1.5	2.5
Eroded steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Gently sloping phase	35	45	17	25	35	45	17	22	1.8	2.2	1.2	1.8	2.4	3.6
Severely eroded sloping phase	20	30	8	12	----	----	8	12	.6	1.0	4	1.0	1.2	2.0
Sloping phase	30	40	15	20	22	30	12	17	1.4	1.8	8	1.4	1.8	2.8
Steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----

[1] The terms "drained" and "undrained" have reference to artificial drainage.

TABLE 11.—*Productivity ratings of soils in Franklin County, Ind.*

[The indexes indicate the approximate average production of each crop in percent of the standard of reference, which represents the approximate average yield obtained without the use of amendments on the more extensive and better soil types of those regions of the United States in which the crop is most widely grown, they are based largely on estimates of yields (see table 10), as yield data are too fragmental to be adequate. Indexes in columns A refer to average yields obtained under prevailing practices, which include crop rotations, some erosion-control practices, and the use of some legumes, commercial fertilizers, lime, and barnyard and green manures; those in columns B refer to average yields obtained with improved methods of management, which include the more intensive use of the prevailing practices. Absence of an index indicates that the crop is not commonly grown].

Soil [1]	Crop productivity index for—																		Remarks
	Corn (100=50 bu.)		Wheat (100=25 bu.)		Oats (100=50 bu.)		Soybeans (100=25 bu.)		Mixed hay (100=2 tons)		Red clover (100=2 tons)		Alfalfa (100=4 tons)		Pasture [2]		General productivity grade [3]		
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
Dark poorly drained soils of the depressions																			Largely used for grain and livestock farming, a 3-year crop rotation of corn, wheat, or oats and legumes common, generally, well suited to corn, soybeans, and truck crops. Fall-sown small grains and legumes occasionally damaged by winter-killing and heaving, crops on undrained areas likely to be damaged by standing water. No lime required for successful growth of legumes. Tilth conditions impaired when cultivated during too high moisture condition.
Brookston silty clay loam																			
Drained	100	120	70	100	75	95	90	100	110	125	90	100	75	95	90	100	1	1+	
Cope silt loam																			
Drained	100	120	70	100	75	95	90	100	110	125	90	100	75	95	90	100	1	1+	
Westland silty clay loam:																			
Drained	100	110	70	90	70	90	90	100	100	110	80	100	70	95	90	100	1	1+	
Clyde silty clay loam:																			
Drained	90	110	60	80	60	90	90	100	100	110	80	100	70	90	90	100	2	1+	
Washtenaw silt loam: [4]																			
Drained	90	110	60	90	60	80	70	90	90	110	80	90	60	80	90	100	2	1	
Alluvial soils (sweet).																			Largely used for grain farming; corn is principal crop, wheat second. Rotation of corn, wheat, and legumes generally followed on Genesee and Ross soils; corn is principal crop on Genesee silt loam, where sufficiently extensive areas. Well adapted to bluegrass pasture. Crops may be damaged by overflow; high-bottom phases somewhat less frequently overflowed. Genesee silt loam, shallow phase, largely in bluegrass or wooded pasture. No lime required for successful growth of legumes.
Genesee silt loam	110	120	80	90	80	90	90	100	110	125	100	110	90	95	90	100	1	1+	
High-bottom phase	110	120	80	90	80	90	90	100	110	125	100	110	90	95	90	100	1	1+	
Shallow phase	-----	-----	-----	-----	-----	-----	-----	-----	70	80	60	70	70	80	80	90	8	7	
Genesee loam	100	110	80	90	80	90	90	100	110	125	100	110	90	95	90	100	1	1+	
High-bottom phase	100	110	80	90	80	90	90	100	110	125	100	110	90	95	90	100	1	1+	
Eel silt loam:																			
Drained	100	120	60	90	60	70	90	100	110	125	90	100	80	90	90	100	1	1+	
Ross silty clay loam	90	110	70	80	60	70	90	100	110	120	90	100	75	90	90	100	1	1+	
High-bottom phase	90	110	70	80	60	70	90	100	110	120	90	100	75	90	90	100	1	1+	
Genesee fine sandy loam	70	80	50	70	50	60	70	80	60	75	40	60	60	80	80	90	4	3	
High-bottom phase	70	80	50	70	50	60	70	80	60	75	40	60	60	80	80	90	4	3	
Hartman gravelly stony loam	-----	-----	-----	-----	-----	-----	-----	-----	50	70	50	70	50	60	60	70	8	7	

Alluvial soils (medium acid):																			Largely used for grain farming; common rotation includes corn, wheat, and clover or timothy; corn occasionally grown for two or more consecutive years. Lime not necessary for growing clover, but 1 to 2 tons an acre increase stands and yields; lime necessary for alfalfa.
Haymond silt loam	70	90	60	80	40	60	70	90	80	100	60	100	40	75	80	90	3	1	
Wilbur silt loam	70	90	60	80	40	60	70	90	80	100	60	100	40	75	80	90	3	1	
Imperfectly drained soils of the uplands:																			Fincastle soils largely used for grain and livestock farming. A 3-year rotation of corn, wheat or oats, and legumes common; soybeans increasing in importance in rotation. Well adapted to clover and alfalfa when properly limed (1 to 3 tons an acre) Small grains and legumes occasionally damaged by winterkilling, damage occasionally severe to crops on undrained areas. Avonburg soils used largely for general farming, although some areas used for grain and livestock farming Common rotation consists of corn, wheat, and clover and/or timothy; not suited to alfalfa, acre application of 3 to 4 tons of lime necessary for successful growth of clover Damage occasionally severe on undrained areas.
Fincastle silt loam:																			
Drained	70	90	60	80	60	80	80	100	90	110	70	90	60	80	80	90	3	1	
Gently sloping phase	70	90	60	80	60	80	80	100	90	110	70	90	60	80	80	90	3	1	
Shallow phase:																			
Drained	70	85	60	80	60	80	80	100	90	110	70	90	60	80	80	90	3	1	
Avonburg silt loam:																			
Drained	50	90	50	80	40	60	60	80	50	90	30	70	----	----	30	50	5	2	
Gently sloping phase	50	90	50	80	40	60	60	80	50	90	30	70	----	----	30	50	5	2	
Eroded gently sloping phase	40	90	40	70	30	50	50	60	40	75	20	40	----	----	25	40	6	3	
Imperfectly drained soil of the alluvial terraces:																			Largely used for general farming, although some areas used for grain and livestock farming. Common rotation consists of corn, wheat, and clover and/or timothy, not suited to alfalfa; acre application of 3 to 4 tons of lime necessary for successful growth of clover. Crop damage occasionally severe on undrained areas.
Bartle silt loam.																			
Drained	50	90	50	80	40	60	60	80	50	90	30	50	----	----	30	50	5	2	
Moderately well-drained soils of the uplands.																			Largely used for general farming, some areas used for grain and livestock farming. Common rotation consists of corn, wheat, and clover and/or timothy; not suited to alfalfa; acre application of 3 to 4 tons of lime necessary for successful growth of clover. Sloping phase susceptible to erosion under cultivation.
Rossmoyne silt loam	50	70	50	80	50	70	60	80	50	75	30	60	----	----	30	50	5	3	
Eroded phase	40	60	40	60	40	60	40	60	30	60	20	50	----	----	25	40	6	4	
Sloping phase	50	70	50	70	50	70	50	80	30	75	30	60	----	----	30	50	5	3	
Eroded sloping phase	40	60	40	60	40	60	40	60	30	60	20	50	----	----	25	40	6	4	

See footnotes at end of table.

TABLE 11.—*Productivity ratings of soils in Franklin County, Ind.*—Continued

Soil [1]	Crop productivity index for—																		Remarks
	Corn (100=50 bu.)		Wheat (100=25 bu.)		Oats (100=50 bu)		Soybeans (100=25 bu.)		Mixed hay (100=2 tons)		Red clover (100=2 tons)		Alfalfa (100=4 tons)		Pasture [2]		General productivity grade [3]		
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
Moderately well-drained soil of the alluvial terraces:																			
Pekin silt loam	50	80	50	80	50	70	50	80	40	75	30	70	----	----	30	50	5	3	Largely used for general farming, some areas used for grain and livestock farming. Common rotation consists of corn, wheat, and clover and/or timothy; not suited to alfalfa; acre application of 3 to 4 tons of lime necessary for successful growth of clover.
Well-drained soils to the uplands:																			Russell and Wynn soils used chiefly for grain and livestock farming. 3- to 5-year rotations of corn, wheat or oats, soybeans, and legumes commonly followed; alfalfa and clover well adapted, especially after application of 1 to 3 tons of lime an acre. Russell silt loam, its eroded phase, and Wynn silt loam, gently sloping phase, subject to accelerated erosion. Cincinnati soils used largely for general farming, some areas used for grain and livestock farming. Common rotation consists of corn, wheat, and clover and/or timothy; not suited to alfalfa; 3 to 4 tons of lime necessary for successful growth of clover. Susceptible to accelerated erosion under cultivation. Fairmount silty clay loam, colluvial phase, used largely for corn, alfalfa, and tobacco; not well adapted to small grains.
Russell silt loam	70	90	70	100	70	90	70	90	90	110	60	90	60	90	80	100	3	1	
Level phase	70	90	70	100	70	90	70	95	90	110	60	90	60	90	80	100	3	1	
Eroded phase	60	80	50	70	50	70	60	80	60	80	40	70	45	70	60	80	4	2	
Wynn silt loam	70	90	70	100	70	90	70	90	90	110	60	90	60	90	80	100	3	1	
Gently sloping phase	70	90	70	100	70	90	70	90	90	110	60	90	60	90	80	100	3	1	
Eroded gently sloping phase	65	80	60	80	60	80	60	80	75	90	50	75	50	80	70	90	4	2	
Cincinnati silt loam	50	70	50	80	50	70	50	80	50	75	30	60	----	----	40	60	6	3	
Eroded phase	40	60	35	60	40	60	40	60	20	50	20	40	----	----	30	50	7	5	
Fairmount silty clay loam, colluvial phase	50	70	----	----	----	----	70	90	75	100	75	100	70	90	90	100	6	4	

Well to excessively drained soils of the glaciofluvial outwash plains and terraces:																			Largely used for grain and livestock farming; 3- to 5-year rotations consisting of corn, wheat, soybeans, and legumes usually followed. Not suited to oats; except Williamsburg silt loam, well suited to alfalfa, stands and yields improved by 1 to 2 tons of lime an acre. Fox soils, especially Fox fine sandy loam, somewhat droughty. Williamsburg silt loam somewhat more acid than other soils of this group.
Martinsville silt loam	70	90	80	100	50	70	70	80	90	110	60	90	70	95	70	90	3	1	
Martinsville loam	60	80	75	85	45	65	60	80	90	110	60	90	70	90	70	90	3	1	
Fox silt loam	70	90	80	100	50	60	70	80	80	100	50	80	70	90	70	90	3	1	
Eroded phase	50	70	50	70	40	50	50	60	70	90	40	70	60	80	50	70	5	3	
Fox loam	60	80	75	90	50	60	60	80	70	100	50	80	70	90	60	80	4	2	
Fox fine sandy loam	50	70	50	60	40	50	50	60	50	70	30	60	50	75	40	60	6	4	
Williamsburg silt loam	50	70	50	80	40	60	50	80	50	75	30	60	35	65	40	60	5	3	
Well-drained soil of the alluvial terraces:																			Largely used for general farming, some areas used for grain and livestock farming. Common rotation consists of corn, wheat, and clover and/or timothy; not suited to alfalfa; acre application of 3 to 4 tons of lime necessary for successful growth of clover.
Elkinsville silt loam	50	70	50	80	50	70	50	80	40	75	30	60	-----	-----	30	50	6	3	
Poorly drained soils of the uplands.																			Delmar soil used chiefly for grain and livestock farming; corn, wheat, oats, soybeans, and mixed hay principal crops; adequate artificial drainage necessary for cropping. Clermont soil used chiefly for general farming; corn, wheat, timothy and/or clover principal crops; not suited to alfalfa; adequate artificial drainage necessary for cropping.
Delmar silt loam																			
Drained	50	80	40	60	40	50	40	60	50	80	40	70	40	60	50	60	6	4	
Clermont silt loam:																			
Drained	50	80	40	60	40	50	40	60	50	80	30	60	-----	-----	30	50	6	3	
Well to excessively drained soils of the uplands:																			Princeton soils used for grain and livestock farming; well adapted to melons and cucumbers. Bellefontaine soil used for grain and livestock farming, well adapted to alfalfa, but not to small grains, especially oats. Sloping and eroded sloping phases of Russell and Wynn soils may be used for long rotations with a predominance of legumes in a system of grain and livestock farming. Edenton soils and the sloping and eroded sloping phases of Cincinnati soils not well suited to cropping, although a long rotation including a predominance of hay crops and fall-sown small grains may be successfully used. Fairmount soils not suited to small grains; better suited to bluegrass pasture than to corn or soybeans.
Princeton fine sandy loam	40	60	40	60	-----	-----	50	60	25	50	20	30	50	80	30	40	6	3	
Eroded phase	30	50	30	40	-----	-----	30	40	20	40	15	25	40	70	25	35	7	4	
Bellefontaine silt loam	60	80	50	80	35	50	60	80	60	90	50	75	65	90	50	70	5	3	
Russell silt loam:																			
Sloping phase	60	80	60	80	50	70	60	80	80	100	50	80	50	75	70	80	5	3	
Eroded sloping phase	50	70	40	60	40	60	50	60	50	80	30	60	40	65	50	60	7	5	
Severely eroded sloping phase	40	60	30	50	-----	-----	40	50	30	50	20	50	30	50	30	40	8	6	
Wynn silt loam:																			
Sloping phase	60	80	60	80	45	60	50	70	70	90	40	70	45	70	70	80	5	3	
Eroded sloping phase	50	75	40	60	40	55	40	60	50	75	30	60	40	60	50	60	7	5	
Severely eroded sloping phase	40	60	30	50	-----	-----	30	50	30	50	20	50	30	50	30	40	8	6	
Cincinnati silt loam:																			
Sloping phase	40	60	30	60	30	40	40	60	20	50	10	50	-----	-----	30	50	7	5	
Eroded sloping phase	30	50	25	40	25	30	30	50	15	40	10	40	-----	-----	25	40	8	6	
Gullied sloping phase	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	10	15	-----	-----	
Edenton silt loam	50	70	50	70	30	40	40	60	20	50	10	40	-----	-----	30	50	7	5	
Eroded phase	30	50	25	40	25	30	30	50	15	40	10	40	-----	-----	25	60	8	6	
Fairmount silty clay loam	40	60	-----	-----	-----	-----	50	70	50	75	50	75	50	75	60	80	6	4	
Eroded phase	30	50	-----	-----	-----	-----	40	60	-----	-----	-----	-----	35	50	40	60	7	5	
Severely eroded phase	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30	40	30	50	8	7	

See footnotes at end of table.

TABLE 11.—*Productivity ratings of soils in Franklin County, Ind.*—Continued

Soil [1]	Crop productivity index for—																		Remarks
	Corn (100=50 bu.)		Wheat (100=25 bu.)		Oats (100=50 bu.)		Soybeans (100=25 bu.)		Mixed hay (100=2 tons)		Red clover (100=2 tons)		Alfalfa (100=4 tons)		Pasture [2]		General productivity grade [3]		
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	
Well to excessively drained soil of the alluvial terraces																			
Elkinsville silt loam, sloping phase.	30	50	30	50	--	--	40	60	30	50	20	50	--	--	30	50	7	5	Used to a limited extent for corn, wheat, and timothy and/or clover. Long rotation with predominance of hay crops and fall-sown small grains may be used successfully.
Excessively drained soils of the uplands																			
Russell silt loam:																			
Steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50	70	--	--	Generally unsuited to cultivation, various phases of Russell, Wynn, and Fairmount soils suited, to a limited extent, to bluegrass pasture, rest probably better suited to forestry.
Eroded steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	40	60	--	--	
Hennepin clay loam	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	30	--	--	
Wynn silt loam:																			
Steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50	70	--	--	
Eroded steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	40	60	--	--	
Cincinnati silt loam:																			
Steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	30	--	--	
Eroded steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15	25	--	--	
Gullied steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	10	--	--	
Edenton silt loam:																			
Steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	30	--	--	
Eroded steep phase	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15	25	--	--	
Rough gullied land (Cincinnati soil material).	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Fairmount silty clay loam, very steep phase.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	40	50	--	--	

Excessively drained soils of the glacio-fluvial outwash plains and terraces:																			
Fox loam:																			
Sloping phase	----	----	----	----	----	----	----	----	50	75	40	60	50	80	30	50	8	7	Used to a limited extent for corn, wheat, and hay; steeper slopes suitable for pasture and forest but not cultivated crops.
Eroded sloping phase	----	----	----	----	----	----	----	----	40	60	30	50	40	70	20	35	9	8	
Fox gravelly loam	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Martinsville silt loam, eroded sloping phase.	----	----	----	----	----	----	----	----	50	75	----	----	50	70	20	35	8	7	
Williamsburg silt loam, steep phase.	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15	25	9	8	
Miscellaneous land types:																			
Stony and gravelly alluvium	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	Small areas of stony and gravelly alluvium cultivated to corn, wheat, and hay crops; neither suited to cultivated crops.
Riverwash	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	

[1] The term "drained" has reference to artificial drainage.
[2] These indexes are only relative for the county and do not refer to the standard of reference because of a lack of data
[3] Numbers indicate the general productivity of the soils for the common crops under the two general levels of management outlined in the headnote. Refer to the text for further explanation regarding their determination by the weighting of individual crop indexes
[4] Washtenaw silt loam consists of light-colored material deposited over Brookston, Clyde, and other dark-colored soils

The estimates in columns A under each crop indicate yields obtained under prevailing practices, which, on most of the soils, include the use of small to moderate quantities of commercial fertilizers but generally do not include careful and intensive soil-management practices in regard to the control of erosion, incorporation of organic matter, and maintenance and increase of soil fertility and soil productivity. Those in columns B indicate yields under more careful and intensive practices, consisting of a regular crop rotation, including the growing of legumes where possible, the use of barnyard and green manures, the application of lime and liberal quantities of suitable commercial fertilizers, the installation of artificial drainage where necessary, the use of improved varieties and high-quality seed, and, where needed, the use of mechanical measures, as contour tillage, strip cropping, and terracing or constructing diversion ditches for control of erosion.

The soils are listed by groups that conform in general to the color groups shown on the soil map. The groups are arranged in the approximate order of their general productivity. The rating compares the productivity of each soil for each crop to a standard—100. This standard index represents the approximate average acre yield obtained without the use of amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index. The standard yield for each crop shown in table 11 (except pasture) is given at the head of respective columns. Soils given amendments, as lime and commercial fertilizers, or special practices, as drainage and protective levees, and unusually productive soils have productivity indexes of more than 100 for some crops.

The indexes for pasture are comparative only for the soils within the county and do not conform necessarily to standards set up for the country as a whole. Because of the great variety of uses of pasture in the county, the apparent lack of a well-planned pasture program on many areas, and the extreme difficulty in estimating cow-acre-days or pounds of beef to the acre in a year, the ratings for pasture are inductive to a considerable degree and apply only within the county.

General productivity grade numbers are assigned in the column so designated. This grade is based on a weighted average of the indexes for the various crops, the weighting depending on the relative acreage and value of the crops. If the weighted average is between 90 and 100, the soil is given a grade of 1; if between 80 and 90, a grade of 2; and so on. In those instances in which the weighted average is above 100 and less than 110, a grade of 1 is given. In this county the grades were based largely on the indexes of the important crops on each soil. Because it is difficult to measure mathematically either the exact significance of a crop in the agriculture of an area or the importance or suitability of certain soils for particular crops, perhaps too much significance may be given to the general productivity grades.

Additional information regarding the individual soils in relation to their use for agriculture is given in the right-hand column of table 11.

Productivity tables do not present the relative roles that soil types, because of their extent and pattern of distribution, play in the agriculture of the county. The tables show the relative productivity of individual soils; they cannot picture in a given county the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types used for each of the specified crops.

Economic considerations have played no part in determining the crop productivity indexes. They cannot be interpreted, therefore, into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land. It is important to realize that productivity, as measured by yields, is not the only consideration that determines the relative worth of a soil for growing crops. The ease or difficulty of tillage and the ease or difficulty of maintaining productivity are examples of considerations other than productivity that influence the general desirability of a soil for agricultural use. In turn, steepness of slope, presence or absence of stone, the resistance of the soil to tillage because of its consistence or structure, and the size and shape of areas are characteristics that influence the relative ease with which soils may be tilled. Likewise, inherent fertility and susceptibility to erosion are characteristics that influence the ease in maintaining soil productivity at a given level. Productivity, as measured by yields, is influenced to some degree by all of these and other factors, as moisture-holding capacity of the soil and its permeability to roots and water, and so they are not factors to be considered entirely separate from productivity, but, on the other hand, schemes of land classification to designate the relative suitability of land for agricultural use generally give some separate recognition to them.

Some of the characteristics that influence the suitability of the soils for growing crops are given in table 12.

The relief on which a soil occurs very often is the principal factor determining the use that may be made of a soil and largely governs the yields that may be obtained. Although the susceptibility of a soil to erosion may not necessarily control its use, it does have a great influence on the maintenance of productivity. Again, the internal drainage condition may be the principal factor influencing the productivity of a soil. The larger part of the areas of the imperfectly drained, poorly drained, and very poorly drained soils in this county have been sufficiently drained artificially for growing the common crops. The pH of a soil is usually an indication of its lime requirement, although, in general, lighter textured soils require less lime than do heavier textured ones having the same pH.

TABLE 12.—*Some characteristics that influence the suitability of soils for growing crops in Franklin County Ind.*

Soil	Relief	Susceptibility to erosion under cultivation	Internal drainage	Reaction	Approximate lime requirements	General productivity group [1]		Use limitations
						A	B	
					Tons			
Avonburg silt loam	Nearly level	Very slight	Imperfect	Strongly to very strongly acid.	3–5	Low to medium [2] Very low to low [3]	Medium to high [2]	Puddles and bakes readily, drainage needed, acid, low in organic content and general fertility.
Eroded gently sloping phase.	Gently sloping	Slight to moderate.	do	do	3–4	Low to medium [2] Very low to low [3]	Medium to high [2]	Puddles and bakes readily, drainage needed, acid, low in organic content and general fertility, slightly to moderately susceptible to erosion.
Gently sloping phase.	do	do	do	do	3–4	Low to medium [2] Very low to low [3]	Medium to high [2]	Do.
Bartle silt loam	Nearly level	Very slight	Poor	do	3–5	Low to medium [2] Very low to low [3]	Medium to high [2]	Puddles and bakes readily, drainage needed, acid, low organic content and general fertility.
Bellefontaine silt loam	Undulating to sloping.	Moderate to severe	Good to excessive	Medium acid	1–3	Medium	do	Droughty, low inorganic content and fertility, erodible.
Brookston silty clay loam.	Depressions in upland	None to very slight.	Very poor	Neutral to slightly acid.	0	Very high [2] Medium [3]	Very high [2]	Drainage needed, potash deficiency.
Cincinnati silt loam	Undulating to gently sloping	Moderate to very severe.	Good	Strongly to very strongly acid.	3–4	Medium to low	Medium	Strongly acid, low in organic content and general fertility, susceptible to erosion.
Eroded phase	do	do	do	do	3–4	do	do	Do.
Eroded sloping phase.	Sloping	Severe to very severe.	Good to excessive	do	3–4	Low	Low to medium	Susceptible to erosion, strongly acid, low in organic content and general fertility.
Eroded steep phase	Steep	do	do	do	3–4	Very low	Very low	Nonarable, steep, susceptible to erosion, strongly acid, low in organic content and general fertility.

Gullied sloping phase.	Sloping	Severe gully	do	do	3-4	do	do	Nonarable, severe gully erosion
Gullied steep phase.	Steep	do	do	do	3-4	do	do	Nonarable, severe gully erosion, steep slopes.
Sloping phase	Sloping	Severe to very severe.	d9	do	3-4	Medium to low	Medium	Susceptible to erosion, strongly acid, low in organic content and general fertility.
Steep phase	Steep	do	do	do	3-4	Very low	Very low	Nonarable, steep, susceptible to erosion, strongly acid, low in organic content and general fertility.
Clermont silt loam	Nearly level	None to very slight.	Poor	do	3-4	Low [2] Very low [3]	Medium [2]	Drainage needed, acid, low in organic content and general fertility, puddles and bakes readily.
Clyde silty clay loam	Depressions in upland.	do	Very poor	Neutral	0	High [2] Low [3]	Very high [2]	Drainage needed; potash deficiency.
Cope silt loam	do	do	Poor to very poor	Neutral to slightly acid.	0	Very high [2] Medium [3]	Very high [2]	Do.
Delmar silt loam	Nearly level	do	Poor	Medium to strongly acid.	2-3	Medium to low [2] Low [3]	Medium [2]	Drainage needed; low in organic content.
Edenton silt loam	Sloping	Severe to very severe	Good to excessive	Strongly to very strongly acid.	3-4	Medium to low	Medium	Susceptible to erosion, strongly acid, low in organic content and general fertility.
Eroded phase	do	do	do	do	3-4	Very low	Low	Do.
Eroded steep phase.	Steep	Very severe to gully.	do	do	3-4	do	Very low	Nonarable, steep slopes, susceptible to erosion, strongly acid, low in organic content and general fertility.
Steep phase	do	do	do	do	3-4	do	do	Do.
Eel silt loam	Level or depressed	None	Fair to imperfect	Neutral	0	Very high [2] High [3]	Very high [2]	Overflow and backwater damage.
Elkinsville silt loam	Undulating to gently sloping.	Moderate to severe.	Good	Strongly to very strongly acid.	3-4	Medium to low	Medium	Strongly acid, low in organic content and general fertility, susceptible to erosion
Sloping phase	Sloping	Severe to very severe.	Good to excessive	do	3-4	Very low	Low	Do.
Fairmount silty clay loam.	Sloping to steep	do	Fair to slow	Neutral to slightly alkaline.	0	Medium to low	Medium to low	Susceptible to erosion, relatively shallow depth to bedrock, heavy texture of surface soil and subsoil.

See footnotes at end of table.

TABLE 12.—*Some characteristics that influence the suitability of soils for growing crops in Franklin County, Ind.*—Continued

Soil	Relief	Susceptibility to erosion under cultivation	Internal drainage	Reaction	Approximate lime requirements	General productivity group [1]		Use limitations
						A	B	
Fairmount silty clay loam—Continued					*Tons*			
Colluvial phase	Gently sloping to sloping.	Moderate to severe.	Fair to slow	Neutral to slightly alkaline	0	Low to medium	Medium	Susceptible to erosion, relatively shallow depth to bedrock, heavy texture of surface soil and subsoil, high content of rock fragments in surface soil and subsoil
Eroded phase	Sloping to steep	Severe to very severe.	do	do	0	Low	Low to medium	Susceptible to erosion, relatively shallow depth to bedrock, texture of surface soil and subsoil heavy.
Severely eroded phase	do	do	do	do	0	Low to very low	Low	Do.
Very steep phase	Very steep	Very severe	Good to excessive	do	0	Very low	Very low	Do.
Fincastle silt loam	Nearly level to gently undulating.	None to slight	Imperfect	Medium to strongly acid.	1-3	High [2] Medium to low [3]	Very high [2]	Drainage needed; low in organic content.
Gently sloping phase.	Gently sloping	Slight to moderate.	do	do	1-3	High [2]	Very high [2]	Low in organic content; imperfect internal drainage.
Shallow phase	Nearly level to gently undulating.	None to slight	do	do	1-3	High [2] Medium to low [3]	Very high [2]	Drainage needed; low in organic content.
Fox fine sandy loam	do	do	Good to excessive	Slightly to medium acid.	1-2	Medium to low	Medium	Droughty, low in organic content.
Fox gravelly loam	Strongly sloping to steep.	Severe to very severe	Excessive	Slightly acid to calcareous.	0	Very low	Very low	Nonarable, steep slopes, shallow profile, droughty.
Fox loam	Nearly level to gently sloping.	None to slight	Good to excessive	Slightly to medium acid.	1-2	Medium to high	High	Droughty; low in organic content.

Eroded sloping phase.	Sloping	Moderate to severe.	do	do	1-2	Very low to low	Low	Droughty; low in organic content, susceptible to erosion.
Sloping phase	do	do	do	do	1-2	Low	do	Do.
Fox silt loam	Nearly level to gently undulating.	Very slight	do	do	1-2	High	Very high	Somewhat droughty; low in organic content
Eroded phase	Gently undulating to gently sloping.	Slight to medium	do	do	1-2	Medium	Medium to high	Somewhat droughty; low in organic content, susceptible to erosion.
Genesee fine sandy loam	Nearly level	None to slight	Good	Neutral to slightly alkaline.	0	do	High	Overflow.
High-bottom phase	do	do	do	do	0	do	do	Do.
Genesee loam	do	do	do	do	0	Very high	Very high	Do.
High-bottom phase	do	do	do	do	0	do	do	Do.
Genesee silt loam	do	do	do	do	0	do	do	Do.
High-bottom phase	do	do	do	do	0	do	do	Do.
Shallow phase	do	do	do	do	0	Low	Medium to low	Overflow, shallow to bedrock.
Hartman gravelly stony loam.	do	do	Good to excessive	do	0	do	Low	Overflow, droughty, interference of boulders and gravel to cultivation.
Haymond silt loam	do	do	Good	Medium acid	1-2	Medium to high	High	Overflow, medium acidity.
Hennepin clay loam	Very steep	Very severe	Good to excessive	Neutral to alkaline.	0	Very low	Very low	Nonarable, steep slopes, shallow profile.
Martinsville loam	Nearly level to gently undulating.	Very slight	do	Slightly to medium acid.	1-2	High	Very high	Low organic content; slight droughtiness.
Martinsville silt loam	do	do	Good	do	1-2	do	do	Do.
Eroded sloping phase.	Sloping	Moderate to severe	Good to excessive	do	1-2	Low	Low to medium	Susceptibility to erosion, low organic content, slight droughtiness.
Pekin silt loam	Nearly level to gently undulating.	Slight	Good upper, restricted lower.	Strongly to very strongly acid.	3-4	Medium to low	Medium to high	Strongly acid, low organic content, low general fertility.
Princeton fine sandy loam.	Undulating to sloping.	Slight to severe (wind).	Excessive	Medium acid	1-2	do	do	Droughtiness, low organic content, susceptibility to wind erosion.
Eroded phase	do	do	do	do	1-2	Low	Low to medium	Do.
Riverwash	Nearly level	None	do	Neutral to alkaline.	0	Very low	Very low	Nonarable, stoniness and droughtiness, overflow.
Ross silty clay loam	do	None to slight	Good	Neutral	0	Very high	Very high	Subject to overflow, puddles readily.
High-bottom phase	do	do	do	do	0	do	do	Do.

See footnotes at end of table.

TABLE 12.—*Some characteristics that influence the suitability of soils for growing crops in Franklin County, Ind.*—Continued

Soil	Relief	Susceptibility to erosion under cultivation	Internal drainage	Reaction	Approximate lime requirements	General productivity group [1]		Use limitations
						A	B	
					Tons			
Rossmoyne silt loam	Nearly level to undulating.	Slight	Good upper, restricted lower.	Strongly to very strongly acid.	3-4	Medium to low	Medium	Strongly acid, low in organic content and general fertility.
Eroded phase	do	do	do	do	3-4	Low	do	Do.
Eroded sloping phase.	Sloping	Severe to very severe.	do	do	3-4	Very low	Low to medium	Susceptible to erosion, strongly acid, low in organic content and general fertility
Sloping phase	do	do	do	do	3-4	Medium to low	Medium	Do
Rough gullied land (Cincinnati soil material).	Sloping to very steep.	Severe gully	Excessive	do	3-4	Very low	Very low	Nonarable, severe gullying.
Russell silt loam	Undulating to gently sloping.	Slight to severe	Good	Medium to strongly acid	2-3	High	Very high	Susceptible to erosion, low in organic content.
Eroded phase	do	do	do	do	2-3	Medium to low	Medium to high	Do
Eroded sloping phase.	Sloping	Severe to very severe.	do	do	2-3	do	Medium	Do.
Eroded steep phase.	Steep	do	do	do	2-3	Very low	Very low	Susceptible to erosion, low in organic content, steep slopes.
Level phase	Nearly level	None to slight	do	do	2-3	High	Very high	Low in organic content
Severely eroded sloping phase.	Sloping	Severe to very severe.	do	do	2-3	Very low	Low to medium	Susceptible to erosion, low in organic content and productivity level.
Sloping phase	do	do	do	do	2-3	Medium	Medium to high	Susceptible to erosion, low in organic content
Steep phase	Steep	do	do	do	2-3	Very low	Very low	Susceptible to erosion, low in organic content, steep slopes
Stony and gravelly alluvium.	Nearly level	None to slight	Good to excessive.	Neutral to alkaline.	0	do	do	Nonarable, droughty, boulders and gravel interfere with cultivation.

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Washtenaw silt loam	Depressions	None to very slight.	Very poor	Neutral to slightly acid.	1-2	{Medium to high [2] {Low [3]	High to very high [2]	Drainage needed, potash deficiency.
Westland silty clay loam	do	do	Poor to very poor	Neutral	0	Very high	Very high	Do
Wilbur silt loam	Nearly level	None to slight	Good upper, restricted lower.	Medium acid	1-2	Medium	High	Subject to overflow, medium acid
Williamsburg silt loam	Nearly level to gently undulating.	Slight to moderate	Good	Medium to strongly acid.	2-4	Low to medium	Medium to high	Acid, low in organic content, moderately susceptible to erosion.
Steep phase	Steep	Severe to very severe.	Good to excessive	do	2-4	Very low	Very low	Susceptible to erosion, steep slopes, nonarable.
Wynn silt loam	Nearly level	Slight	Good	Slightly to medium acid.	1-2	High	Very high	Low in organic content.
Eroded gently sloping phase	Gently sloping	Slight to severe	do	do	1-2	Medium	High	Low in organic content; susceptible to erosion.
Eroded sloping phase.	Sloping	Severe to very severe.	do	do	1-2	Medium to low	Medium	Susceptible to erosion; low in organic content.
Eroded steep phase	Steep	do	do	do	1-2	Very low	Low	Steep slopes, susceptible to erosion, low in organic content.
Gently sloping phase.	Gently sloping	Slight to severe	do	do	1-2	High	Very high	Low in organic content, susceptible to erosion.
Severely eroded sloping phase.	Sloping	Severe to very severe.	do	do	1-2	Very low	Low to medium	Susceptible to erosion, low in organic content and natural fertility.
Sloping phase	do	do	do	do	1-2	Medium	Medium to high	Susceptible to erosion; low in organic content.
Steep phase	Steep	do	do	do	1-2	Very low	Low	Steep slopes, susceptible to erosion, low in organic content.

[1] General productivity is given here in descriptive terms. The terms in column A refer to the general productivity under prevailing practices that include crop rotations, some erosion-control practices, the use of some legumes, commercial fertilizers, lime, and barnyard and green manures; those in column B refer to the general productivity under improved methods of farm management that include the more intensive use of the above-mentioned practices

[2] Artificially drained.

[3] No artificial drainage.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of weathering and soil development acting on the parent material deposited or accumulated by geologic agencies.[9] The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the material. The climate, and its influence on soil and plants, depends not only on temperature, rainfall, and humidity but also on the physical characteristics of the soil or soil material and on the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

ENVIRONMENT AND CHARACTERISTICS OF THE SOILS OF THE AREA

This county lies in the region of Gray-Brown Podzolic soils[10] occupying the east-central part of the United States. Most of the soils have developed under a heavy forest cover of deciduous trees, with sufficient rainfall to wet the soil to an indefinite depth, so that a moist condition, except in short periods, is maintained throughout the soil. The climatic and biologic conditions permit only a relatively thin surface accumulation of organic litter and a few inches of dark-colored soil in the upper part of the profile. The surface mat of organic matter is thinner than in the Podzol region to the north but thicker than in the Red and Yellow Podzolic region to the south. Except for certain of the poorly drained soils, all are light-colored and relatively low in organic content, and they vary from medium to strongly acid in the solum.

The soil parent material is derived from three different geologic formations or sources of material: (1) Early Wisconsin glacial drift; (2) Illinoian glacial drift; and (3) Ordovician and Silurian limestone.

The soils developed on drift material of the Early Wisconsin glaciation occupy that part of the county east of the valleys of the West Fork of Whitewater River and the Whitewater River, except the area just east of the valley of the West Fork of Whitewater River in the north-central part of the county, a small area in the southeastern part, and also a small area in the extreme northwestern part. The parent material of most of the soils is unconsolidated deposits of mixed silt, clay, sand, gravel, and rock fragments left by the retreating ice sheet. These materials are composed largely of the local underlying bedrock formations over which the glacier advanced, and in this county a large proportion of limestone is included in the drift. Part of the drift, however, consists of quartz, granite, schist, gneiss, and other igneous and metamorphic rocks. These do not outcrop in Indiana but were transported by the glacier from the northern part of the United States and from Canada. The mineralogical and chemical composition of the drift varies somewhat, depending upon the proportion of each constituent. Thus the soils developed on this heterogeneous mixture under a given drainage condition vary somewhat.

As the glacier moved forward, it ground up the bedrock formations over which it moved, mixed the material, and either pushed it along in

[9] MARBUT, C. F. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Atlas of Amer. Agr., pt. 3, 98 pp., illus. 1935.
[10] BALDWIN, M. THE GRAY-BROWN PODZOLIC SOILS OF THE EASTERN UNITED STATES. Internatl. Cong. Soil Sci., (1) 1927, Proc. and Papers 4–5: 276–282. 1928. Washington.

front of the ice or carried it within or on top of it. The ice sheet rounded off the hills and filled in the valleys. Where it remained rather stationary—when the rate of melting at the front equaled the rate of forward movement—the material was deposited as moraines or kames. When the retreat of the ice sheet was rather uniform, the material was deposited as ground moraines or gently undulating plains, the latter characterizing the majority of the area of Early Wisconsin drift. Gravel and sand, which was assorted and usually shows cross bedding, was deposited by the interglacial streams and in crevices on the sides of the glacier.

The rather wide streams flowing from the melting glacier carried gravel, sand, silt, and clay and rolled large boulders along where the current was torrential. The coarser gravel was deposited nearer the ice front, and the finer materials were carried progressively farther downsteam. In some instances large boulders were floated down incased in ice, as icebergs. As the ice sheet retreated the distance or length of the glacial streams became longer, and sand, silt, and clay were deposited on the gravel and coarser material. This material, deposited by the streams flowing from the glacier front, comprises the glaciofluvial outwash plains and terraces of Wisconsin age. They occur as valley terraces, often as a series in step formation, along the East and West Forks of the Whitewater River, the Whitewater River, and in the valleys of the larger tributary streams. Those adjacent to the alluvial flood plains are only a few feet above the flood plains, and each succeeding terrace is farther removed from them and 5 to 20 feet or more higher than the adjacent lower terrace.

Soils developed on drift material of the Illinoian glaciation occupy the rest of the county except most of the slope areas adjacent to the Whitewater River and most of the tributaries. The composition and mode of deposition are similar to those of the Early Wisconsin glaciation, but owing to the much greater age and longer exposure to the forces of weathering, lime carbonates are leached to an average depth of about 120 inches.

The bedrock formations of limestone belong to the Silurian geologic age in the western part of the county and to the Ordovician in the other parts. They outcrop on the slopes adjacent to the flood plains and terraces of most of the streams and drainageways, except along the smaller drainageways in the northeastern, east-central, and southwestern parts of the county.

Wind-deposited sands, occurring in small isolated areas on the east side of the Whitewater River and the West Fork Whitewater River, were probably blown from the glaciofluvial terraces and the uplands before vegetation had become established.

Acid alluvial terraces of silt and clay occur adjacent to the flood plains in the south-central and southwestern parts of the county, in the regions of Illinoian glaciation, principally in the valleys of Little Laughery Creek and its larger tributaries. They represent old alluvium that has been elevated above the present stream and flood plain by the lowering of the stream channel.

Sweet alluvium occurs on the flood plains of the Whitewater River and its tributaries, and medium acid alluvium on the flood plains of Little Laughery Creek and its tributaries in the southwestern part of the county and in the upper courses of the tributaries to the Whitewater River in the regions of Illinoian glaciation.

CLASSIFICATION OF SOILS

The soils are classified and discussed on the basis of their characteristics in three orders—(1) zonal, (2) intrazonal, and (3) azonal.[11]

The zonal order comprises soils that have well-developed characteristics reflecting the active factors of soil genesis—climate and vegetation. It is represented in this county by Gray-Brown Podzolic soils, which may be subdivided into three subgroups—(1) those having ABC profiles,[12] (2) those having ABYC profiles, and (3) those having ABYC profiles with a suggestion of an X horizon.

The first subgroup has grayish-brown, light yellowish-brown, or brown eluviated A horizons; brown, yellowish-brown, brownish-yellow, or weak reddish-brown illuviated B horizons; and C horizons composed of physically weathered rock materials which are partly chemically weathered.

The second subgroup has A and B horizons similar to those of the first subgroup, with a thicker B horizon (designated as the Y horizon in the Indiana system of horizon designation) consisting of strongly physically and chemically weathered parent material. The C horizon underlying the Y is similar to that in the normal ABC profiles.

The third subgroup, having normal A and B horizons, a suggestion of a siltpan development (designated as the X horizon in the Indiana system of horizon designation), and normal C horizons, represents a transition from the Gray-Brown Podzolic soils to the Planosols.

The intrazonal order comprises soils that have more or less well-developed soil characteristics reflecting the dominating influence of some local factor of relief, parent material, or age over the normal effect of the climate and vegetation. It is represented by the Planosols, semi-Planosols, Wiesenboden, and Rendzina soils.

The Planosols have ABXYC or AXYC profiles. Except in the very poorly drained members of the group, the A and B horizons are more or less normal. Immediately below the B horizon (if present) is a thin light-gray silty horizon a fraction of an inch to a few inches thick, streaks or tongues of which extend into the X horizon, or siltpan, immediately beneath it. The X horizon is always more or less mottled and has somewhat ill-defined to good columnar structure. The Y horizon, beneath the X, is similar to that described above, and is underlain by the C horizon consisting of slightly weathered parent material. The X horizon apparently develops best on flat relief where soil-forming processes have been active over a long period of time. An oscillating ground-water table also probably contributes to its formation. Where geologic erosion is encroaching on the old peneplains, lowering the water table and developing a mature relief, there is often a progressive transition from the ABXYC profile to the ABYC and the ABC profiles. Here there is a tendency for the X, or siltpan, horizon to be gradually lowered by soil-forming processes, to conform to the slope, and to eventually disappear.

The semi-Planosols have ABXYC or ABYC profiles. In the ABXYC profile the X, or siltpan, horizon is weakly developed, and there may be only a slight heaviness in the B horizon.

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[11] See footnote 5, p. 25.

[12] BUSHNELL, T. M. THE STORY OF INDIANA SOILS. Ind. Agr. Expt. Sta. Special Cir. 1, 52 pp., illus. 1944.

The Wiesenboden are dark-colored soils of naturally poorly drained depressions, classified as having HMU profiles in the Indiana system of horizon designation. The very dark brownish-gray to nearly black H horizon is high in humus content. The M horizon, underlying the H, is characterized by a gray to light-gray color in the more poorly drained members of the group—the true Wiesenboden—and a mottled gray, yellow, and rust-brown color, with gray predominating, in the less poorly drained members—the timbered Wiesenboden. The U horizon represents the relatively unmodified underlying mineral material. As drainage and relief change, there is probably a progressive transition from the HMU profile to the ABXYC. The HMU profiles occur in appreciable areas in the Early Wisconsin glacial drift regions, but few occur in areas of Illinoian glacial drift.

The Rendzina soils, developed on sloping to steep relief, have essentially AC profiles. The A horizon is very dark gray to nearly black, high in organic content, and neutral to alkaline in reaction. The calcareous C horizon of limestone and shale, or glacial till, occurs at a shallow depth.

The azonal order comprises soils that do not have well-developed soil characteristics—the alluvial soils. They consist of recent deposits of material that are, in most cases, subject to additional water deposits. Thus soil-forming processes have not yet had time to bring about the development of eluviated and illuviated horizons, except in the higher areas, where there may be a slight development.

A grouping of the soil series into great soil groups, natural drainage conditions, drainage group designation, profile designation, and underlying material is given in table 13.

TABLE 13.—*Soil series of Franklin County, Ind., arranged according to great soil groups, drainage, profile horizons, and underlying material*

ZONAL SOILS

Great soil group [1] and series	Natural drainage conditions [2]	Drainage group designation [3]	Profile designation [4]	Underlying material
Gray-Brown Podzolic soils:				
Bellefontaine	Good to excessive	V	ABC	Loose permeable Early Wisconsin glacial drift (calcareous).
Cincinnati	Good	IV	AB (X) YC	Illinoian glacial drift (calcareous).
Edenton	do	IV	AB (X) YC	Illinoian glacial drift (calcareous) over limestone and shale.
Elkinsville	do	IV	ABYC	Silts and clays of old alluvium (strongly acid).
Fox	Good to excessive	V	ABC	Gravel and sand of Wisconsin age, leached 30 to 50 inches (calcareous).
Martinsville	Good	IV	ABC	Stratified silt and sand, with minor quantities of clay and gravel (calcareous).
Princeton	Good to excessive	V	ABYC	Wind-deposited sand (calcareous).
Russell	Good	IV	ABYC	Early Wisconsin glacial drift (calcareous).
Williamsburg	do	IV	ABYC	Stratified sand, silt, and gravel, leached 10 to 12 feet (calcareous).
Wynn	do	IV	ABYC	Early Wisconsin glacial drift (calcareous), with bedrock of limestone and shale at an average depth of 42 inches.

See footnotes at end of table.

TABLE 13.—*Soil series of Franklin County, Ind., arranged according to great soil groups, drainage, profile horizons, and underlying material*—Continued

INTRAZONAL SOILS

Great soil group [1] and series	Natural drainage conditiong [2]	Drainage group designation [3]	Profile designation [4]	Underlying material
Planosols				
Avonburg	Imperfect	II	A(B)XYC	Illinoian glacial drift (calcareous)
Bartle	do	II	ABXYC	Silts and clays of old alluvium (strongly acid)
Clermont	Poor	I	AXYC	Illinoian glacial drift (calcareous)
Delmar	do.	I	ABYC (some X)	Early Wisconsin glacial drift (calcareous)
Semi-Planosols				
Fincastle	Imperfect	II	ABYC	Do
Pekin	Moderate	III	AB(X)YC	Silts and clays of old alluvium (strongly acid).
Rossmoyne	do	III	AB(X)YC	Illinoian glacial drift (calcareous).
Wiesenboden (timbered)				
Brookston	Very poor	VIII	HMU	Early Wisconsin glacial drift (calcareous).
Cope	Poor to very poor	VII	HMU	Do
Washtenaw [5]	Very poor	VIII or IX	DHMU	Do
Westland	Poor to very poor	VIII	HMU	Gravel and sand of Wisconsin age, leached 40 to 60 inches (calcareous)
Wiesenboden				
Clyde	Very poor	IX	HMU	Early Wisconsin glacial drift (calcareous).
Rendzina soils				
Fairmount	Good to excessive	VI	AC	Bedrock of Ordovician and Silurian limestone and calcareous shale.
Hennepin	do	VI	AC	Early Wisconsin glacial drift (calcareous).

AZONAL SOILS

Great soil group and series	Natural drainage conditions	Drainage group designation	Profile designation	Underlying material
Alluvial soils				
Eel	Moderate to imperfect.	III	DDD	Calcareous alluvium from Wisconsin glacial drift
Genesee	Good	IV	DDD	Do
Hartman	Good to excessive	IV	DDD	Do
Haymond	Good	IV	DDD	Medium acid mixed alluvium from Illinoian glacial drift and Ordovician and Silurian limestone and calcareous shale.
Ross	do	IV	DDD	Calcareous alluvium from Wisconsin glacial drift.
Wilbur	Moderate	III	DDD	Medium acid mixed alluvium from Illinoian glacial drift and Ordovician and Silurian limestone and calcareous shale.

[1] Grouping based on soil classification defined in Soils and Men, Yearbook of Agriculture, 1938.

[2] Natural drainage conditions refer to drainage conditions existing before improvements. Most areas of soil classified as having imperfect, poor, and very poor drainage conditions have been artificially drained.

[3] Based on data by T. M. Bushnell (see footnote 12, p. 100). Group I includes nearly level poorly drained soils without organic accumulation and with eluviated and illuviated horizons, group II includes nearly level to gently undulating imperfectly drained soils, with mottling in the lower A horizon, group III includes nearly level to gently sloping moderately well-drained soils, with mottling in the B_1 or B_2 horizons, group IV includes undulating to strongly rolling well-drained soils, group V includes level to rolling well to excessively drained soils, characterized by loose porous substratum of gravel or sand, group VI includes sloping to steep well to excessively drained soils in which geologic erosion has prevented soil development; group VII includes poorly drained to very poorly drained depressional soils with an accumulation of organic material in the surface horizon somewhat less than that in groups VIII and IX, and groups VIII and IX include very poorly drained depressional soils with an accumulation of organic material in the surface horizon.

[4] Based on Indiana system of horizon designation The X horizon includes the siltpan or claypan and is a part of the B horizon; the Y horizon includes the lower B that is silty in character; the H horizon designates the humus or organic-bearing horizons in the VII, VIII, and IX drainage profiles and the organic horizons in the X profile, the M horizon is the modified mineral subsoil below the H, the U horizon is the unmodified geologic deposits below the M, and the D horizons refer to various depositional layers in alluvium.

[5] Washtenaw silt loam consists of light-colored materials deposited over Brookston, Clyde, and other dark-colored soils.

GRAY-BROWN PODZOLIC GROUP

The Gray-Brown Podzolic group comprises well-drained and well to excessively drained soils of the uplands and terraces of the county. The well-drained soils are the Russell, Wynn, Cincinnati, Edenton, Elkinsville, Martinsville, and Williamsburg.

Russell silt loam is a zonal soil developed on Early Wisconsin glacial drift. A sample taken in a wooded area, consisting of a fair stand of beech, walnut, maple, and oak trees with an understory of briers and weeds, in the NE¼ sec. 24, T. 12 N., R. 13 E., has the following profile:

A_0. About ¼-inch accumulated layer of partly decayed leaves, twigs, stems, and other forest litter.

A_1. 0 to 2 inches, dark brownish-gray friable fine-granular silt loam, relatively high in organic content and containing a mass of fine feeder tree roots. The granules are soft and in places approach crumb structure. Reaction, medium acid.

A_2. 2 to 5 inches, grayish-brown to light yellowish-brown friable medium-granular silt loam, having good phylliform structure and containing numerous small roots and small worm casts of dark-gray silty material. Reaction, medium acid.

A_3. 5 to 11 inches, brownish-yellow friable silt loam, breaking into about ⅛-inch coarse granules. Roots are less numerous, and numerous small worm casts of dark-gray silty material, less than ⅛ inch in diameter, are present. Reaction, medium acid.

B_1. 11 to 17 inches, yellowish-brown or brownish-yellow heavy silty clay loam breaking into ¼- to 1-inch subangular aggregates, which when moist may be easily broken down into coarse granules. A thin gray coating of colloidal clay is usually on the cleavage faces, giving a somewhat mottled appearance to the material in place. This appearance disappears when the material is crushed. A few larger roots are present, with the smaller ones becoming less numerous, and worm activity is high. Reaction, strongly acid.

B_2. 17 to 36 inches, brownish-yellow silty clay loam breaking into ¾- to 2-inch subangular aggregates. Some of the cleavage faces have a thin gray coating of colloidal clay. Few roots are present, and worm activity is diminishing. Reaction, strongly acid.

Y_1. 36 to 46 inches, yellowish-brown or brownish-yellow silty clay with numerous streaks and spots of rust brown occurring in no definite pattern. It is very slightly gritty and contains a few small weathered pebbles. Reaction, medium acid in the upper part and slightly acid in the lower.

C. 46 inches +, gray and yellow friable calcareous glacial till, composed of unassorted silt, clay, and rock fragments, which represents the parent material.

Wynn silt loam has essentially the same profile characteristics as Russell silt loam, except that the Y horizon is usually thinner and the calcareous C horizon is only 6 to 12 inches thick and underlain by limestone and shale bedrock. Because of the presence of the rather porous bedrock at shallow depths (averaging about 42 inches), the normal relief is nearly level.

Cincinnati silt loam, developed on Illinoian glacial drift, differs from Russell silt loam in the color and number of horizons and in the depth and the degree of leaching of bases. Both the A and B horizons are strongly acid and of silty texture. In some areas a weakly developed siltpan, or X horizon, is present at a depth of about 36 inches. The Y horizon, representing the material between the main B and the C horizon, is brownish-yellow silty material in the upper part and mottled gray and yellow in the lower. The calcareous C horizon, or parent material, lies at a depth of 100 to 150 inches.

The upper part of the profile of Edenton silt loam is essentially the same as that of Cincinnati silt loam, but, instead of the silty Y horizon and the calcareous till C horizon, limestone bedrock is encountered at a depth of 40 to 80 inches, and a 6- to 12-inch olive-yellow plastic clay layer may be immediately above the bedrock. This soil represents a relatively thin deposit of Illinoian drift on bedrock, in which the lime carbonates have been leached the entire depth of the drift.

Elkinsville silt loam is developed on old silty terraces, derived from Illinoian till material, and is acid to a depth of several feet. It has an ABYC profile.

The Martinsville soils, developed on calcareous silt and sand with minor quantities of gravel and clay on glaciofluvial outwash plains and terraces of Wisconsin age, have ABC profiles. They differ from the Williamsburg soils in having no Y horizon, in being younger and having been exposed a shorter time to soil-forming processes, and in having a less acid profile.

Williamsburg silt loam is developed on high glaciofluvial terraces, which are older than the glaciofluvial outwash plains and terraces on which the Martinsville soils are developed. It has an ABYC profile and is developed predominantly from silt and fine sand, with some gravel.

The well to excessively drained Fox, Bellefontaine, and Princeton soils of the Gray-Brown Podzolic group have a well to excessively drained surface soil and are underlain by loose gravel or sand.

The Fox soils are developed on glaciofluvial outwash plains and terraces of Wisconsin age. The deposits consist largely of gravel and sand, with finer textured materials deposited over these materials in the loam and silt loam types. A sample of Fox silt loam, taken under a forest cover of oak and maple in the NE¼ sec. 9, T. 9 N., R. 2 W., has the following profile:

A_0. ⅛-inch accumulated layer of leaves, twigs, roots, and other forest debris

A_1. 0 to 2 inches, dark brownish-gray fine-granular friable silt loam, containing a mass of fine roots. The organic content is relatively high. Reaction, slightly acid.

A_2. 2 to 8 inches, light yellowish-brown medium-granular friable silt loam having good phylliform structure. A few small worm casts composed of gray fine silty material are present. Reaction, medium acid.

B_1. 8 to 12 inches, yellowish-brown slightly plastic silty clay loam, containing a few very small pebbles. It breaks into about ½-inch subangular aggregates. Reaction, medium acid.

B_2. 12 to 32 inches, weak reddish-brown plastic waxy and gravelly clay loam, containing an occasional large boulder. It breaks into angular irregular-sized pieces, plastic when moist and hard when dry. Reaction, medium acid.

B_3. 32 to 36 inches, dark yellowish-brown waxy and gravelly clay loam, having no regular breakage but usually breaking into large irregularly sized and shaped chunks. An abrupt change occurs from the above horizon to this material and from this horizon to the underlying material. Lens-shaped tongues, 2 to 10 inches in length, extend into the horizon below. Reaction, neutral.

C. 36 inches +, gray and light-yellow calcareous loose gravel and coarse sand having good horizontal stratification.

Bellefontaine silt loam occupies morainic and kame areas in the Early Wisconsin drift regions. The profile is similar to that of the Fox soils but less uniform in horizon development, and the loose gravel and sand of the C horizon are usually cross-bedded rather than horizontal-bedded. The A and B horizons, except the B_3, are usually somewhat more acid than those of the Fox soils.

Princeton fine sandy loam is developed on wind-deposited sands of Wisconsin age. Profile development has produced ABYC horizons. The clay accumulation in the B horizon is variable and is underlain by rather loose fine sand representing the Y horizon. The C horizon of gray and yellow calcareous fine sand to sand lies at an average depth of about 60 inches.

PLANOSOLS

The Planosol group comprises imperfectly drained and poorly drained soils. The imperfectly drained soils are the Avonburg and Bartle silt loams.

Avonburg silt loam occurs on nearly level interstream areas in the Illinoian glacial drift regions. Following is a profile description typical under a forest vegetation:

A_0. About ½-inch accumulated layer of partly decayed leaves, twigs, stems, and other forest litter.

A_1. 0 to 2 inches, dark-gray or dark brownish-gray friable silt loam, relatively high in organic content. It is composed of soft, fine to medium granules. Reaction, strongly acid.

A_2. 2 to 7 inches, light brownish-gray to brownish-gray smooth friable medium-granular silt loam. Numerous crawfish casts and old root channels of gray silty material extend downward into the lower horizon. Reaction, strongly acid.

A_{3}. 7 to 10 inches, light brownish-gray to brownish-gray smooth coarse-granular heavy silt loam to silty clay loam, with an occasional light-yellow mottling. Reaction, strongly acid.

B_1. 10 to 16 inches, mottled gray, yellow, and rust-brown smooth silty clay loam, breaking into ¼- to ½-inch subangular aggregates. Reaction, strongly acid.

B_2. 16 to 30 inches, mottled gray, yellow, and rust-brown smooth silty clay loam, breaking into ½- to 1½-inch subangular aggregates. It is slightly compact in place but may be easily broken down when moist into coarse granules. Reaction, strongly acid.

X_1. 30 to 32 inches, light-gray with light-yellow mottling friable silt loam to silty clay loam, representing the caps of the vertical columns of the horizon below. Reaction, strongly acid.

X_2. 32 to 50 inches, mottled gray, yellow, and rust-brown heavy compact silty clay loam, breaking into 6- to 8-inch or more vertical columns having a 1½- to 3-inch horizontal dimension. The cleavage faces usually have a thin coating of gray colloidal clay. Reaction, strongly acid.

Y. 50 to 120 inches, mottled gray, yellow, and rust-brown somewhat friable silty clay loam, breaking into subangular irregular-sized pieces, easily broken down into coarse granules. Small quantities of grit, sand, and rock fragments in the upper part increase with depth. Reaction, strongly acid in the upper part and slightly acid in the lower.

C. 120 inches +, gray and yellow compact calcareous glacial till, composed of unassorted silt, clay, sand, and rock fragments, which represent the parent material.

Variations in the profile are in the texture and thickness of the various horizons (except the texture of the surface horizon) and the depth to calcareous till.

Bartle silt loam, developed on strongly acid stratified silt and clay on old alluvial terraces, has an ABXYC horizon. It is similar to the Avonburg soils in profile characteristics, but the C horizon or underlying material is stratified silt and clay with thin layers or lenses of fine sand.

The poorly drained Planosols are the Clermont and Delmar silt loams.

Clermont silt loam occurs on nearly level interstream areas in the Illinoian glacial drift regions. Following is a profile description in a wooded area, having a tree growth of sweetgum, sour gum, pin and red oaks, and maple, in the SW¼ sec. 32, T. 8 N., R. 2 W.:

- A_0. ½-inch accumulated layer of partly decayed leaves, leafmold, twigs, and other forest litter.
- A_1. 0 to ½ inch, yellowish-gray friable fine-granular silt loam, relatively high in organic content. The fine feeder roots of trees and shrubs are largely concentrated in this horizon, and numerous small worm casts composed of dark-gray silty material are present. Reaction, strongly acid.
- A_2. ½ to 6 inches, light-gray fine-granular silt loam, mottled, streaked, and blotched with rust brown, the brown color often following old root channels. Small roots and worm casts are numerous. Reaction, strongly acid.
- A_{31}. 6 to 18 inches, light-gray silt loam, blotched, streaked, and mottled with rust brown and yellow. It appears massive in place and breaks out into irregularly sized and shaped chunks, easily crushed into fine granules. It contains numerous soft rounded manganese concretions, averaging about 1 millimeter in diameter, and numerous crawfish holes, as well as crawfish casts. The latter are filled with dark-gray silty material. Reaction, strongly acid.
- A_{32}. 18 to 28 inches, gray friable silt loam, with light-gray streaks and blotches, showing a tendency toward platy structure. It contains numerous crawfish casts of dark-gray silty material, with a light-gray colloidal clay thin coating on the outer edges. Reaction, strongly acid.
- X_1. 28 to 34 inches, gray silty clay loam, with pale-yellow mottling and pale yellowish-gray and rust-brown spots. It becomes pale yellowish gray when pulverized. The material shows some evidence of columnar structure and represents the gray caps on the columns below. Reaction, strongly acid.
- X_2. 34 to 60 inches, intensely mottled gray and yellow light silty clay, having good columnar structure, with a thin coating of light-gray colloidal clay on the cleavage faces and outer surfaces of the numerous crawfish casts. Reaction, strongly acid.
- Y_1. 60 to 102 inches, predominantly gray silty clay having wide streaks and blotches of yellow and irregular breakage. It contains numerous crawfish casts of gray fine silty material having a thin gray coating of colloidal clay on the clevage faces and outer surfaces. Reaction, strongly acid.
- Y_2. 102 to 120 inches, brownish-yellow silty clay, mottled and streaked with gray. It has strong vertical and medium to strong horizontal breakage and is somewhat plastic under medium moisture conditions, becoming sticky when wet and hard when dry. Some manganese spots and blotches occur, and a few small pebbles are present. Reaction, medium acid.
- Y_{31}. 120 to 144 inches, gray silty clay, irregularly mottled with yellow and brown. A few small pebbles are present. Reaction, medium acid.
- Y_{33}. 144 to 168 inches, yellowish-brown silty clay, with pockets of lighter textured material. Pebbles are more numerous than in the above horizon. Reaction, slightly acid.
- C. 168 to 185 inches +, yellow and gray friable calcareous till, composed of unassorted silt, clay, and rock fragments.

Variations in the profile characteristics are in the texture and thickness of the various horizons (except the texture of the surface horizon) and the depth of 100 to 170 inches to calcareous till.

Delmar silt loam, developed on Early Wisconsin glacial drift, has an ABXYC profile, but the X horizon is not so well developed as in Clermont silt loam.

SEMI-PLANOSOLS

The semi-Planosol group comprises moderately well-drained and imperfectly drained soils. The moderately well-drained are the Rossmoyne and Pekin silt loams, in which surface runoff is not rapid and internal drainage is good in the upper part of the horizon and restricted in the lower.

Rossmoyne silt loam, developed on Illinoian glacial drift, occurs on nearly level to undulating relief, with a few small areas on sloping relief. The A horizons are similar to those of Cincinnati silt loam, except that the lower A is usually light brownish yellow. The B_1 horizon is light brownish-yellow to pale-yellow silt loam to silty clay loam, becoming mottled gray, yellow, and rust brown in the extreme lower part or in the B_2 horizon. The X horizon, usually occurring at a depth of about 30 inches, is usually only 6 to 12 inches thick and is similar in texture and structure to that of Avonburg silt loam. (The X horizon is occasionally absent, or is only weakly developed.) The more friable Y horizon contains some grit and pebbles and is underlain by calcareous glacial till at an average depth of about 120 inches.

Pekin silt loam, developed on strongly acid silt and clay on old alluvial terraces, is similar to Rossmoyne silt loam in profile characteristics, except that the Y horizon contains very little if any pebbles and the C horizon is stratified silt and clay with thin layers or lenses of fine sand.

Fincastle silt loam, the imperfectly drained semi-Planosol developed on Early Wisconsin glacial drift, has ABYC horizons and has been leached of free-lime carbonates to an average depth of about 45 inches. The A and upper B horizons are smooth and free of coarse-textured material. The B horizon is somewhat compact and impervious to moisture movement, with a slight siltpan development; the Y, or lower B, is friable and gritty, and the C consists of unassorted calcareous till composed of silt, clay, sand, and rock fragments.

WIESENBODEN GROUP

The Wiesenboden group comprises soils now timbered and those having a grass vegetation. The timbered Wiesenboden group, approaching the Half Bog soils, consists of the Brookston, Cope, Washtenaw, and Westland soils.

Brookston silty clay loam occupies slight depressions and broad flats in the regions of Early Wisconsin glacial drift. Following is a profile description typical in wooded areas:

H_1 ¼- to ½-inch accumulated layer of leaves, twigs, and other forest litter.

H_2. 0 to ½ inch, very dark-gray fine-granular silt loam, containing a very high percentage of organic content and numerous small feeder tree roots. Reaction, neutral.

H_3 ½ to 5 inches, dark-gray or very dark brownish-gray coarse-granular silty clay loam, relatively high in organic content and containing numerous fine tree roots. Reaction, neutral.

H_4. 5 to 14 inches, dark brownish-gray heavy silty clay loam or clay loam, breaking into ⅛- to ¾-inch angular pieces. Numerous small pebbles and an occasional boulder are present. Reaction, neutral.

M_1. 14 to 21 inches, mottled gray, yellow, and rust-brown plastic silty clay to sandy clay, breaking into ½- to 2½-inch angular pieces. It is sticky when moist, hard when dry, and contains much grit, numerous pebbles, and an occasional boulder. Reaction, neutral.

M_3. 21 to 60 inches, intensively mottled gray and yellow plastic silty clay to sandy clay containing numerous pebbles and rock fragments, the mottling often occurring in pockets or as blotches, with an occasional pocket of lighter textured material. The material breaks into irregular angular pieces varying from 1 to 6 inches. Reaction, neutral.

U. 60 inches +, gray and yellow compact calcareous glacial till composed of unassorted silt, clay, sand, and rock fragments.

Cope silt loam, occurring in shallow depressions and rather broad flats in the regions of Early Wisconsin glaciation, has an HMU profile similar to that of the Brookston soil, except that the H horizons are thinner and somewhat lighter colored and lower in organic content.

Washtenaw silt loam represents an accumulation of material washed in from the surrounding Russell and Fincastle soils over areas of the Brookston and Clyde soils. It is 8 to 40 inches thick and is light yellowish brown or brownish gray, with some gray and yellow mottling immediately above the dark-gray Brookston or Clyde material.

Westland silty clay loam, occurring on glaciofluvial outwash plains and terraces, is developed on calcareous gravel and sand of Wisconsin age. It has an HMU profile similar to the Brookston soil, except that the M horizons are waxy and contain more gravel and the U horizon is loose stratified gravel, similar to the C horizon of the associated Fox soils.

The true Wiesenboden group is represented by Clyde silty clay loam that occupies the depressional areas in the regions of Early Wisconsin glaciation. The H horizons are higher in organic content and thicker than those in the associated Brookston soil, the upper M horizon is gray, and the lower M horizons are highly mottled gray, yellow, and rust brown. The U horizon, or underlying material, consists of unassorted glacial till.

RENDZINA SOILS

The Rendzina soils of the county include the Fairmount and Hennepin soils.

Fairmount silty clay loam is developed on Ordovician and Silurian limestone containing thin layers of calcareous shale. It occurs on moderate to steep slopes, and geologic erosion has counterbalanced soil development. The high organic content of the surface soil is largely due to the presence of a high content of lime carbonates, which has brought about the accumulation of calcium humate.

Following is a profile description of a sample taken on the east side of the hard-surfaced Brookville-Oldenburg road, in the NW¼ sec. 30, T. 9 N., R. 2 W., having a predominate tree cover of oak and hickory, with an undergrowth of sumac and briers:

A_0. ⅛- to ¼-inch accumulated layer of partly decomposed leaves, twigs, branches, and other forest litter.

A_1. 0 to 1 inch, very dark-gray heavy silt loam having medium firm-granular structure, with a faint indication of phylliform structure. It contains numerous fine feeder roots and limestone fragments of various shapes and sizes.

A_2. 1 to 7 inches, dark grayish-brown silty clay loam, breaking into ¼- to 1½-inch angular particles. It contains some small worm casts of dark-gray silty material, various sizes and quantities of limestone fragments, and a decreasing number of roots.

A_{12}. 7 to 11 inches, dark grayish-yellow heavy silty clay, breaking into 1- to 3-inch angular particles. Few fine roots are present, and worm activity is low. When wet, the material becomes sticky.

C_1. 11 to 16 inches, olive-yellow to brownish-yellow calcareous silty clay to clay, breaking into irregularly sized and shaped chunks. It is brittle under average moisture conditions, becoming very sticky when wet and hard when dry. Limestone and shale rock fragments are numerous.

C_2. 16 inches +, limestone and shale bedrock. The limestone in all horizons is partly weathered.

Variations in the profile characteristics are in the thickness of the various horizons and the depth to limestone and shale bedrock.

Hennepin clay loam, developed on Early Wisconsin glacial drift, has an AC profile. The surface, or A horizon, is dark-gray to dark brownish-gray clay loam, about 2 or 5 inches thick, having a neutral to alkaline reaction. The C horizon is calcareous glacial till of Early Wisconsin age. The relief is very steep, and geologic erosion has counterbalanced soil development.

ALLUVIAL SOILS

The Azonal soils comprise the alluvial soils, which are divided into two groups—(1) neutral to calcareous alluvium and (2) medium acid alluvium. Those of the first group—the Genesee, Hartman, Ross, and Eel—occur on neutral to calcareous alluvium washed from areas of Early Wisconsin glacial drift and glaciofluvial outwash plains and terraces. The Genesee and Ross are well drained, the Hartman is well to excessively drained, and the Eel is moderately well to imperfectly drained. The soils of the second group, occurring on medium acid mixed alluvium from regions of Illinoian glacial drift and Ordovician and Silurian limestone and shale slopes are the well-drained Haymond and moderately well-drained Wilbur.

The soils of this county may be grouped into catenas. The term was first used by Milne.[13] The catena is composed of soil series developed on similar parent material under similar climatic conditions, but having differences in profile characteristics corresponding to differences in natural drainage conditions. For example, members of the Hennepin, Russell, Fincastle, Delmar, Cope, Brookston, and Clyde series comprise a catena of soils developed on calcareous drift of the Early Wisconsin glaciation. Differences in the profile characteristics of these soils are due very largely to differences in drainage conditions and relief and their attendant effects. The concept of the catena is very useful and convenient for field identification and mapping of soils and for considering their geographic and geologic relations.

The results of mechanical analyses of samples of Wynn and Williamsburg silt loams and their pH value are shown in table 14.

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[13] MILNE, G. A PROVISIONAL SOIL MAP OF EAST AFRICA (KENYA, UGANDA, TANGANYIKA, AND ZANZIBAR) WITH EXPLANATORY MEMOIR. 34 pp., illus. London. 1936.

TABLE 14.—*Mechanical analyses and pH determination of two soil types from Franklin County, Ind.*

Soil type and sample number	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay	pH
Wynn silt loam	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
285857	0- 2	0.6	1.9	2.2	5.2	4.4	67.5	18.2	7.6
285858 [1]	----	----	----	----	----	----	----	----	----
285859	7- 12	6	1.6	1.8	4.3	3.7	67.7	20.3	7.5
285860	12- 16	.7	1.5	1.5	3.4	3.0	63.5	26.4	7.4
285861	16- 35	.1	1.1	1.5	3.4	3.4	57.1	33.4	7.0
285862	35- 44	1.9	4.6	6.6	16.3	9.7	31.1	29.8	6.9
285863	44- 51	4.7	8.1	7.7	18.0	14.1	35.7	11.7	8.5
Williamsburg silt loam									
285890	0- 1	.3	1.6	2.5	6.1	6.6	68.0	14.9	7.0
285891	1- 4	1.2	3.7	5.6	11.7	8.9	57.4	11.5	5.6
285892	4- 11	.3	1.5	2.6	5.5	5.8	63.4	20.9	4.8
285893	11- 16	9	2.6	3.8	7.3	5.6	53.3	26.5	4.8
285894	16- 38	1	1.5	3.7	11.4	9.2	49.4	24.7	4.9
285895	38- 84	.1	1.2	2.8	9.0	8.2	54.6	24.1	5.2
285896	84-114	0	2	.4	1.1	4.0	63.7	30.6	6.1
285897	114-139	6.0	21.1	15.4	6.4	9.8	24.0	17.3	8.2
285898	139+	6.8	24.3	31.2	11.0	3.7	15.9	7.1	8.5

[1] Data not available.

MANAGEMENT OF THE SOILS OF FRANKLIN COUNTY

By A. T. WIANCKO, Department of Agronomy, Purdue University Agricultural Experiment Station

The farmer should know his soil and have a sound basis for every step in its treatment. Building up its productivity 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 if he is 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 if crops are to 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 eventually produces profitable returns. 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.

PLANT NUTRIENTS IN FRANKLIN COUNTY SOILS

The approximate total content of nitrogen, phosphorus, and potassium in the principal types of soil in Franklin County, expressed in pounds of elements in 2,000,000 pounds of plowed surface soil of an acre (6 to 7 inches deep), and the relative quantities of available phosphorus and potassium are shown in table 15.

TABLE 15.—*Approximate quantities of nitrogen, phosphorus, and potassium in certain soils of Franklin County, Ind.*

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

Soil type	Total nitrogen	Total phosphorus [1]	Total potassium	Available phosphorus [2]	Available potassium [2]
	Pounds	*Pounds*	*Pounds*		
Avonburg silt loam	2,000	700	23,000	L	L
Bartle silt loam	2,200	520	21,000	L	L
Bellefontaine silt loam	2,800	960	29,000	M	M
Brookston silty clay loam	4,800	1,300	34,000	M	H
Cincinnati silt loam	2,000	470	29,000	L	M
Clermont silt loam	2,200	670	25,000	L	L
Clyde silty clay loam	7,000	1,330	35,000	H	H
Cope silt loam	4,400	1,140	32,000	M	M
Delmar silt loam	2,400	570	29,000	L	L
Edenton silt loam	2,400	500	30,000	L	M
Eel silt loam	3,200	1,390	30,000	M	H
Elkinsville silt loam	2,400	860	24,000	L	M
Fairmount silty clay loam	5,000	5,080	40,000	VH	H
Colluvial phase	4,400	4,100	35,000	VH	H
Fincastle silt loam	2,608	610	29,000	L	L
Shallow phase	2,800	810	31,000	L	L
Fox silt loam	3,000	1,140	29,000	M	M
Genesee silt loam	3,000	1,300	31,000	H	H
High-bottom phase	3,400	1,410	30,000	H	M
Genesee loam	2,600	1,220	28,000	H	M
High-bottom phase	2,400	960	30,000	M	M
Genesee fine sandy loam	1,600	1,000	24,000	M	M
Haymond silt loam	2,400	530	28,000	L	L
Martinsville silt loam	2,400	820	28,000	M	M
Martinsville loam	2,200	810	26,000	L	M
Pekin silt loam	2,200	550	23,000	VL	L
Princeton fine sandy loam	2,000	810	22,000	L	M
Ross silty clay loam, high-bottom phase	3,600	2,200	34,000	H	H
Rossmoyne silt loam	2,000	550	26,000	L	L
Russell silt loam	2,800	640	31,000	L	L
Washtenaw silt loam	3,400	870	39,000	L	L
Westland silty clay loam	4,400	1,160	34,000	M	M
Wilbur silt loam	2,200	490	28,000	L	L
Williamsburg silt loam	2,200	980	30,000	L	L
Wynn silt loam	3,000	640	31,000	M	M

[1] Soluble in strong hydrochloric acid (specific gravity 1.115)
[2] VL=very low; L=low; M=medium; H=high, VH=very high.

The total content of nitrogen is generally indicative of the soil's need for nitrogen. It generally indicates also the need for organic matter, because nitrogen and organic matter are closely associated in soils. Usually, the darker the soil the higher its content of both organic matter and nitrogen. Soils having a low total nitrogen content soon wear out, as far as that element is concerned, unless the supply is replenished by growing and turning under legumes or by the use of nitrogenous fertilizer.

The quantity 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 is low in most Indiana soils, and phosphatic fertilizers are generally needed.

The total quantity of potassium in the soil can seldom be taken as indicative of whether or not it needs potash fertilizer. Some Indiana soils, having 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 content is in an available form. Sandy and muck soils are more often in need of potash fertilization than clay and loam soils. Poorly drained soils and soils with impervious subsoils usually need potash fertilization more than do well-aerated deep soils.

The available phosphorus and potassium determinations have been made by means of the so-called "quick tests" and are expressed in terms indicating relative amounts, as very low, low, medium, high, and very high. In interpreting these terms it may usually be assumed that soils testing low or very low will respond to fertilization with the element concerned. If the soil tests medium, there may be doubt as to whether fertilization would pay. A soil testing high or very high would seem to be in no immediate need of application of the plant-food element concerned. Since the quick test is easily made, it is recommended that the soil or soils of each field of the farm be tested every few years, because the available supply of any particular element may change, owing to the cropping system, the quantities of crops removed, manure returned, and fertilizer added. Plant-tissue tests at critical periods in the development of the crop will show its nutrient status and which plant-food elements are lowest and most in need of replenishing.

In considering what has just been said about the total and available supplies of plant foods in the soils, it should be recognized that there are many other factors that affect the crop-producing powers of soils. 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 profile, and the previous treatment and management of the soil are all factors of great importance and should be taken into consideration.

Tests indicate that nitrogen and phosphorus are much less available in subsurface soils and subsoils than in surface soils. On the other hand, potash in the subsoil seems to be of relatively high availability. Crop growth depends largely on the quantity of available plant nutrients with which the roots may come in contact. If the crop can root deeply, it may make good growth on a soil 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 quantities 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 well, even though there be no lack of plant nutrients. Although nitrogen, phosphorus, and potassium are of some value when added to acid soils, they will not produce their full effect until after such soils are limed.

The percentage of nitrogen and the acidity of the principal soils of the county and the estimated lime requirements are shown in table 16.

TABLE 16.—*Nitrogen, acidity, and lime requirement of certain soils in Franklin County, Ind.*

Soil type	Depth	Nitrogen	pH	Average depth to neutral material	Indicated ground limestone requirement per acre
	Inches	*Percent*		*Inches*	*Tons*
Avonburg silt loam	0-6	0.10	5.1	120	3-5
	6-18	.05	4.8		
	18-36	.03	4.7		
Bartle silt loam	0-6	.11	5.2	100	3-5
	6-18	.04	5.6		
	18-36	.03	5.4		
Bellefontaine silt loam	0-6	.11	6.6	39	1-3
	6-18	.06	5.8		
	18-36	.04	5.8		
Brookston silty clay loam	0-6	.24	7.2	0	0
	6-18	.19	7.2		
	18-36	.07	7.3		
Cincinnati silt loam	0-6	.10	5.1	120	3-4
	6-18	.06	5.4		
	18-36	.04	5.3		
Clermont silt loam	0-6	.11	5.1	120	3-4
	6-18	.04	5.4		
	18-36	.03	5.6		
Clyde silty clay loam	0-6	.35	7.2	0	0
	6-18	.20	7.2		
	18-36	.06	7.3		
Cope silt loam	0-6	.22	7.0	0	0
	6-18	.20	7.2		
	18-36	.04	7.6		
Delmar silt loam	0-6	.16	5.3	42	2-3
	6-18	.06	5.8		
	18-36	.05	6.4		
Edenton silt loam	0-6	.12	5.4	48	3-4
	6-18	.05	5.1		
	18-36	.04	5.8		
Eel silt loam	0-6	.11	7.3	0	0
	6-18	.10	7.1		
	18-36	.06	6.9		
Elkinsville silt loam	0-6	.12	5.7	[1]	3-4
	6-18	.09	5.5		
	18-36	.05	5.4		
Fairmount silty clay loam	0-6	.25	7.4	0	0
	6-18	.15	7.9		
	18-36	.03	[2]		
Colluvial phase	0-6	.22	7.4	0	0
	6-18	.17	6.8		
	18-36	.06	6.3		
Fincastle silt loam	0-6	.13	5.7	45	1-3
	6-18	.06	5.8		
	18-36	.04	5.9		
Shallow phase	0-6	.14	5.8	40	1-3
	6-18	.07	5.5		
	18-36	.05	6.0		
Fox silt loam	0-6	.15	6.1	36	1-2
	6-18	.09	5.9		
	18-36	.05	7.0		
Genesee silt loam	0-6	.15	7.4	0	0
	6-18	.10	7.6		
	18-36	.07	7.6		
High-bottom phase	0-6	.17	7.4	0	0
	6-18	.13	7.5		
	18-36	.10	7.6		
Genesee loam	0-6	.13	7.6	0	0
	6-18	.10	7.5		
	18-36	.08	7.5		
High-bottom phase	0-6	.12	7.6	0	0
	6-18	.10	7.4		
	18-36	.07	7.3		
Genesee fine sandy loam	0-6	.08	7.6	0	0
	6-18	.06	7.5		
	18-36	.04	7.5		
Haymond silt loam	0-6	.12	5.8	40	1-2
	6-18	.06	6.0		
	18-36	.04	6.7		
Martinsville silt loam	0-6	.12	6.1	45	1-2
	6-18	.09	5.7		
	18-36	.04	5.5		
Martinsville loam	0-6	.11	5.9	45	1-2
	6-18	.08	5.1		
	18-36	.04	5.4		

See footnotes at end of table.

TABLE 16.—*Nitrogen, acidity, and lime requirement of certain soils in Franklin County, Ind.*—Continued

Soil type	Depth	Nitrogen	pH	Average depth to neutral material	Indicated ground limestone requirement per acre
	Inches	*Percent*		*Inches*	*Tons*
Pekin silt loam	0-6	0 11	5 3	([1])	3-4
	6-18	.08	5 5		
	18-36	.03	5 6		
Princeton fine sandy loam	0-6	.10	6.2	38	1-2
	6-18	.05	6 9		
	18-36	.04	7.0		
Ross silty clay loam, high-bottom phase	0-6	.18	7.4	0	0
	6-18	.14	7 2		
	18-36	.10	7.0		
Rossmoyne silt loam	0-6	.10	5 4	120	3-4
	6-18	.06	5 3		
	18-36	.04	5 2		
Russell silt loam	0-6	.14	6 0	45	2-3
	6-18	.07	5 8		
	18-36	.06	5 6		
Washtenaw silt loam	0-6	.17	6 4	20	1-2
	6-18	.10	6 2		
	18-36	.15	6 7		
Westland silty clay loam	0-6	.22	7 6	0	0
	6-18	18	7.6		
	18-36	.06	7 6		
Wilbur silt loam	0-6	.11	5.6	40	1-2
	6-18	08	6.0		
	18-36	.05	6.4		
Williamsburg silt loam	0-6	11	5 6	120	2-4
	6-18	06	5 4		
	18-36	04	5 2		
Wynn silt loam	0-6	.15	6 0	40	1-2
	6-18	.10	5.9		
	18-36	.06	5.7		

[1] Strongly acid to a depth of several feet.
[2] Calcareous.

The acidity is expressed as pH, or approximate hydrogen-ion concentration. For example, pH 6.6 to 7.3 is considered neutral, and a soil with a pH value in this range contains enough lime to neutralize the acidity. Soils testing between pH 6.1 and 6.6 are called slightly acid; those between 5.6 and 6.0, medium acid; those between 5.1 and 5.5, strongly acid; and those below 5.0, very strongly acid. As a rule, the lower the pH value the more the soil needs lime. Samples are taken from the surface soil (0 to 6 inches), the subsurface soil, and the subsoil, as it is important to know the reaction, not only of the surface soil, but of the lower layers 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 quantity 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 other crops do. As it is advisable to grow these better soil-improving legumes in the crop rotation, acid soils should be limed.

In interpreting the soil survey map and soil analyses, it should be borne in mind that a well-farmed and well-fertilized 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 management, the several soils of the county are arranged in groups according to certain important characteristics that indicate that in some respects similar treatment is required. The intensity of the treatments, however, varies considerably with the soil types. For example, several of the light-colored silt loams of the uplands and terraces that have somewhat similar 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. It should be emphasized, however, that relief, acidity reaction, physical characteristics of the surface soil, subsoil, and substratum, as well as other characteristics of a type within a group may be and frequently are sufficiently different to require different recommendations and treatment. This includes quantity of limestone required, quantity and analysis of commercial fertilizers needed, and the feasibility of attempting to grow certain crops. The reader should study the group including the soils in which he is particularly interested.

About 73 percent of the soils of this county are undulating or rolling to broken and hilly uplands, of which approximately one-third are so very sloping, steep, eroded, or gullied as to be practically unfit for cultivation; about 15 percent are naturally poorly drained, flat or depressed to gently undulating upland silt loam and silty clay loam soils, of which approximately one-fourth are dark-colored; about 3 percent are terrace, or second-bottom, soils; and about 9 percent are bottom-land soils.

IMPERFECTLY AND POORLY DRAINED LIGHT-COLORED SOILS OF THE UPLANDS AND TERRACES

The imperfectly and poorly drained light-colored soils of the uplands and terraces comprise the silt loams of the Avonburg, Clermont, Fincastle, Delmar, and Bartle series. Together, they occupy 29,952 acres, or about 11.9 percent of the total area of the county, with Fincastle silt loam greatly predominating.

Although some of these soils differ in parent material, age, depth of leaching, and topographic relations, the several soils of this group have a number of agriculturally important characteristics in common, in respect to which their management problems are similar. They are all in need of artificial drainage, although the Clermont and Delmar are naturally more poorly drained than the other soils; all are low in total content of organic matter, nitrogen, and phosphorus; all are low in available phosphorus and potassium; and all are naturally acid and in need of liming.

DRAINAGE

The soils of this group were developed under conditions of imperfect to poor drainage. Their flat to gently undulating relief, together with heavy subsoils, makes them naturally wet and more or less seriously in need of artificial drainage. Surface drainage by means of dead furrows and open ditches is more or less practical but is wasteful of fertility in surface runoff. Tile underdrainage is much more desirable and where not already provided should have early attention in any permanent soil-improvement program. Without tile drainage, these soils cannot be managed to the best advantage, and no other beneficial soil treatment can produce its full effect.

With reasonable provision for drainage, these soils respond well to lime, manure, and fertilizer and can be made profitably productive. This has been fully demonstrated on the soil fertility experiment fields conducted by the Purdue University Agricultural Experiment Station on comparable imperfectly and poorly drained soils in other parts of the State. The results on these fields indicate that tile lines laid 30 to 40 inches deep and 3 to 4 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 allow silting up in low spots, and to poor quality tile which chips and breaks down easily. Only the best quality 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, in order 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.

In a comprehensive, long-time tile drainage experiment on Clermont silt loam of the Jennings County Experiment Field near North Vernon, the land that was tiled 3 rods apart in 1920 has since averaged 17.6 bushels more corn, 19.9 bushels more soybeans, 7.3 bushels more wheat, and 518 pounds more hay an acre than the untiled land with the same lime and fertilizer treatment in the corn, corn, soybeans, wheat, and mixed hay rotation used in this experiment. The cost of tiling was paid for by the increased yields of crops during the first 8 years of the experiment, and up to 1943 the increased returns averaged approximately $6 an acre a year.

LIMING

The soils of this group are all naturally acid, but the quantity of limestone required varies with the different soil types. They will not produce a satisfactory growth of legumes without liming, and no other beneficial treatment can produce its full effect until the land has been limed. Fincastle soils are, however, better adapted to growing alfalfa and clover than are the other members of this group. Liming, therefore, should be one of the first treatments in any sound program for the improvement of these soils.

Ground limestone generally is the most economical form of lime to use, and sources of supply are fairly convenient. The amount of ground limestone that should be applied to these soils is shown in the last column of table 16. From 2 to 3 tons an acre are indicated as minimum requirements. After that, 1 to 2 tons every second round of the crop rotation will keep the soil sufficiently sweet for most crops otherwise adapted to the local conditions. To determine the lime requirement in any particular case, the soil should be tested for acidity. The test is simple and should not be neglected. If the farmer cannot make the test, he can have it made by the county agricultural agent or the vocational agriculture teacher or he can send representative samples of the soil and subsoil to the Purdue University Agricultural Experiment Station at La Fayette.

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 is steadily making matters worse. In many places the original supplies of organic matter have become so reduced that the soil has lost much of its natural mellowness and easily becomes puddled and baked. The only practical remedy for this condition is to supply the soil with 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 usually supply the greater part of the nitrogen required by crops. For this reason, legumes should provide large quantities of the organic matter to be incorporated in the soil.

The acid soils should be limed and otherwise put in condition to grow clover, and this or some other legume should appear in the crop rotation every 2 or 3 years; as much manure as possible should be made from the produce that can be utilized for livestock; and all produce not so utilized, as cornstalks, straw, and cover crops, should be plowed under. Legumes are the only crops that can add appreciable quantities of nitrogen to the soil. Wherever clover seed crops are harvested, the threshed haulm should be returned to the land and plowed under. Cornstalks, straw, or other crop residues should not be burned. Burning destroys both organic matter and nitrogen. Modern plows equipped with Purdue or other efficient trash shields will turn down and completely cover cornstalks or other heavy growth.

Cover crops should be grown wherever possible to supply additional organic matter for incorporating into the soil. Sowing sweetclover, drilling soybeans between the corn rows at the time of the last cultivation, and seeding rye as a cover crop early in 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 growing crop of some kind on these soils over winter because, without living crop roots to take up the soluble nitrogen from the soil water, large losses may occur between crop seasons through drainage. In this latitude the ground is not frozen at times during winter, and heavy rains may cause much leaching and loss of plant nutrients, especially nitrates, if not taken up by crops.

CROP ROTATION

With proper liming, drainage, and fertilization, these soils will produce satisfactorily most ordinary crops adapted to the locality, although their adaptability to crops varies somewhat. On account of the prevailing shortage of organic matter and nitrogen, every cropping system 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. The advent of the European corn borer, however, may make this rotation impractical, unless the corn can be cut close to the ground and completely removed from the field or the stalks shredded and the borers killed in the field.

The 4-year rotation of corn, soybeans, wheat, and clover or mixed seeding is well adapted to these soils and aids in destroying the corn borer, which is accomplished by completely plowing under the cornstalks in preparation for the soybeans. The wheat should be seeded in the soybean stubble without plowing. The two legumes in this rotation will build up the nitrogen supply of the soil if reasonable quantities of the produce are returned to the land, either directly or in the form of manure.

If more corn is wanted than the 3- or 4-year rotations will provide, as on intensive livestock farms, the 5-year rotation of corn, corn, soybeans, wheat, and clover or mixed seeding 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 feed grain and roughage in this rotation, there should be enough manure produced to make a fair application for each corn crop.

In both the 4- and 5-year rotations, rye should be seeded in the standing corn as a winter cover crop and plowed under with the cornstalks in spring. The soybean straw should be spread on the wheat in winter. This not only will help the wheat and lessen winter injury, but it will also help to insure a stand of clover or the mixed seeding for the hay crop.

Spring small grains are not well adapted to the climatic conditions of this section of the State and, as a rule, are not to be recommended. In special situations where oats are wanted, one of the newer, early maturing varieties should be used.

To guard against clover failures in any of the suggested crop rotations, which may be caused by unfavorable weather conditions even though the land has been properly limed and is kept in a good state of fertility, it has proved to be a good plan to sow a mixture of seeds made up of about 3 or 4 pounds of red clover, 2 or 3 pounds of alfalfa, 2 pounds of alsike clover, 2 pounds of timothy, and 4 pounds of Korean lespedeza an acre. If this fails to make a satisfactory stand, soybeans make a good substitute hay crop.

FERTILIZATION

The soils of this group are naturally low in both total and available phosphorus, and in most cases the phosphorus required by crops should be wholly supplied in applications of manure and commercial fertilizer. The nitrogen supply in these light-colored soils is also too low to meet satisfactorily the needs of corn, wheat, and other nonleguminous crops, and provisions for adding nitrogen should be an important item in the soil-improvement program. The total quantity of potassium in these soils is large but the available supply low, and the addition of considerable potash fertilizer will be profitable, especially where little manure is applied. Without substantial provision for supplying all three of these fertilizer elements, the productivity of these soils will remain relatively low.

The problem of supplying nitrogen has been discussed in connection with provisions for supplying organic matter. Legumes and manure are the logical 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 residues of an immediately preceding legume does not become available quickly enough to be of much help to the wheat in fall. The leguminous residue must first decay, and that does not take place to any great extent until the following spring.

Where a good clover or other legume sod is not available for the corn crop and little or no manure is applied, it will be profitable to plow under 300 to 400 pounds of ammonium sulfate or cyanamide along with liberal quantities of phosphate and potash.

Phosphorus is the mineral plant nutrient in which these soils are most deficient. The natural supply is small and should not be drawn on further. The only practical way to increase the supply of phosphorus in the soil is through the application of purchased phosphatic fertilizer, and it will prove profitable to supply more than the crops to be grown actually need in order to raise the productive capacity of the soil. In rotations of ordinary crops producing reasonably satisfactory yields 20 pounds of available phosphoric acid an acre are required each year to produce the crops and, since large proportions of the phosphates applied are fixed by the soil in forms not available to the crop, larger quantities should be used. Where manure is applied, each ton supplies about 5 pounds of phosphoric acid; therefore, a correspondingly smaller quantity need be provided in the commercial fertilizer.

The quantity of potash that should be supplied as fertilizer depends on the general condition of the soil, the disposition of the crops grown, and the quantity of manure used. It is becoming more and more evident that the natural forces making soil potash available operate too slowly in these flat gray soils to provide for the needs of satisfactory yields of crops. According to the analyses shown in table 15, the soils of this group are all low in available potash and therefore incapable of producing good crops without potash fertilizer. In any program to build up the productivity of these soils, considerable quantities of fertilizer potash should be used, at least until such time as considerable quantities of manure can be applied and the general condition of the soil greatly improved. The availability of the soil potash may be somewhat increased by good farming practices, including tile drainage, proper tillage, the growing of deep-rooted legumes, and the incorporation into the soil 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 will need to be purchased.

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 an acre, may be applied profitably on the wheatland as a top dressing during winter. Manure so used not only helps the wheat and lessens winter injury but also helps to insure a stand of clover or other crop seeded in the wheat. In addition to the manure, corn should receive 100 to 150 pounds an acre of a phosphate and potash mixture at least as good as 0–12–12 applied in the row or beside the hill at planting time. Wheat should be given 300 to 400 pounds of a high-analysis complete fertilizer, which may be something like 2–12–6, 2–16–8, or 3–12–12, depending on the quantity of manure used in the rotation. In places where the wheat is backward in spring, a top dressing of about 100 pounds of a soluble nitrogen fertilizer should be applied soon after growth begins. Such top dressing generally will add several bushels an acre to the yield.

On run-down land or land of naturally low productivity that cannot be heavily manured, it is profitable to apply at least 500 pounds of 8–8–8 fertilizer, or its equivalent, plowed under for corn and to accompany this with 100 pounds of 3–12–12 an acre in the row or beside the hill at planting time. Such fertilization has been found profitable in experiments on similar soils in other parts of the State.

Where soybeans follow heavily fertilized corn, as should usually be the case, they need not be specially fertilized. If the land to be planted to soybeans has not been heavily fertilized for the preceding crop, most of the fertilizer needed should be plowed under and only a small quantity applied when drilling in the seed because soybeans are sensitive to fertilizer injury during germination and early growth if much fertilizer is applied with the seed. Usually the 0–12–12 or 0–10–20 analysis should be used at the rate of 300 to 400 pounds an acre, of which two-thirds should be plowed under.

For special crops, special fertilization will be needed. Specific fertilizer recommendations for different crops on different soils under different conditions can be procured from the Purdue University Agricultural Experiment Station at La Fayette.

WELL TO EXCESSIVELY DRAINED, WELL-DRAINED, AND MODERATELY WELL-DRAINED LIGHT-COLORED SOILS OF THE UPLANDS AND TERRACES

The well to excessively drained, well-drained, and moderately well-drained light-colored soils of the uplands and terraces include the silt loams of the Cincinnati, Rossmoyne, Edenton, Russell, Wynn, Bellefontain, Fox, Martinsville, Elkinsville, Pekin, and Williamsburg series; the loams of the Fox and Martinsville series; the fine sandy loams of the Fox and Princeton series; Fox gravelly loam; and Hennepin clay loam. Together, these soils occupy 157,120 acres, or about 62.2 percent of the total area of the county, with the Cincinnati and Russell soils greatly predominating. Practically all of Hennepin clay loam, most of the Edenton soils, and the very sloping, steep, badly eroded, and gullied phases of the Cincinnati, Russell, Wynn, Williamsburg, Fox, and Martinsville soils are unfit for cultivation and are classed as nonarable lands. A separate discussion of these will be found at the end of this chapter.

The arable soils of this group differ considerably in parent material, topography, texture, and depth of leaching, but they do have certain characteristics in common in respect to which their management problems are similar. They are all low in organic matter, nitrogen, and phosphorus and low to medium in available potash. Natural drainage is good to excessive, except on the nearly level Rossmoyne silt loam. The more sloping phases of the Russell, Wynn, Cincinnati, and Edenton soils, the steep phase of Williamsburg silt loam, and Hennepin clay loam are subject to excessive runoff in times of heavy rains. The coarser textured soils with sandy or gravelly subsoils, including Fox loam, fine sandy loam, and gravelly loam, and Princeton fine sandy loam, are deficient in water-holding capacity and crops are likely to suffer from drought. The Fox, Martinsville, Pekin, Williamsburg, Rossmoyne and Wynn soils, except their sloping and steep phases, occur on nearly level relief and erosion is not a problem.

CONTROL OF EROSION

On many of the soils of this group, especially their sloping and eroded phases, the problems of controlling erosion are of major importance in practical systems of soil management. Even after taking out of cultivation all the rough and very sloping land, which should never be plowed, a large part of the remaining tillable land needs especial 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 greater part of the store of fertility and should be protected against erosion by every practicable means. Gradual sheet erosion, in which the runoff 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 have been irreparably damaged in this way, and many others have only a little of the surface soil left and the plow reaches into the unproductive subsoil.

Plowing and other tillage operations should extend crosswise of the slopes wherever possible in order to prevent the formation of watercourses down the slopes, which are certain 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 performance of all tillage operations crosswise of the slopes. Intertilled crops should be interspersed with small-grain and sod-forming crops. The cropped land can be further protected against erosion by leaving all unused crop material on top of the soil. Straw dropped by the combine harvester should be spread as evenly as possible and left on the surface as a mulch and to lessen the impact of heavy rains until the land must be plowed again. Incipient gullies, or draws, forming natural waterways 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

The Bellefontaine, Fox, and Princeton soils of this group are slightly to medium acid; the rest are medium to strongly acid, and liming should be one of the first steps in their improvement. No other beneficial soil treatment can be fully effective on a very acid soil until after it is adequately limed. Minimum requirements are 2 to 3 tons of ground limestone an acre. Once the land has been properly limed, 1 to 2 tons every second round of the crop rotation will be sufficient for the major crop rotations. For best results with alfalfa and sweetclover, somewhat heavier liming may be needed.

ORGANIC MATTER AND NITROGEN

For the most part, the soils of this group are similar to the poorly drained light-colored soils of the uplands and terraces in their organic-matter and nitrogen content, and what has been said about ways and means and the importance of increasing the organic-matter and nitrogen content of those soils applies equally well here and often needs still more emphasis. The rolling upland soils, in particular, need more organic matter in order to improve their permeability to rain water and thereby lessen surface runoff and erosion damage.

CROP ROTATION

With liming, where needed, and proper fertilization, these soils will usually produce satisfactory yields of the grain and forage crops adapted to the locality, as well as various fruits and vegetables for home and market. Among the field rotation crops, corn, wheat, oats, soybeans, clover, alfalfa, and timothy are well known and more or less commonly used. Because of the prevailing shortage of organic matter and nitrogen, every system of cropping should include clover, alfalfa, or other legume to be returned to the land in one form or another. Because of the relatively good natural drainage and areation of these soils, more emphasis may profitably be placed on the deep-rooted legume hay and pasture crops—red clover, alfalfa, and sweetclover—than on the poorly drained soils.

The 3-year rotation of corn, wheat, and clover, or mixed clover, alfalfa, and timothy, is well adapted to these soils and doubtless will continue to be most popular for general use, provided the European corn borer menace can be satisfactorily dealt with, either by low cutting and entire removal of the corn crop or by thorough shredding of the cornstalks to kill the borer in the field. The 4-year rotation of corn, soybeans, wheat, and clover or mixed seeding is also well adapted to these soils, if proper erosion control practices are followed. This rotation avoids extra operations for corn borer control, since that is accomplished by turning under the cornstalks in the normal plowing of the ground in preparing for the soybean crop. Because of the erosion hazard, the 5-year rotation with two corn crops in succession, which has been mentioned for the flat poorly drained soils, will seldom be justified on the rolling upland soils of this group. On some livestock farms, however, where there is need for more corn than the 3- or 4-year rotations can provide, particularly on the terraces and more level uplands, this rotation may be used with simple erosion-control practices.

In both the 4- and 5-year rotations, rye with fertilizer should be seeded in the cornfields early in September to provide a winter cover crop to lessen soil erosion and to conserve soluble plant nutrients that might be lost by leaching between the regular crop seasons, and this should be plowed under in spring along with the cornstalks or corn stubble. The wheat should be seeded in the soybean stubble without plowing. If the soybean straw is left on the ground, it will serve to lessen soil erosion, as well as protect the wheat from winter injury and help insure a stand of clover or other seeding for the hay crop. Where enough livestock is kept to utilize all the feed grain and roughage in these rotations, there should be enough manure produced to make a fair application for each corn crop.

On the rolling uplands where the soil erosion problems are troublesome, the cropping systems should contain large proportions of sod-forming crops. This may be accomplished by making the seeding in the wheat or other small grain a mixture of about 3 pounds each of red clover, alfalfa, and lespedeza and 2 pounds each of alsike clover and timothy and allowing this to stand for 2 or 3 years to be used for hay or pasture. Contour strip cropping should be practiced as much as possible.

On some of the soils of the terraces where erosion is not much of a problem but corn usually suffers from drought, soybeans might be more extensively grown to good advantage as they stand periods of drought much better than corn. Where sweetclover does well in such situations, a 2-year rotation of wheat and soybeans has possibilities, with sweetclover seeded in the wheat as an intercrop to be plowed under the following spring with phosphate and potash for the soybeans.

Alfalfa and sweetclover may be grown on most of the soils of this group after proper inoculation and sufficient liming to meet the needs of these crops. Alfalfa, however, is not well adapted to the Elkinsville, Pekin, Cincinnati, Rossmoyne, and Edenton soils. In particular, these deep-rooted legumes may be recommended for the Princeton, Fox, and Bellefontaine soils, which have calcareous gravelly and sandy subsoils and are inclined to be more or less droughty for other crops. Alfalfa is preferable for hay, and sweetclover is excellent for pasture and soil-improvement purposes. Special literature on the cultural requirements of these crops may be obtained from the Purdue University Agricultural Experiment Station at La Fayette.

The more mellow and droughty soils are also adapted to truck and cannery crops, as melons, early potatoes, tomatoes, sweet corn, cannery peas, and certain fruits. A 5-year rotation of melons (rye and vetch cover crop), early potatoes (rye and vetch cover crop), tomatoes, and alfalfa for 2 years is well suited to the sandy soils on which these crops can be grown to advantage. Success with this rotation will depend largely on the success with the cover crops and the alfalfa. All crops should be fertilized. Where alfalfa responds to additions of lime on these soils, it will be advisable to confine applications to drilling 300 to 400 pounds an acre of ground limestone with the alfalfa seed each time this crop is sown, because heavier liming may be detrimental to the potatoes and tomatoes. The alfalfa seeding should be made immediately after potato harvest, and the cover crop should be seeded as soon as possible after harvesting the melons.

FERTILIZATION

The general discussion of the plant-food requirements of the poorly drained light-colored soils holds also for the well-drained light-colored soils, except that the well-drained ones generally have somewhat larger supplies of available potash because, owing to the better aeration which accompanies better drainage, the weathering of the potash naturally in the soil proceeds more rapidly. The natural supplies of nitrogen, organic matter, and phosphorus are not importantly different from those found in the poorly drained light-colored soils. On these better drained soils, however, the more desirable soil-improvement legumes are more dependable for supplying nitrogen and organic matter, but, on the other hand, consumption of these materials is accelerated by the better aeration that goes with better drainage and by unavoidable losses due to erosion.

The bulk of the manure produced on the farm should be applied for the corn crop, but where the wheatland does not have a cover of soybean straw or other crop residue, some of the manure may be spread on the wheat during winter. This will help protect the wheat from winter injury, as well as supply some plant nutrients and help insure a stand of the clover or mixed seeding made in the wheat. The wheat crop should receive 300 to 400 pounds an acre of a high-analysis complete fertilizer, regardless of its place in the rotation. In places where the wheat is backward in spring, a top dressing of 100 pounds an acre of a soluble nitrogen fertilizer should be applied soon after growth begins. Such top dressing will add several bushels an acre to the yield. Manured corn should receive 100 pounds an acre of a phosphate and potash mixture beside the hill or twice as much in the row. For corn that cannot be manured, it will pay to plow under 400 to 600 pounds of 8–8–8 fertilizer, or its equivalent, and also apply 100 pounds of 3–12–12, 2–16–8, or 2–12–6 in the row or beside the hill when planting the corn.

Where soybeans follow heavily fertilized corn, as should usually be the case, they need not be specially fertilized. If the land to be planted to soybeans has not been heavily fertilized for the preceding crop, 200 to 400 pounds of 0–20–20 or 0–12–12 an acre should be plowed under and only about 100 pounds applied at planting time, because of the danger of injury to germination if much fertilizer is drilled with the seed.

Where alfalfa is to be seeded by itself, 300 to 500 pounds an acre of a high-grade phosphate and potash mixture should be applied at seeding time. Where it is desired to establish an alfalfa field by seeding on wheat in spring, the wheat should be extra heavily fertilized with fertilizer especially high in both phosphate and potash.

For tomatoes, tobacco, and other more or less specialized crops that may be grown on these soils, heavy applications of high-analysis complete fertilizer are usually needed. Specific recommendations for specified crops can be procured from the State agricultural experiment station at La Fayette.

DARK-COLORED SOILS OF THE DEPRESSIONS

The dark-colored soils of the depressions include the silty clay loams of the Brookston, Clyde, and Westland series and the silt loams of the Cope and Washtenaw series. Together, these soils occupy 8,320 acres, constituting about 3.2 percent of the total area of the county. The Washtenaw is not strictly a black soil but is included in this group because it consists of more or less overwash on black soils.

All these soils are naturally wet and in need of artificial drainage. To a large extent this has been provided, and surplus water is fairly well taken care of. In some places, however, there would be good response to more tiling. After proper drainage, these dark-colored soils, except the very small acreage of Washtenaw silt loam that is low in both available phosphorus and available potash, are the most productive soils in the county.

LIMING

The Brookston, Clyde, Cope, and Westland soils are only slightly acid and not in need of liming. Washtenaw silt loam is slightly acid, indicating a lime requirement of 1 to 2 tons of ground limestone an acre.

CROP ROTATION

These dark-colored soils are especially well adapted to corn, and this may well be the major crop as in a corn, corn, soybeans, wheat, and clover rotation. Usually some timothy should be seeded with the wheat in fall and on well-drained land some alfalfa should be mixed with the clover seeded in the wheat in spring.

FERTILIZATION

Manure and fertilizer are not so necessary on these dark-colored soils as on the lighter colored ones with which they are associated. Wheat, however, generally should receive 200 to 300 pounds an acre of a complete fertilizer, as 2–12–6, 2–16–8, or 3–12–12, both for itself and for the seeding to follow. According to chemical tests that have been made on these soils, something like the 0–20–10 grade of fertilizer is indicated for corn on the Brookston and Clyde soils and 0–12–12 or 0–20–20 on the Cope and Westland. Washtenaw silt loam should be fertilized the same as the adjoining lighter colored soils. 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 it supplies.

DARK-COLORED SOILS OF THE SLOPES

The dark-colored soils of the slopes consist entirely of Fairmount silty clay loam and its several phases developed along the slopes of the valleys that were cut down through the limestone. They are high in lime content and relatively high in organic matter and plant nutrients, particularly phosphorus, which, together with their topographic relations, give them distinctive characteristics that place them in a class by themselves. They are naturally high in fertility and, where not too sloping, are capable of satisfactorily producing certain kinds of crops under careful management. The more sloping areas, and particularly the steep phase, should not be used for cultivated crops. The less sloping areas and the colluvial phase, where not too stony, may be farmed with fair to good results by using long crop rotations that do not require plowing of the land more than once in several years. Erosion control is the most difficult problem in the management of these soils, and every possible precaution against loss of soil should be exercised. Plowing and other tillage operations should always extend crosswise of the slope. The use of these hillsides for corn should be avoided as much as possible. The land is well adapted to tobacco, which has a high acre value and will provide a good income from a relatively small acreage under cultivation at any one time.

A practical crop rotation is tobacco 1 or 2 years, depending on the condition of the land, then wheat or rye seeded to alfalfa and grass to be left for several years, cutting as much of the alfalfa for hay as may be needed for winter feeding and utilizing the rest as livestock pasture. This hay and pasture mixture will eventually go to bluegrass, for which these limy hillsides are especially well adapted. Liberal rates of seeding should be practiced in order to provide a good stand and complete soil cover as quickly as possible. If two crops of tobacco are grown in succession, the first should be followed by a heavy seeding of rye as early in fall as possible as an intercrop for winter protection of the soil.

The tobacco crop should be adequately fertilized, especially on the eroded and colluvial phases that have lost much of their native fertility. Usually a heavy application of manure is advisable. In addition, there should be applied in the row at planting time about 500 pounds an acre of a high-analysis complete fertilizer, as 2–12–6, 3–12–12, or 3–9–18, depending on the condition of the soil, with special regard to the supply of available potash. Where tobacco is to be grown without manure, the plowing under of 500 to 1,000 pounds an acre of 8–8–8 fertilizer, or its equivalent, should be considered in its place. Proper and adequate fertilization is important not only to increase yield but also to improve quality, which greatly affects the market value.

ALLUVIAL SOILS

This group of soils includes Genesee loam; Eel, Genesee, Haymond, and Wilbur silt loams; Genesee fine sandy loam; Hartman gravelly stony loam; Ross silty clay loam; and Stony and gravelly alluvium. Together, these soils occupy about 22,016 acres or 8.7 percent of the total area of the county. About 2,000 acres of this is stony and gravelly material that, for the most part, has little or no agricultural value. Most of the shallow phase of Genesee silt loam is not suitable for cultivation, because of the shallow depth to bedrock and its occurrence in narrow, more or less broken strips.

The Haymond and Wilbur soils are medium acid in the surface soil and upper subsoil and for best results should receive about 2 tons of ground limestone an acre. The rest of the soils of this group are neutral to slightly alkaline and not in need of liming.

DRAINAGE

Natural drainage is limited by the periodic overflows and, in the heavier textured types, by tight subsoil. The latter should be tile-underdrained wherever suitable outlets can be obtained in order that the land may drain more quickly after floods or heavy rains.

ORGANIC MATTER AND NITROGEN

Ross silty clay loam and its high-bottom phase have fair supplies of organic matter and nitrogen, but the other soils of this group are in need of additional supplies of these important soil constituents. On the lighter colored and poorer areas, especially, considerable quantities of organic matter should be plowed under, and legumes should be included in the rotation wherever possible 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, 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. Cover crops, as 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 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, and in some places, where flooding is not too prolonged, wheat with a mixture of red clover, alfalfa, timothy, and alsike are satisfactory crops for this land. Corn should doubtless continue to predominate, 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 most of the bottoms where red clover and alfalfa are too often damaged by floodwater, and this mixture may be allowed to stand for more than 1 year and utilized as hay or pasture. For late seeding in emergencies, early varieties of soybeans and Sudan grass for either hay or seed will be found useful. On some of the more productive areas where the flood hazards are not great, especially on the high-bottom phases, various truck crops may be grown successfully and alfalfa and sweetclover do well.

FERTILIZATION

Eel and Genesee silt loams, Ross silty clay loam and its high-bottom phase, and some areas of Genesee loam are still fairly well supplied with available plant food, but the high-bottom phase of Genesee loam, Genesee fine sandy loam, and the Haymond and Wilbur silt loams are low in nitrogen and medium to low in available phosphate and potash. The floodwater deposits that come to these bottom lands from the adjoining watersheds are not so rich as they were years ago and more commonly consist of eroded subsoil material of low fertility.

In the practical fertilization of crops on these soils where yields are unsatisfactory, it is profitable to apply 150 to 200 pounds an acre of 0–12–12 or 0–20–20 in the row or half that quantity beside the hill for corn. Where the flood hazards are not too great it may pay, on the poorer soils at least, to apply larger quantities of fertilizer by the plow-under method accompanied by row applications of complete fertilizer, as suggested in the discussion of the fertilization of the poor light-colored upland soils. Where wheat is grown, it should receive 200 to 300 pounds an acre of complete fertilizer at least as good as 2–12–6. Response of soybeans to fertilizer is less certain, but where fertilizer is needed, this crop should receive a phosphate-potash mixture broadcast before plowing or applied through a modern fertilizer attachment on the plow.

NONARABLE SOILS

The more sloping, eroded, and gullied phases of the Cincinnati, Russell, Williamsburg, Wynn, Fox, and Martinsville soils, most of the Fairmount and practically all of the Edenton and Hennepin soils are not suited to ordinary farming purposes and should be regarded as nontillable and kept out of cultivation. Some of the cleared land in this category may be put into permanent pasture by seeding to a mixture of bluegrass, redtop, and lespedeza, but much of it should be reforested and given protection from livestock as the most practical means of saving it from complete destruction by erosion. Where it seems feasible to establish pasture on acid soil areas of nontillable land, the chances of success may be greatly improved by applications of 1 to 2 tons of ground limestone and 300 to 400 pounds of superphosphate an acre, either on top of present stands or before fresh seedings. Establishment of a good vegetative cover to hold the soil in place is essential. Contour furrows on hillsides and dams or other engineering devices in gullies should be employed wherever practicable, but undisturbed forest or a solid vegetative cover of some other kind should be the ultimate aim.

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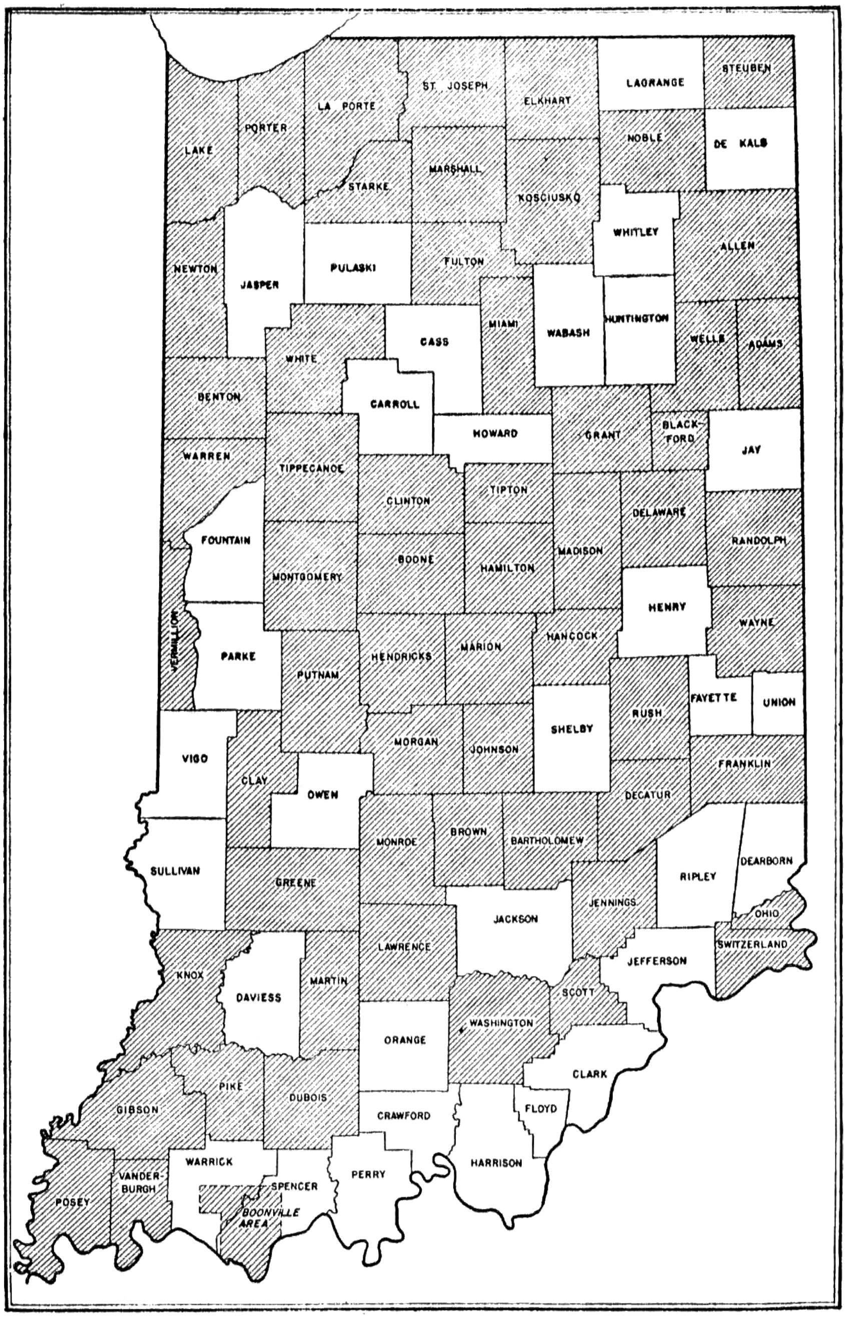

Areas surveyed in Indiana shown by shading.

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